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PJBS

ISSN 1028-8880

**Pakistan
Journal of Biological Sciences**

ANSI*net*

Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Distribution of Non-Indigenous Fish Species, Prussian Carp *Carassius gibelio* (Bloch, 1782) in the Turkish Freshwater Systems

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Abstract: The non-indigenous fish species, Prussian carp *Carassius gibelio* (Bloch, 1782), was first reported in the Thrace region of Turkey. The species is now established in at least 46 freshwater systems (lake, river, reservoir, lagoon and pond) of Turkey and the species' spread has been especially rapid between 1998 and 2006. Especially, this species show the rapid invasion of *Carassius gibelio* in Turkish freshwater systems from Thrace to Anatolia.

Key words: *Carassius gibelio*, Prussian carp, non-indigenous, distribution, Turkey

INTRODUCTION

The Prussian carp (*Carassius gibelio* (Bloch, 1782)) inhabits freshwater streams, ponds and lakes and has wide geographic distribution from northern Europe to Asia (Jiang *et al.*, 1983; Abramenko *et al.*, 1998; Kalous *et al.*, 2004). It has spreaded in Russia, Europe, Korea and northeast China (Zou *et al.*, 2001). Over the last five decades, 25 exotic fish have been introduced to the inland waters of Turkey (Innal and Erkakan, 2006). Amongst the most recent invasive introductions (Baran and Ongan, 1988) is that of the Prussian Carp *Carassius gibelio* (Bloch, 1782). This species is already established in at least 12 European countries and range expansion of the freshwater system of Turkey.

Biological invasions have caused considerable distribution to native ecosystems around the world (Rainbow, 1998; Williamson, 1999; Money and Hobbs, 2000). *C. gibelio* is known as one of the most hazardous fish species for native fish communities (Crivelli, 1995; Kalous *et al.*, 2004). Also is known as a dangerous species for the native fish communities and its introduction should be prohibited.

Three fish species belonging to *Carassius* genus occur in the Turkish freshwater systems: *Carassius gibelio* (Bloch, 1782), *Carassius carassius* (Linnaeus, 1758) and *Carassius auratus* (Linnaeus, 1758). Only *C. carassius* is definitely native to European waters. *C. gibelio* is might be native to northern Europe (Kottelat, 1997).

It has been reported that *C. gibelio* was first found in 1988 in Gala Lake of Turkey (Baran and Ongan, 1988). Later on, Prussian carp was found in Thrace Region (TR) (Özuluğ and Meriç, 1996; Özuluğ, 1999; Özuluğ *et al.*,

2004; Özuluğ *et al.*, 2005a, b; Ilhan *et al.*, 2005; Tarkan *et al.*, 2006) and Asia Minor (AS) (Iznik Lake, Tarkan *et al.*, 2006; Iznik Lake (Van) Özuluğ *et al.*, 2004; Büyük Menderes River Basin (BMR) (Şaşı and Balık, 2003; Ilhan *et al.*, 2005; Present study), Kızılırmak and Yeşilirmak Basin (KYB) (Ilhan *et al.*, 2005; Yılmaz *et al.*, 2007; Uğurlu and Polat, 2007; Bostancı *et al.*, 2007) and Mediterranean region: Lycia Basin (LB) (Çildir, 2001; Balık *et al.*, 2004; Balık *et al.*, 2007; Ilhan *et al.*, 2005; Balık *et al.*, 2003; Bostancı *et al.*, 2007) and Cilicia Basin (CB) (Alagöz *et al.*, 2006)) (Thrace Region (TR), Asia minor (AS), Büyük Menderes river basin (BMR), Kızılırmak and Yeşilirmak Basin (KYB), Mediterranean region: Lycia Basin (LB) and Cilicia Basin (CB)) (Fig. 1).

The objectives of the present study to report the occurrence of the species in a new locality in the Asia minor and recent distribution of the freshwater system of Turkey. The documentation of the exotic species is important in order to track their dispersal and appraise threats to native species (endemic), endangered species and ecosystems.

MATERIALS AND METHODS

Eleven specimen of *C. gibelio* (Bloch 1782), was collected in Kemer Reservoir and Akçay Stream system (Aegean region), Turkey, (between 37°32' 58" N and 28° 32' 48" E) on 19 May 2006. The other data (except for Kemer reservoir and Akçay catchment) related to distribution of Prussian carp based on literature. Sampling was performed by using gill nets (18-45 mm mesh sizes) and cast nets (12-22 mm mesh sizes). The specimen was preserved in 4% formaldehyde and deposited at the Faculty of Fisheries, Mustafa Kemal University, Turkey (in collection of Dr. G. Özcan).

