

## Spatial distribution of exotic fish species in the Guadiana river basin, with two new records

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Received: 25/10/07

Accepted: 14/1/08

### ABSTRACT

#### Spatial distribution of exotic fish species in the Guadiana river basin, with two new records

This work updates the spatial distribution of the exotic fish species in the Guadiana river basin. To this effect, 241 river stretches and 37 reservoirs and lakes were sampled, corresponding to 261 UTM 10 × 10 Km squares. A total of 12 exotic species were found, including two new species that had not been previously cited in the area, the channel cat-fish (*Ictalurus punctatus*) and the roach (*Rutilus rutilus*). These two species, related to lentic systems, had a very restricted distribution in the basin, probably as a consequence of its recent introduction. The expansion of the remaining exotic species was also confirmed. Some species as the pumpkinseed sunfish (*Lepomis gibbosus*), the mosquitofish (*Gambusia holbrooki*) or the largemouth bass (*Micropterus salmoides*) have become common components of the fish community, not only in reservoirs but also in lotic systems.

**Key words:** Exotic species, freshwater fish, Guadiana River, *Ictalurus punctatus*, *Rutilus rutilus*, Spain.

### RESUMEN

#### Distribución espacial de las especies de peces exóticos de la cuenca del río Guadiana, con dos nuevas citas

Este trabajo actualiza la distribución espacial de las especies de peces exóticas presentes en la cuenca del río Guadiana. Para ello se han muestreado 241 tramos fluviales y 37 embalses y lagos que se corresponden con 261 cuadrículas UTM 10 × 10 Km. Se encontró un total de 12 especies de peces exóticos, incluyendo dos nuevas especies no citadas hasta el momento en la cuenca: el pez gato punteado (*Ictalurus punctatus*) y el rutilo (*Rutilus rutilus*). Estas dos especies, relacionadas con medios leníticos, tuvieron un área de distribución muy restringida en la cuenca, consecuencia probable de su reciente introducción. Además se confirmó la expansión del resto de especies exóticas. Algunas de ellas como el pez sol (*Lepomis gibbosus*), la gambusia (*Gambusia holbrooki*) o el black-bass (*Micropterus salmoides*) se han convertido en componentes habituales de las comunidades de peces, no sólo en embalses, sino también en medios lóticos.

**Palabras clave:** Especies exóticas, peces de agua dulce, Río Guadiana, *Ictalurus punctatus*, *Rutilus rutilus*, España.

### INTRODUCTION

Exotic fish species are involved in one of the most irreversible human-induced global changes now under way: the homogenization of Earth's biota (Kolar & Lodge, 2000; Rahel, 2000). At least 35 alien fish species have been introduced into

