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First record of the asp *Leuciscus aspius* introduced into the Iberian Peninsula

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ABSTRACT

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The asp *Leuciscus aspius* (L.), a large piscivorous cyprinid fish, is reported for the first time in the Iberian Peninsula. Six individuals were captured in July 2017 and many other were observed in the Darnius-Boadella Reservoir (Muga river basin, NE Spain). Our observations suggest that the asp has established in the reservoir, representing a potential threat to the native species of the Muga River. As it has been the case with several other alien fish species, the asp is likely to be illegally spread to other Iberian river basins if current management measures do not change.

Key words: alien species, non-native species, piscivorous fish, Darnius-Boadella Reservoir, Muga River

RESUMEN

Primera cita del aspio* Leuciscus aspius *en la Península Ibérica

Se cita por primera vez en la Península Ibérica el aspio Leuciscus aspius *(L.), un ciprínido piscívoro de gran tamaño. Seis individuos fueron capturados en julio de 2017 y muchos otros fueron observados en el embalse de Darnius-Boadella (cuenca del río Muga, NE España). Nuestras observaciones sugieren que el aspio se ha establecido en el embalse, representando una potencial amenaza para las especies nativas del río Muga. Como ha sucedido con otras especies exóticas de peces, es probable que el aspio sea introducido ilegalmente en otras cuencas ibéricas si no cambian las medidas de gestión actuales.*

Palabras clave: *especies exóticas invasoras, especies no-nativas, peces piscívoros, embalse Darnius-Boadella, río Muga*

INTRODUCTION

The Iberian Peninsula (IP) is rich in freshwater biodiversity, with over 40 inland fishes endemic to it, mostly cyprinids (Doadrio *et al.*, 2011). At the same time, many freshwater fishes widespread and common in Europe, such as roch *Rutilus rutilus*, common carp *Cyprinus carpio*, bleak *Alburnus alburnus* or European catfish *Silurus glanis* are not native to the IP, but have been introduced to it and are now invading its aquatic ecosystems (Clavero & García-Berthou, 2006; Doadrio *et al.*, 2011). About 26 alien freshwater fishes have been introduced and are established in the IP. Many of the native ichthyofauna is currently threatened in part due to these invasive species but also other anthropogenic perturbations, such as damming, water abstraction and pollution.

The asp *Leuciscus aspius* (L.) is a large-sized cyprinid fish that inhabits large rivers and lakes and is native from central Europe to western Asia (Kottelat & Freyhof, 2007) but not the IP. It has been often regarded as *Aspius aspius* (L.), but should be included in the *Leuciscus* genus after recent phylogenetic analyses (Perea *et al.*, 2010). This species has been introduced into Belgium, France, Italy, Switzerland, and the Netherlands among a few other countries (Schweyer *et al.*, 1991, Dönni & Freyhof, 2002; Kottelat & Freyhof, 2007; Nocita & Zerunian, 2007), but until now there were no records in the scientific literature for the Iberian Peninsula (Doadrio *et al.*, 2011), except for our brief mention in Aparicio *et al.* (2016).

METHODS

As part of a large fish survey throughout Catalonia, we sampled Darnius-Boadella Reservoir (Muga River Basin, NE Spain, 42º 21' 37" N, 02º 48' 56" E) by gillnetting and electrofishing in July 2017. Location maps and data on limnological features and fish assemblages for the reservoir are given elsewhere (Carol *et al.*, 2006; Benejam *et al.*, 2011).

RESULTS

Six specimens of asp were captured on 20-21 July 2017 in Darnius-Boadella Reservoir. Out of 1264 fish captured during this survey, 6 were asp. These specimens were identified by clear morphological features characteristic of this species (Fig. 1), particularly the maxilla reaching beyond the front margin of the eye and meristic counts (Table 1) that agree with those reported for the species (Kottelat & Freyhof, 2007). The whole specimen LA3 (Table 1) preserved in 10 % buffered formalin and a pelvic-fin fragment of specimens LA1, LA2 and LA3 in ethanol have been deposited at the