The water level of the reservoir decreases every year in the late spring and summer because of irrigational use. When the rainfalls begin winter, the water level increases again. The surface of Kemer Reservoir is 14.75 km², the size of overall volume totals 544 hm³. According to the measurements taken in 2004-2006, the maximum depth measured was 51 m. It has 1 outlet, Akçay Stream system and 6 inlets, Değirmen, Deli, Akdere, Sarhos, Yeni and Mortuma streams.

RESULTS AND DISCUSSION

The Prussian carp have been reported 46 freshwater systems of Turkish (12 lake, 11 reservoir, 14 river and stream, 6 pond, 3 lagoon) so far (Fig. 1). This is the report in two new localities of Prussian Carp in the Asia Minor (Kemer reservoir and Akçay catchment). The population in Kemer Reservoir appears to be reproducing successfully, as large numbers were observed. Besides, it has been utilized economically by the fishermen of the region and sold as such a carp caught in Marmara Lake (Manisa) whose population is intense (Table 1).

Cohabitation with this species, pumpkinseed, *Lepomis gibbosus* (Linnaeus, 1758), the negative outcomes of the food competition in which it attempts to compete with economic native species in the sources

where it is introduced (Şaşlı, 2002; Özcan, 2007). It has been identified as responsible for impacts on native species (Balık *et al.*, 2004; Vetemaa *et al.*, 2005).

After reporting in Topçam reservoir, it spreaded quickly in Anatolia in a very short period of three years. After observing this species in Akçay Stream system which is an important water course in especially Menderes River basin and Kemer reservoir found on it, the area of spread is seen to have expanded. And this shows that the spreading area of exotic species is expanding in Anatolia gradually. It is pointed out by Smith and Darwall (2006) that Menderes river basin is a basin in which important endemic freshwater species of Europe are found and a basin where two or three species are in danger. Many native species do not tolerate cohabitation with the alien species. The expanding population and improving of this species show that the endemic species living in this basin are under threat. Its introduced range is expanding rapidly and for this reason it is important to monitor the dispersal and to assess the impacts of this introduced species on endangered endemic species and natural ecosystems.

As a result, due to the fact that this species, with *L. gibbosus*, is found in Menderes river basin and that there are endemic fishes reported to be under a serious threat by IUCN in 2006, these endemic fish species are in