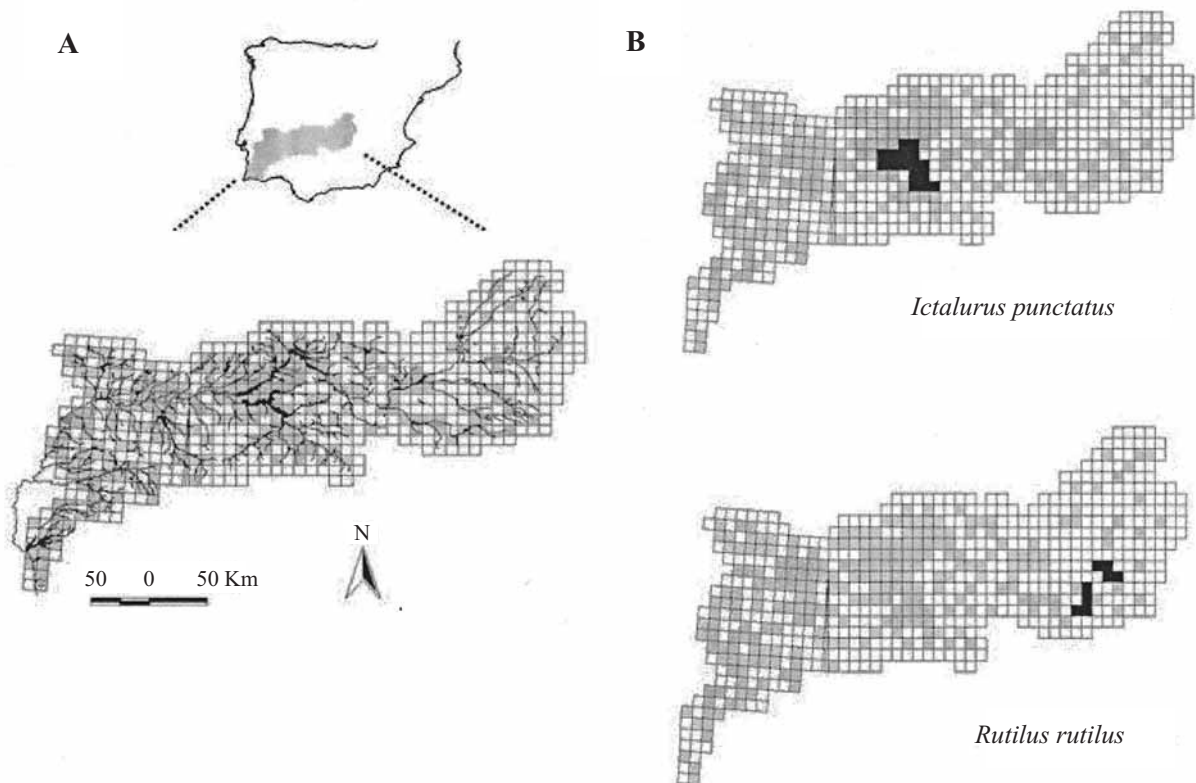
the Iberian Peninsula in the last century and although not all of them prospered (Elvira & Almodovar, 2001; Ribeiro *et al.*, 2007) most are now widespread in this area, specially linked to degraded environments such as reservoirs (Clavero *et al.*, 2004). Paradoxically these environments may also suppose a barrier to their dispersion (Rahel, 2007). The establishment and expansion

of such species has been reported as an important source of local extinction and strong declines in native fish species populations (García-Berthou & Moreno-Amich, 2000; Clavero, *et al.*, 2004; Clavero & García-Berthou, 2005; Prenda *et al.*, 2006; Blanco-Garrido, 2006). According to previous studies (Doadrio, 2002; Gante & Santos, 2002; Pérez-Bote *et al.*, 2004; Ribeiro *et al.*, 2006), a total of 12 exotic fish species inhabit the Spanish part of the Guadiana river basin, which represent 48.0 % of the total freshwater fish species richness of this basin (25 species).

During 2005-06's spring an extensive survey in the Spanish sector of the Guadiana River basin excluding transitional waters was carried out. A total of 241 river stretches and 37 reservoirs and

lakes were sampled, which covered 261 UTM  $10 \times 10$  Km squares. This comprises most of the potentially sampled UTM's in the basin (those with at least a water course or a water mass in it). The fieldwork was carried out by electrofishing in river stretches (lotic systems hereafter) and passive capture methods (trammel-nets, fyke-nets and minnow-traps) in reservoirs (lentic systems hereafter) (Fig. 1A).

A total of 11 exotic fish species were captured in this work (Table 1), including two species never reported for the Guadiana River: the channel catfish (*Ictalurus punctatus* Rafinesque, 1818) and the roach (*Rutilus rutilus* Linnaeus, 1758). In addition three individuals of common trout (*Salmo trutta* Linnaeus, 1758) were



**Figure 1.** A) Location of the Guadiana River basin within the Iberian Peninsula. All the UTM  $10 \times 10$  km squares included in the Spanish portion of the basin are represented and are filled in grey ( $n = 261$ ). B) Distribution of the two new species in the basin: the roach (*R. rutilus*) and the channel catfish (*I. punctatus*). Squares where the species were found are pointed out in black. A) Localización de la cuenca del río Guadiana en la Península Ibérica. Se han marcado en gris las cuadrículas UTM  $10 \times 10$  Km prospectadas ( $n = 261$ ) del total ocupadas por la porción española de la cuenca. B) Distribución de las dos nuevas especies citadas para la cuenca: el rutilo (*R. rutilus*) y el pez gato punteado (*I. punctatus*). Las cuadrículas donde las especies fueron encontradas se marcan en negro.

captured in the Gevora River within an angling reserve. Although this species is considered native to the Iberian Peninsula and its presence in the Guadiana River has been recently confirmed we consider this population as re-introduced just for angling purposes.

