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The status of Anaecypris hispanica in Portugal: Problems of conserving a highly endangered Iberian fish

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Abstract

The status of the distribution and abundance of the endangered stream fish *Anaecypris hispanica* in Portugal is presented. A highly discontinuous and fragmented pattern was observed, mainly caused by water resource development schemes, habitat degradation and introduction of exotic fish species. This reinforces the urgent need for a targeted rehabilitation programme and the implementation of a specific code of practice to conserve and enhance the residual populations.

Keywords: *Anaecypris hispanica*; Conservation; Cyprinidae; Endangered species; Iberian Peninsula

1. Introduction

Anaecypris hispanica (Steindachner in 1866) is considered the most threatened non-migratory species in Portuguese fresh waters (SNPRCN, 1991). It is a small Iberian cyprinid (max. total length 7 cm), which is also classified as "Endangered" in the Spanish Red Data Book (Blanco and González, 1992), and in the IUCN Red List (Baillie and Groombridge, 1996). It is listed in the Bern Convention (Annex II) (1988) and in Annexes II and IV of the EC Habitats Directive (92/43/EEC). Maitland (1995), and more recently Elvira (1997), suggested the species should be included in the group of "Critically Endangered" taxa, due to the rapid decline in stocks observed over the two last decades in both Portugal and Spain.

The abundance and geographic range of *A. hispanica* have progressively contracted since it was first described in Portugal by Collares-Pereira and Almaç (1979), being consequently declared in danger of extinction some time later (Collares-Pereira, 1990). In the 1970s the species was relatively abundant, contributing up to 22% of the local fish community (Table 1). Its geographical distribution is restricted to the Guadiana drainage. It was found throughout Portugal from the River Odeleite in the south to the River Xévora in the north (Collares-Pereira, 1983) and in some Spanish rivers especially close to the border and extending as far east as the River Estena at Ciudad Real (Barrachina et al., 1989). There is also a record of one specimen from the Bembezar River, a tributary of Guadalquivir basin (Doadrio et al., 1991), although this occurrence has never been confirmed (Elvira, personnal communication) (Fig. 1(A)).

More recently, many studies have been carried out in the Guadiana drainage (e.g. DRENA/EGF (1985) and SEIA (1995)) to assess the impact of water resource schemes or to determine the fish community structure, but all these failed to find *A. hispanica*. The presence of the species was subsequently confirmed by Collares-Pereira et al. (1997)Collares-Pereira et al. (1998) and Pires, Cowx and Coelho (unpublished data) in the northern tributaries close to the Spanish border. As a result of these new observations the species has become the focus of a new investigation (Collares-Pereira et al., 1997) to assess the potential impact of the construction of Alqueva Reservoir, a large development project which will impound the middle reaches of the Guadiana in Portugal. This development could potentially destroy the only known populations of *A. hispanica* in

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Table 1
Percentage contribution of *A. hispanica* to the fish community and numbers of fish captured (in brackets) based on unpublished data of Collares-Pereira and Pires (1978–1996) and data from the present study (1997). See text for data collection methods. Rivers listed from north to south (see Fig. 1)

Drainage	Years								
	1978	1979	1980	1981	1982	1986	1995	1996	1997
Xévora						9.4 (23)	3.4 (54)	2.6 (5)	0.7 (5)
Caia	12.7 (119)						6.3 (17)		0.6 (7)
Degebe		21.5 (969)	7.0 (3)	2.2 (19)					0.3 (5)
Álamo				5.3 (17)	3.0 (3)				0.0
Lucefecit				2.8 (4)					0.0
Ardila				10.0 (9)					1.0 (8)
Carreiras									21.6 (124)
Chança									5.6 (58)
Vascão	2.2 (7)								9.8 (23)
Foupana	9.7 (92)			3.3 (5)					2.0 (6)
Odeleite	0.6 (5)								3.8 (5)

Portuguese waters (see Fig. 1) so the commissioning of a new study to assess the current status of this critically endangered species was considered imperative. This paper describes the present status and distribution of *A. hispanica* in Portuguese waters of the Guadiana River, and assesses the problems that will have to be faced in conserving the species, particularly with respect to development activities in the region.