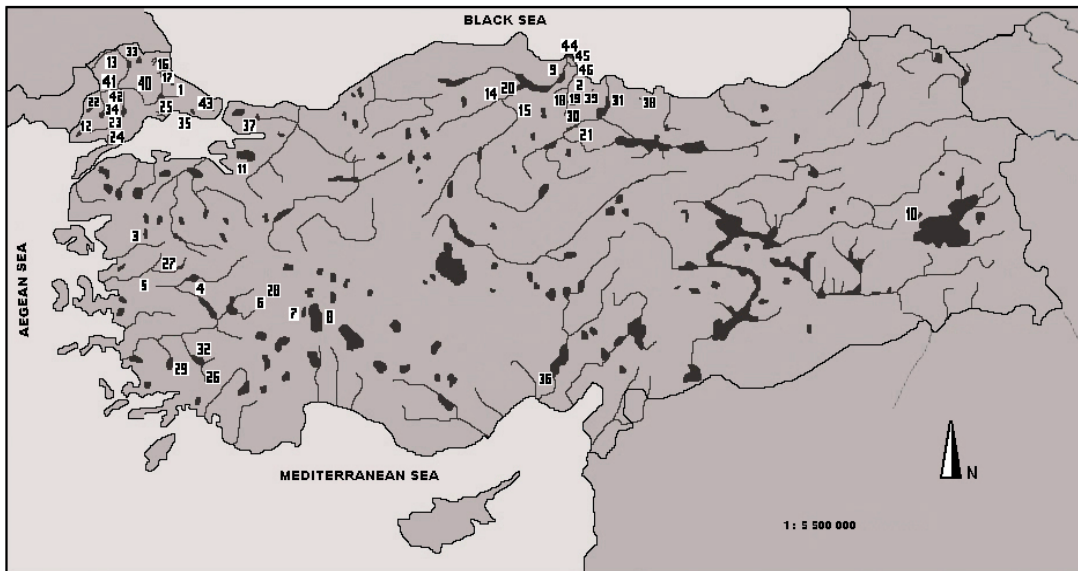


Fig. 1: Map of the study area

1. İlhan *et al.*, 2005; 2. Baran and Ongan, 1988; 3. Balık *et al.*, 2004; 4. Bostancı *et al.*, 2007; 5. Balık *et al.*, 2007; 6. Yılmaz *et al.*, 2007; 7. Uğurlu and Polat, 2007; 8. Balık *et al.*, 2003; 9. Tarkan *et al.*, 2006; 10. Özuluğ *et al.*, 2004; 11. Şaşlı and Balık, 2003; 12. Özuluğ, 1999; 13. Özuluğ and Meriç 1996; 14. Alagöz *et al.*, 2006; 15. Present study

Table 1: Records of *Carassius gibelio* in the inland water of Turkey in 1982-2007