On the other hand, neither the rudd (*Scardinius erythrophthalmus* Linnaeus, 1758), nor the mummichog (*Fundulus heteroclitus* Linnaeus, 1766), both previously cited in Doadrio (2002), were found here (Table 1). It could be possible that the previous citations for the rudd correspond to roach individuals, given their morphological similarity. The mummichog was not captured as it only inhabits estuarine environments, not prospected in this work.

The extent of the distribution of the different species varied between the pumpkinseed (*Lepomis gibbosus*, Linnaeus, 1758), the mosquitofish (*Gambusia holbrooki* Girard, 1859), and the

largemouth bass (*Micropterus salmoides* Lacépède, 1802) each covering more than 35 % of the total lotic screened squares and more than a half of the lentic ones, and the common trout (*S. trutta*), found only in one lotic locality (Table 1). On average the exotic species tended to occupy more frequently lentic systems than lotic ones (Table 1). Thus, reservoirs seem to be an optimal environment for the development of exotic communities.

Comparing our data with those published by Doadrio (2002) it seems that almost all the exotic species previously cited have increased their distribution range within the basin (Table 1, Fig. 2). The pumpkinseed sunfish (*L. gibbosus*) showed the greatest increase, with 82 UTMs more than the previous survey (Doadrio, 2002) (Table 1, Fig. 2). It was followed by the mosquitofish (*G. holbrooki*) and the largemouth bass (*M. salmoides*) with 40 and 38 UTMs more

**Table 1.** Exotic fish species present in the Spanish portion of the Guadiana River basin. The occupation of these species is referred as the total number of UTM 10 × 10 Km squares observed in this study (separated for lotic and lentic systems). The % of occupation in each environment is also showed. The total number of squares in Doadrio, 2002 and in the present study is compared. *Especies de peces exóticas presentes en la parte española de la cuenca del río Guadiana. La ocupación de estas especies se expresa como el número total de cuadrículas UTM 10 × 10 Km obtenidas en este estudio (separadas para medios lóticos y lénticos). Se muestra además el % de ocupación de cada uno de estos medios. Se compara el número total de cuadrículas en Doadrio, 2002 y el presente estudio.*