2. Methods

The Guadiana river basin has a very irregular hydrological regime, with severe droughts and floods, and is under increasing pressure for exploitation of the water resources. This typical Mediterranean river flows 810 km from the headwaters in Spain to its mouth in southern Portugal, with 150 km of main river and many

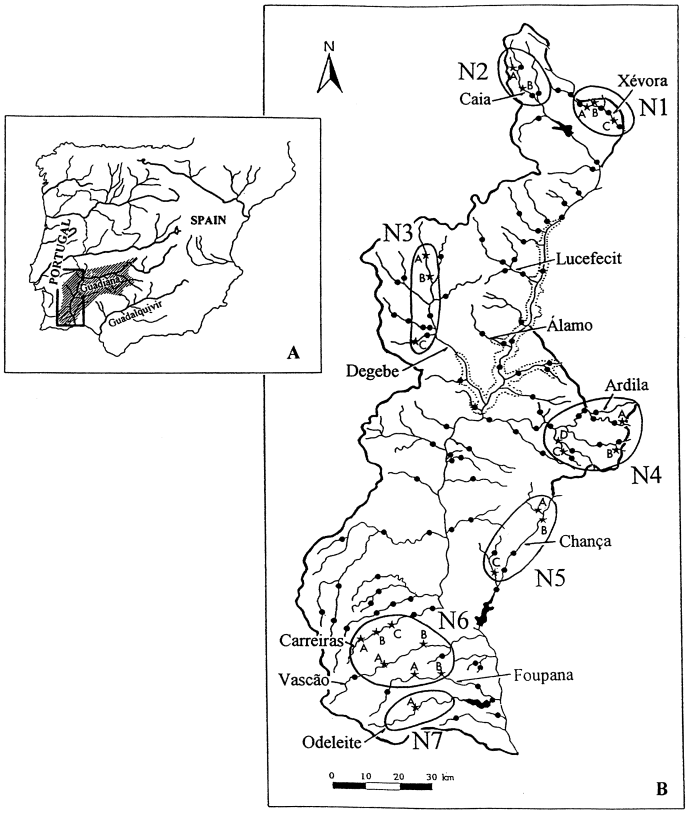

Fig. 1. (A) Distribution area of *Anaecypris hispanica* in the Iberian Peninsula; (B) Sites sampled in the Guadiana river basin in Portugal: (•) indicate sampling sites and (⋆) indicate sites where *Anaecypris* was caught (lettering refers to site codes in Table 2). N1–N7 represent groupings of sites (nuclei) where *Anaecypris* was found. (Outlined area represents zone of impoundment of Alqueva reservoir.)

tributaries in Portugal, and 110 km of main river forming the border between the two countries (Fig. 1). Its most important tributaries in Portugal are the rivers Ardila and Chança on the left bank, and the Caia, Degebe, Cobres, Vascão, Foupana and Odeleite on the right.

The fish community of the Guadiana basin in Portugal is dominated by two primary species: the *Rutilus alburnoides* (Steindachner in 1866) complex and *Barbus steindachneri* (Almaça in 1967). Eight other indigenous species – *Anaecypris hispanica, Chondrostoma willkommii* (Steindachner in 1866), *Chondrostoma lemmingii* (Steindachner, 1866), *Leuciscus pyrenaicus* (Günther in 1868), *Barbus microcephalus* (Almaça in 1967), *B. comiza* (Steindachner in 1865), *B. sclateri* (Günther in 1868) and *Cobitis paludica* (De Buen in 1930), and seven exotic fish species – *Esox lucius* (Linnaeus in 1758), *Micropterus salmoides* (Lacépède in 1802), *Lepomis gibbosus* (Linnaeus in 1758), *Gambusia holbrookii* Girard, 1859, *Cichlasoma facetum* (Jenyns in 1842), *Cyprinus carpio* (Linnaeus in 1758) and *Carassius auratus* (Linnaeus in 1758), plus the American crayfish *Procambarus clarkii* are also present in the previously described geographic range of *A. hispanica* (Collares-Pereira et al., 1998).

To provide a thorough assessment of the distribution of the species, a sampling strategy was designed to screen all the major rivers in the Portuguese sector of the Guadiana catchment. All the main tributaries from the Xévora in the north to the Beliche in the south (a total of 34 rivers) were investigated, although only four sites were selected in the main river due to previous knowledge about habitat preferences of the species (Collares-Pereira et al., 1998) and problems with efficiently sampling such a large river.

