

The Spread of the Introduced *Gymnocephalus cernua* Linnaeus, 1758 (Perciformes: Percidae) along the Transboundary Strymonas (Struma) River Basin: First Report in Kerkini Dam Lake (Greece)

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Abstract: The southernmost geographic expansion of the alien species *Gymnocephalus cernua* (Linnaeus, 1758) in Europe (Kerkini Dam Lake, northern Greece) is reported here. The species was introduced from Bulgaria to Greece along the transboundary Strymonas (Struma) River, adding an example of species spread beyond the national borders.

Keywords: Introduced fish, *Gymnocephalus cernua*, ruffe, Kerkini, Strymonas (Struma), Greece, Bulgaria

Introduction

Several exotic species have been recorded in the aquatic systems of Europe, while at the same time some native species are found outside their natural distribution range (LEPPÄKOSKI *et al.* 2002, PANOV *et al.* 2009). Most of these records concern freshwater fish, whose geographic expansion is mainly due to human introductions and natural spread (GARCÍA-BERTHO *et al.* 2005).

The freshwater fish species *Gymnocephalus cernua* (Linnaeus, 1758) (FROESE, PAULY 2013), known as Ruffe or Gymnocephalos (in Greek), is native to the Caspian, Aral, Black, Baltic and North Sea basins as well as to Siberia (BROWN *et al.* 1998, KOTTELAT, FREYHOF 2007, STEFANOV 2007). However, the presence of this species has also been certified in several aquatic ecosystems outside its native range

both in Europe (LORENZONI *et al.* 2009, HUME *et al.* 2013) and North America (BROWN *et al.* 1998). The species is considered an efficient invader due to its adaptability to tolerate a high range of environmental conditions related to salinity, eutrophication, temperature, turbidity, etc. (RÖSCH *et al.* 1996, SOUCHON, TISSOT 2012). Moreover, the opportunistic behaviour of the species is favoured by its ability to feed in the dark or in highly turbid waters, thus enhancing its competitive advantage (JANSSEN 1997, SCHLEUTER, ECKMANN 2006).

Strymonas (Struma) River Basin (Balkan Peninsula) is shared among Bulgaria (50%), Greece (37%), FYROM (9%) and Serbia (4%) (Fig. 1). *G. cernua* was first recorded in the Studena Reservoir (42°31'08"N, 23°09'12"E, Bulgarian part) (Fig. 1),

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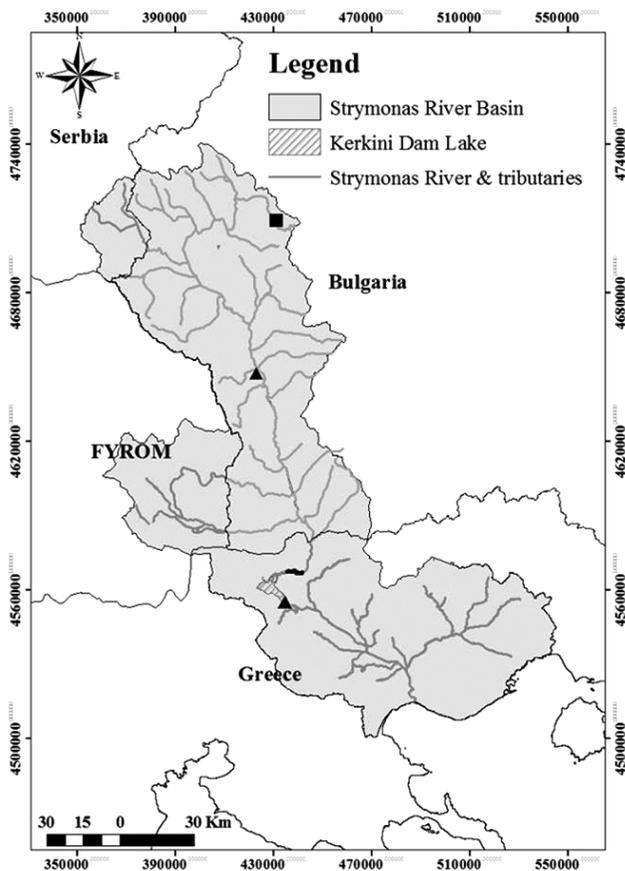


Fig. 1. Strymonas (Struma) River Basin and the sites where *Gymnocephalus cernua* specimens were caught. ■ Studena Reservoir ▲ and bold line indicate the locations upstream Kerkini Dam Lake where the species was found after 2008

based on two specimens caught in 2005 (STEFANOV, VASSILEV 2006). Their presence was attributed to accidental introduction and it was hypothesised, without any explanation for this assumption, that the species would not spread outside the reservoir (STEFANOV, VASSILEV 2006). Its presence was not verified by GOUSIA, BOBORI (2009) and PETRIKI, BOBORI (2009), who intensively surveyed Strymonas River during 2007-2008 (using biannually electro-fishing at 12 sampling stations in the main channel and its tributaries in the high and low flow period) and Kerkini Dam Lake (using seasonally gillnets).