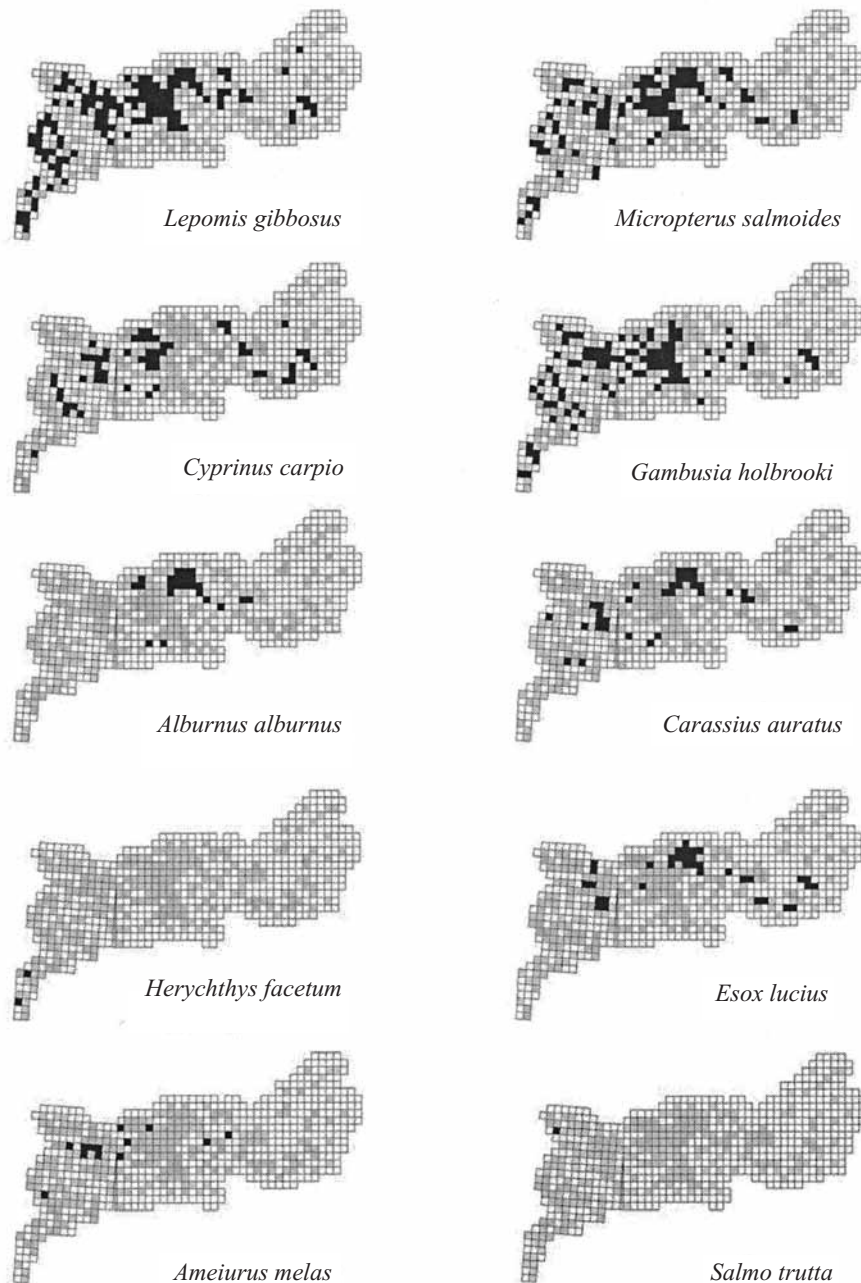
| Species                              | Presences in UTM 10 × 10 Km squares |                    | Presences in UTM 10 × 10 Km squares according to Doadrio (2002)/Total in this study |
|--------------------------------------|-------------------------------------|--------------------|---|
|                                      | Lotic (n = 160)                     | Lentic (n = 81)    |   |
| <i>Lepomis gibbosus</i>              | 65 (40.6)                           | 73 (90.1)          | 56/138  |
| <i>Gambusia holbrooki</i>            | 50 (31.3)                           | 49 (60.5)          | 59/99   |
| <i>Micropterus salmoides</i>         | 27 (16.9)                           | 71 (87.7)          | 60/98   |
| <i>Cyprinus carpio</i>               | 11 (6.9)                            | 47 (58.0)          | 50/58   |
| <i>Esox lucius</i>                   | 5 (3.1)                             | 30 (37.0)          | 31/35   |
| <i>Carassius auratus</i>             | 10 (6.3)                            | 25 (30.9)          | 15/35   |
| <i>Alburnus alburnus</i> £           | 4 (2.5)                             | 19 (23.5)          | 0/23  |
| <i>Ictalurus punctatus</i>           | 0 (0.0)                             | 16 (19.8)          | 0/16  |
| <i>Ameiurus melas</i> ¶              | 8 (5.0)                             | 5 (6.2)            | 0/13  |
| <i>Rutilus rutilus</i>               | 1 (0.6)                             | 7 (8.6)            | 0/8   |
| <i>Australoheros facetus</i>         | 3 (1.9)                             | 1 (1.2)            | 3/4   |
| <i>Salmo trutta</i> *                | 1 (0.6)                             | 0 (0.0)            | 1/1   |
| <i>Scardinius erythrophthalmus</i> † | —                                   | —                  | 1/0   |
| <i>Fundulus heteroclitus</i> †       | —                                   | —                  | 1/0   |
| <b>MEAN</b>                          | <b>15.4 (9.6)</b>                   | <b>28.6 (35.3)</b> | <b>27.7/44.0</b>  |

† Species previously cited in the basin (Doadrio, 2002) but not captured in the present study

\* This species comes from fish stocking within angling reserves and can be considered as "reintroduced" in the basin