The field work was carried out between late December 1996 and March 1997 (winter period) and April to late June 1997 (spring/summer) to account for seasonal variation in the distribution. A total of 124 different sites were sampled (Fig. 1(B)), of which 60 were revisited to account for seasonal differences in distribution. The fish populations were sampled by electric fishing 40-m sections of river (wading upstream with a single anode using 240 V pulsed direct current). Fish were treated carefully due to their sensitivity to handling, and after being weighted (nearest 0.1 g) and measured (fork length to nearest mm) were returned to the water. A general habitat description and fish community assessment were performed according to the methodology referred to in Martins et al. (1998).

The data on distribution and abundance were compared with information from previous studies to show how the importance of the species has changed over the past 20 years. It is important to note that only comparison of percentage contribution to the fish community is possible because information from the 1970s and 1980s is based mainly on qualitative sampling using a variety of gears, including small seine and hand nets.

3. Results

The abundance of *A. hispanica* has declined dramatically since the 1970s. During the 1997 study, *A. hispanica* was captured at 23 of the 124 sites (Fig. 1) sampled and usually in low numbers (Table 2). The numbers of fish caught and their contribution to the fish community structure were also considerably lower than in the 1970s and 1980s (Table 1). In 1997, *A. hispanica* was found at only nine (25%) of the 34 rivers studied, and was absent from several rivers where it was previously abundant, e.g. Degebe (Tables 1 and 2). It was caught at only one site, on the Vascão, during both the summer and winter sampling periods. These sites can be grouped into seven distinct nuclei segregated by artificial barriers which constrain their migratory activities (Fig. 1): N1–Xévora (not in the headwaters, just in tributaries near to the Spanish border, although it is also known to exist in Spain); N2–Caia (up to the dam); N3–Degebe (only in two small tributaries of the upper zone-Pardiela and Pecena); N4–Ardila (mainly in the tributaries near the Spanish border, Murtigão, Murtega and Safara); N5–Chança (in the upper zone, near the Spanish border, upstream the dam); N6–Carreiras, Vascão and Foupana; N7–Odeleite (isolated from N6 by a dam). Furthermore, the distribution of the size-classes (see Fig. 2 for the most representative samples from the Carreiras and Chança) suggests that *A. hispanica* migrates upstream to spawn because smaller fish were generally found at the upstream sites.

The species was more abundant in the southern streams, but there was a complete lack of consistency in the habitat types where the fish were caught, i.e. the fish was not necessarily found in zones of the same or different rivers which exhibited similar habitat characteristics (depth, width, substrate type, flow regime and cover). For example, it was not found in the rivers Oeiras, Limas, Terges/Cobres which are similar in habitat characteristics to the Carreiras and Chança. The species shows a preference for small, shallow, well-oxygenated streams (<70 cm), with aquatic and riparian vegetation, coarse substrate and medium to low flow (0.1–0.7 m s^{-1}). An avoidance of extremes in water temperature ($>25°C$) also seems to exist. However, during the summer, under extreme drought conditions, the fish are found in a few isolated permanent pools.

4. Discussion

The current information indicates that there have been considerable changes in the distribution and

Table 2
Number of specimens, fork length range, biomass and abundance of *Anaecypris hispanica* per site and drainage in surveys carried out during 1997 (note order of rivers is in a north-south direction, see Fig. 1)

Drainage	Site Ref.	Number caught	Fork length (mm)	Biomass (g 100 m^{-2})	Abundance (N 100 m^{-2})
Xévora	A	2	45–50	2.2	1.4
	B	1	47	0.8	0.8
	C	2	46–49	1.1	1.3
Caia	A	3	36–43	0.7	1.2
	B	4	40–55	5.6	7.3
Degebe	A	1	50	0.3	0.2
	B	3	40–48	1.0	1.1
	C	1	43	0.8	1.0
Ardila	A	2	45–50	0.6	0.7
	B	1	50	0.6	0.6
	C	1	39	1.2	2.0
	D	4	46–50	2.1	1.9
Chança	A	36	28–42	7.4	21.9
	B	16	40–60	4.4	4.5
	C	6	40–52	1.8	1.9
Carreiras	A	57	34–48	29.2	44.0
	B	8	48–56	7.6	5.5
	C	59	45–58	10.5	7.4
Vascão	A-win	17	30–58	3.7	6.3
	A-sum	3	40–43	0.6	0.9
	B	3	39–40	0.4	1.1
Foupana	A	5	46–54	3.1	2.1
	B	1	47	0.2	0.3
Odeleite	A	5	30–40	0.3	1.0