Map	Location	Area size	Specimens	Record	References
Lakes					
1	Saka lake (Kırklareli)	1.345 ha	1 specimens	1982	Ilhan <i>et al.</i> , 2005
2	Uzun Lake (Samsun)	-	7 specimens	1999	Ilhan <i>et al.</i> , 2005
3	Marmara Lake (Manisa)	6800 ha	10 specimens	1990	Ilhan <i>et al.</i> , 2005
	Marmara Lake (Manisa)	6800 ha	10 specimens	2007	Present study
4	Işıklı Lake (Denizli)	7300 ha	5 specimens	1998	Ilhan <i>et al.</i> , 2005
5	Gölcük Lake (İzmir)	-	1 specimens	2001	Ilhan <i>et al.</i> , 2005
6	Yayla Lake (Denizli)	105 ha	2 specimens	2001	Ilhan <i>et al.</i> , 2005
7	Eğri Lake (Antalya)	300 ha	1 specimens	1996	Ilhan <i>et al.</i> , 2005
	Eğri Lake (Antalya)	300 ha	5 specimens	1997	Ilhan <i>et al.</i> , 2005
	Eğri Lake (Antalya)	300 ha	13 specimens	2000	Ilhan <i>et al.</i> , 2005
8	Eğirdir lake (Isparta)	48150 ha	616 specimens	2001-2002	Ballık <i>et al.</i> , 2004
	Eğirdir lake (Isparta)	48150 ha	265 specimens	2001-2002	Ballık <i>et al.</i> , 2003
	Eğirdir lake (Isparta)	48150 ha	283 specimens	2001-2003	Bostancı <i>et al.</i> , 2007
	Eğirdir lake (Isparta)	48150 ha	2300 specimens	2001-2003	Ballık <i>et al.</i> , 2007
	Eğirdir Lake (Isparta)	48150 ha	4 specimens	2001	Ilhan <i>et al.</i> , 2005
9	Bafra fish Lakes (Samsun)	-	173 specimens,		
9a	Balk (Samsun)	1389 ha			
9b	Cemek (Samsun)	589 ha			
9c	Liman (Samsun)	322 ha			Bostancı <i>et al.</i> , 2007
9d	Uzun (Samsun)	293 ha	173 specimens,	2000-2002	Bostancı <i>et al.</i> , 2007
9e	Gc (Samsun)	125 ha	173 specimens,	2000-2003	Yılmaz <i>et al.</i> , 2007
9f	Tatlı (Samsun)	52 ha	10 specimens,	2003-2005	Uğurlu and Polat, 2007
10	Nazik lake (Van)	4450 ha	7 specimens	1998	Özuluğ <i>et al.</i> , 2004
11	Iznik lake (Bursa)	29800 ha	344 specimens	2003-2004	Tarkan <i>et al.</i> , 2006
12	Gala lake (Edirne)	770 ha	4 specimens	1998	Özuluğ <i>et al.</i> , 2004
	Gala lake (Edirne)	2369 ha	-	1986	Baran and Ongan, 1988
River and stream					
13	Tunca river (Edirne)	48 km	5 specimens	1983	Ilhan <i>et al.</i> , 2005
	Tunca river (Edirne)	48 km	4 specimens	1998	Özuluğ <i>et al.</i> , 2004
14	Miliç (Kocaman) river (Samsun)	24 km	21 specimens	2003-2005	Uğurlu and Polat, 2007
15	Mert river (Samsun)	-	4 specimens	2003-2005	Uğurlu and Polat, 2007
16	Arnavut stream (Kırklareli)	-	3 specimens	1982	Ilhan <i>et al.</i> , 2005
17	Bulanık stream (Kırklareli)	-	4 specimens	1982	Ilhan <i>et al.</i> , 2005
18	Abdal river (Samsun)	-	32 specimens	2003-2005	Uğurlu and Polat, 2007
19	Çobanlar stream (Samsun)	-	30 specimens	2003-2005	Uğurlu and Polat, 2007
20	Terme Çayı (Samsun)	-	14 specimens	2003-2005	Uğurlu and Polat, 2007
21	Yurtluk çayı (Samsun)	-	22 specimens	2003-2005	Uğurlu and Polat, 2007
22	Meriç River (Edirne)	187 km (Turkish part)	5 specimens	1998	Özuluğ <i>et al.</i> , 2004
23	Çamlıca Creek (Edirne)	-	9 specimens	1998	Özuluğ <i>et al.</i> , 2004
24	Kavaklı Stream (Çanakale)	-	1 specimens	1998	Özuluğ <i>et al.</i> , 2004
25	Kİnkil Stream (Tekirdağ)	-	2 specimens	2001	Özuluğ <i>et al.</i> , 2004
26	Akçay stream (Aydın)	-	3 specimens	2006	Present study
Reservoir					
27	Avşar reservoir (Manisa)	570 ha	2 specimens	1994	Ilhan <i>et al.</i> , 2005
	Avşar reservoir (Manisa)	570 ha	1 specimens	1994	Ilhan <i>et al.</i> , 2005
28	Buldan reservoir (Denizli)	290 ha	22 specimens	1995	Ilhan <i>et al.</i> , 2005
29	Topçam reservoir (Aydın)	440 ha	172 specimens	1999-2000	Şaşı and Ballık, 2003
30	Çakmak reservoir (Samsun)	628 ha	25 specimens	2003-2005	Uğurlu and Polat, 2007
31	Suat Uğurlu reservoir (Samsun)	964.4 ha	3 specimens	2003-2005	Uğurlu and Polat, 2007
32	Kemer reservoir (Aydın)	1210 ha	9 specimens	2006	Present study
33	Kayalı Reservoir (Kırklareli)	1018.6 ha	1 specimens	1998	Özuluğ <i>et al.</i> , 2004
34	Ibriktepe Reservoir (Edirne)	390 ha	1 specimens	1998	Özuluğ <i>et al.</i> , 2004
35	Büyükçekmece R. (Istanbul)	2847 ha	-	1995	Özuluğ, 1999
	Büyükçekmece R. (Istanbul)	2847 ha	-	1995	Özuluğ and Meriç 1996
	Büyükçekmece R. (Istanbul)	2847 ha	10 specimens	2001	Özuluğ <i>et al.</i> , 2004
36	Seyhan reservoir (Adana)	6304 ha	-	2004-2005	Alagöz <i>et al.</i> , 2006
37	Ömerli Reservoir (Istanbul)	2140 ha	258 specimens	2003-2004	Tarkan <i>et al.</i> , 2006
Pond					
38	Divanbaşı pond (Samsun)	27.03 ha	26 specimens	2003-2005	Uğurlu and Polat, 2007
39	Üniversite pond II (Samsun)	1.48 ha	19 specimens	2003-2005	Uğurlu and Polat, 2007
40	Sarıcaali pond (Kırklareli)	3.45 ha	3 specimens	1998	Özuluğ <i>et al.</i> , 2004
41	Çöpköy pond (Edirne)	-	1 specimens	1998	Özuluğ <i>et al.</i> , 2004
42	Bülbüldere pond (Edirne)	5.53 ha	2 specimens	1998	Özuluğ <i>et al.</i> , 2004
43	Pond of ITU (Istanbul)	-	3 specimens	2002	Özuluğ <i>et al.</i> , 2004
Lagoon					
44	Karaboğaz lagoon (Samsun)	170 ha	2 specimens	2003-2005	Uğurlu and Polat, 2007
45	Liman lagoon (Samsun)	272 ha	8 specimens	2003-2005	Uğurlu and Polat, 2007
46	Simenit-Akgöl lagoon (Samsun)	200 ha	22 specimens	2003-2005	Uğurlu and Polat, 2007

a serious danger. We need a better international coordination structures to develop a cooperative strategy for the protection of native species against invasive alien species and it is important to prevent the further spread of invasive.

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