¶ Species presence cited in Gante & Santos, 2002

£ Species presence cited in Pérez-Bote et al., 2004



**Figure 2.** Distribution maps of other exotic species that inhabits the Guadiana River basin. *S. trutta* has been included, although it can be considered a reintroduced species. *Mapas de distribución de otras especies exóticas que habitan en la cuenca del río Guadiana. Se ha incluido S. trutta, aunque puede ser considerada como una especie reintroducida.*

respectively (Table 1, Fig. 2). In contrast, the chameleon cichlid (*Australoheros facetus* Jenyns, 1842) with a restricted distribution range within the basin (Chanza River and Lagunas de Ruidera) did not show any increase in its distribution. This

species seems to be at a standstill at the moment, from a spatial point of view. There is a significant increase in the number of squares occupied by species not cited in Doadrio, 2002 but in other studies, such as the bleak (*Alburnus albur-*

*nus* Linnaeus, 1758) (Pérez-Bote *et al.*, 2004) or the black bullhead (*Ameiurus melas* Rafinesque, 1820) (Gante and Santos, 2002) (Table 1, Fig. 2). Of course, these results must be carefully considered as they may be related to the difference in sampling effort between the present study and that of Doadrio, 2002.

The channel catfish is an ictalurid native to North America (Central drainages of the United States to southern Canada and northern Mexico). It was previously cited in the Delta del Ebro within the Iberian Peninsula (Doadrio, 2002), although its occurrence has been confirmed in almost all Europe (Froese & Pauly, 2006). The presence of the channel catfish in the Guadiana basin was restricted to La Serena reservoir (fish captured in four localities sampled there in August-06). We captured a total of 151 fish by trammel-nets and fyke-nets, always placed close to shallow shores at no more than 2 m depth. Fish length, which ranged between 64-617 mm of total length ( $250.8 \pm 82.8$  mm, Mean  $\pm$  SD), showed almost no juveniles. In spite of this, they could be potentially captured since small individuals of other species appeared in minnow-traps. This species was supposed to be present in the basin (Zujar and Orellana reservoirs, Pérez-Bote, 2006) since early 90s, although these data had not been formally confirmed until this study. We contributed here with 16 new UTM  $10 \times 10$  Km squares where the species is present in the basin (Fig. 1B).

The roach is a cyprinid native to central and Eastern Europe that could be introduced for angling purposes. The presence of this species within the Iberian Peninsula was restricted to the Llobregat River (Doadrio, 2002). This species was more widespread than the channel catfish, although with local abundances asymmetrically distributed and always in the calcareous section of the basin. It was present both in lentic and lotic systems, being collected in three reservoirs (Peñarroya, Cabezuelas and Vallehermoso, September-06) and two lakes (located within the Ruidera Natural Park: Cueva Morenilla and Colgada lakes, September-06), and in running waters in the Guadiana river within the Ruidera Natural Park ( $38^{\circ}97'87''$  N,  $2^{\circ}89'19''$  W,

June-06). All these localities showed the presence of the species in a total of 8 new UTM  $10 \times 10$  Km squares (Fig. 1B). In contrast to the channel catfish, young of year were captured in the lotic systems. These individuals ranged between 12-265 mm of total length ( $119.6 \pm 38.6$  mm, Mean  $\pm$  SD). All the fish captured in reservoirs were longer than those, ranging between 145-221 mm ( $188.2 \pm 31.0$  mm, Mean  $\pm$  SD). These two new records represent the southern limit of the distribution of both species within Europe.

## ACKNOWLEDGEMENTS

We thank Ángel Nieva (Jefe de Servicio de Control del Estado de las Masas de Agua, CHG), the Confederación Hidrográfica del Guadiana, which supported this survey through the project “Consolidación y Explotación de la Red de Control Biológico del Guadiana”, and the Spanish Ministry of Science and Technology (REN2002-03513 and CGL2005-02699/HID). We also thank Miriam Fernandez and M<sup>a</sup> del Mar Motero (University of Huelva) and URS’ people for the help they gave us in the sampling work. V. Hermoso held a doctoral fellowship from the Spanish Ministry of Education (FPU AP 2004-1414).

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