Figure 1. The specimen LA1 of *Leuciscus aspius*, captured in the Darnius-Boadella Reservoir in July 2017. *El espécimen LA1 de* Leuciscus aspius*, capturado en el embalse de Darnius-Boadella en julio de 2017.*

collection of the Museo Nacional de Ciencias Naturales (Madrid, Spain): voucher numbers MNCN_ICTIO 291.467, MNCN/ADN 94227, MNCN/ADN 94228, and MNCN/ADN 94229, respectively. During our surveys from October 2016 to July 2017, many other individuals (approximately from 300 to 600 mm TL), usually solitary, were observed swimming in shallow waters in different zones of the reservoir, from the connection with the Muga River to the dam. In one case, a medium-sized individual (≈ 350 mm TL) was observed preying on a school of small cyprinids (presumably roach *Rutilus rutilus*) and in another occasion, about 15 specimens (≈ 400 mm TL) were observed shoaling inactive under the surface. The identification without capture was possible due to high water transparency and to the fact that all the detected fish were swimming right beneath the water surface, close to the bank. Moreover, other people referred to be aware of the presence of this species at least since September 2014 in the reservoir.

Table 1. Features of *Leuciscus aspius* specimens captured in July 2017 in the Darnius-Boadella Reservoir. Missing data are due to fin and scale damage during gillnetting. Abbreviations: TL = total length; SL = standard length; TW = total weight; LL = scales on lateral line. *Datos de los especímenes de* Leuciscus aspius *capturados en julio 2017 en el embalse de Darnius-Boadella. La falta de algunos recuentos de escamas y radios se debe a daños de algunos individuos durante la captura con redes. Abreviaciones: TL = longitud total; SL = longitud estándar; TW = peso total; LL = escamas en la línea lateral.*

Id	TL (mm)	SL (mm)	TW (g)	LL (left)	LL (right)	Anal fin branched rays
LA1	610	495	1724	68	70	12 ½
LA2	494	408	1070	68	71	13 ½
LA3	149	119	245	68	70	12 ½
LA4	171	140	40.5	-	-	12 ½
LA5	-	134	32.5	-	-	-

DISCUSSION

This species has not been cited so far for the IP and was not detected in fish surveys in Darnius-Boadella Reservoir (formerly named Boadella Reservoir) in 2003 (Carol *et al.*, 2006) and 2004 (Benejam *et al.*, 2005). Therefore, the introduction year probably was after 2004 but clearly before 2015, since the population seems to be not small and well-structured along a range of age/size classes. Consequently, this asp population may be already established (Table 1, personal observations). The introduction of asp into the Iberian Peninsula is worrying for a number of reasons. First, the IP is very rich in endemic, threatened fish species, mostly cyprinids (Doadrio *et al.*, 2011; Aparicio *et al.*, 2016). Asp is a large piscivorous species, growing up to 800 mm standard length (Kottelat & Freyhof, 2007), which could prey on native fauna. Moreover, it can live in estuaries and freshened parts of the sea (Kottelat & Freyhof, 2007). Finally, it is one of the most invasive freshwater fish in recent years across France, where it was introduced in 1976 (Poulet *et al.*, 2011).

Darnius-Boadella Reservoir, located close to the French border, has been the location of first introduction record in the IP for common bream *Abramis brama* (Benejam *et al.*, 2005) and spiny-cheek crayfish *Orconectes limosus* (Benejam *et al.*, 2011), and Girona province and NE Spain represents a primary pathway of entry for non-native freshwater species to the Iberian Peninsula (Clavero & García-Berthou, 2006). Many other fish species have been introduced first in NE Spain and then spread illegally throughout the Iberian Peninsula (Clavero & García-Berthou, 2006). Therefore, more effective measures to prevent the introduction of this and other non-native freshwater species are required. Since Darnius-Boadella Reservoir has likely been the entry point to the IP of at least three freshwater species, we suggest that much more stringent angling measures (or possibly prohibition) should be implemented in this and nearby reservoirs; we already warned about this in Benejam *et al.* (2005). Moreover, the inclusion of the asp in the 'Spanish black list', i.e. "Catálogo Español de Especies Exóticas Invasoras" (BOE, 2013),

which officially forbids the transport, holding and fishing of invasive alien species throughout Spain, should be urgently considered.

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