Here, we report the presence of this species downstream of Studena Reservoir and its spread as far as to Kerkini Dam Lake (the Greek part of the Strymonas River), which constitutes, to our knowledge, the southernmost limit of its distribution range in Europe (Fig. 1).

Materials and Methods

Lake Kerkini (northern Greece, 41°13' N, 23°08' E) (Fig. 1) is a shallow (max depth 6 m) eutrophic

dam lake (KAMARIANOS *et al.* 1993), which was created after damming Strymonas River at the village of Lithotopos. The lake is protected under the Ramsar Convention as a wetland site of international importance and is included in the Natura 2000 network. It is also designated a National Park since November 2006.

The specimens used for identification of *Gymnocephalus cernua* from Kerkini were caught by professional fishermen. The record from Bulgarian part of Strymonas River originated from anglers' activities. The species identification was according to the key given by KOTTELAT, FREYHOF (2007).

Results

Five adult specimens of *Gymnocephalus cernua* (Fig. 2) were caught for the first time in Kerkini Dam Lake in 2008. Since then, the species has often been reported in winter catches from the area close to the dam, mostly in small mesh size gillnets targeting small sized fishes.

In 2009, this species was recorded in the flooded part of Strymonas River between the dikes of a fish farm located near the town of Blagoevgrad (41°58'41"N, 23°04'34"E) in Bulgaria (Fig. 1). Single specimens are still captured in the same place almost every year.

In 2012, two specimens were recorded during fish monitoring surveys carried out in the part of Strymonas River that enters Kerkini Dam Lake (Fig. 1). Additional specimens (22 individuals, total weight 332 g) were recorded in the same area during samplings that took place from May to July 2013.

Discussion

Based on the above-mentioned observations and the previous studies carried out in the Strymonas Basin (GOUSIA, BOBORI 2009, PETRIKI, BOBORI 2009), we can assume that *G. cernua* expanded its distribution after 2008 and reached Kerkini Dam Lake, which now is the southernmost limit of the species range expansion in Europe. However, since the sporadically caught number of individuals is small, we hypothesise that the species has not yet been capable to establish large populations in this river system, including in Kerkini Dam Lake. Nevertheless, the establishment of such populations is very likely due to biological and ecological characteristics of this species (RÖSCH *et al.* 1996, JANSSEN 1997, SCHLEUTER, ECKMANN 2006, SOUCHON, TISSOT 2012) and, in particular, its high fecundity and strong reproductive potential (LORENZONI *et al.* 2009).

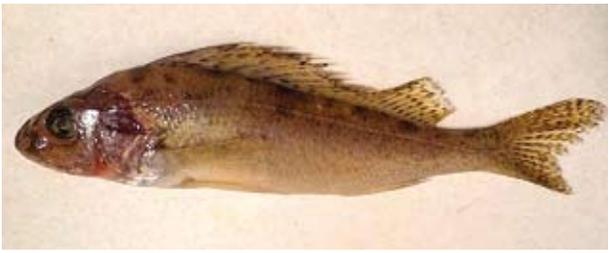


Fig. 2. A specimen of *Gymnocephalus cernua* caught in Kerkini Dam Lake

The colonisation of the examined system by *G. cernua* may have several ecological impacts, including predation on fish eggs (SELGEBY 1998) and competition with native species, especially with other percids as the commercially important *Perca fluviatilis* (SAVINO, KOLAR 1996). It should be mentioned here that *G. cernua* is not the only species that invaded the Greek part of the Strymonas River Basin. Other exotic species, such as *Lepomis gibbosus* and *Pseudorasbora parva* (CRIVELLI *et al.* 1995) used the

same river route to invade Kerkini Dam Lake where they have established abundant populations (PETRIKI, BOBORI 2009). Additionally, *Sander lucioperca* reached Kerkini through the same river (CRIVELLI *et al.* 1995), although the species is no longer considered present.

The impacts of the mentioned introduced species on the native aquatic organisms have not been assessed yet. However, it is clear that the introduction of fish species in new aquatic water bodies and the possible impacts they may impose are not restricted by the national borders. Moreover, measures concerning the elimination of illegal introductions should include the education of local fishermen about the impacts of the alien species on the native biodiversity. Finally, *G. cernua* should be included in the programs for monitoring the fish fauna in the Strymonas River Basin, which will enable the detection of its possible establishment and the assessment of management measures.

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