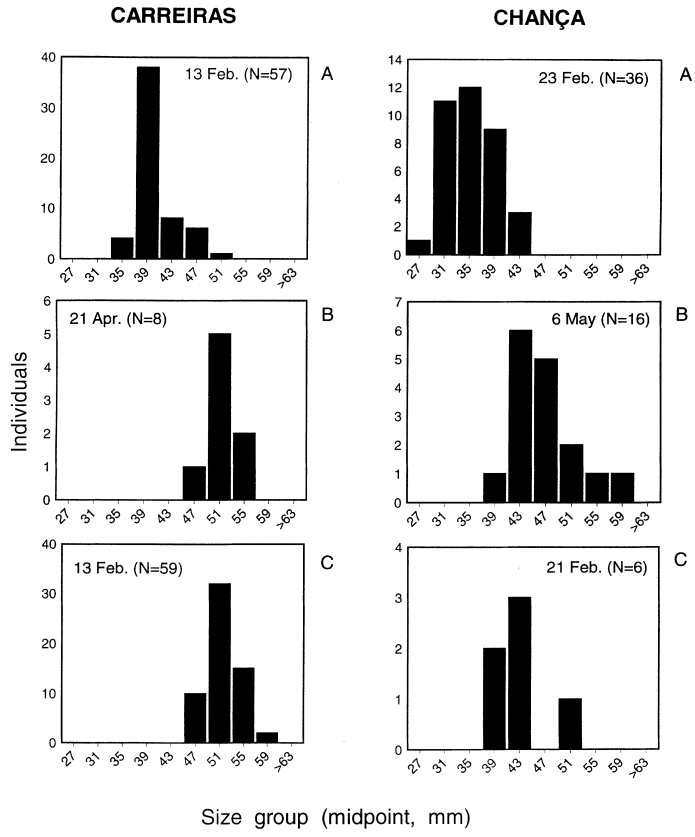

Fig. 2. Size-class distributions of *A. hispanica* in various sampling sites in the Carreiras and Chança drainages. Note site A represents the most upstream site and C the most downstream site sampled in each river.

abundance of *A. hispanica* in Portuguese waters of the Guadiana since the 1970s. The fish populations have become fragmented into seven nuclei. Relatively low numbers of fish were found in nuclei N4 and N7, both in the past and currently; N5 and N6 have comparatively higher densities; whilst in the northern rivers (N1, N2 and N3 nuclei), where *Anaecypris* used to be quite common (Table 1) (Collares-Pereira and Almaça, 1979; Collares-Pereira, 1983, 1990), it is now only found in very low numbers. Some difference in the distribution could be attributed to several of the smaller streams sampled during the winter period being dry in the summer or reduced to isolated pools. Also difficulties were encountered sampling the larger rivers during the winter because of high flows. However, provisional observations suggest that habitat degradation, such as the loss of riparian vegetation cover and siltation, increased water abstraction and impoundment, plus the dispersion of introduced species, especially *Esox lucius* and *Micropterus salmoides*, have contributed to the demise of the species (Collares-Pereira et al., 1998). Intense anthropogenic activities are mainly concentrated in the most northern and central drainages of the Portuguese Guadiana (INAG, 1997), the regions where *Anaecypris* appears to be in greatest decline, or has disappeared, e.g. the Lucefecit and Álamo rivers.

When stock decrease is coupled with fragmentation, as in the present situation, conservation actions are particularly complex due to the possible reduction of the gene pool (Carvalho and Cross, 1998). Thus, if concerted action towards this endangered species is not forthcoming, extinction appears inevitable due to the present environmental pressures which exceed its ability to adapt (Collares-Pereira et al., 1998).

Unfortunately, classical strategies based on active breeding programmes or transfer of stock from one subcatchment to another are not feasible because the species is small, extremely sensitive to handling and the residual populations are too small to risk transplanting programmes (Collares-Pereira et al., 1998). Also, it is unclear at the moment whether the existing nuclei represent distinct populations adapted to the region where they exist.

Notwithstanding, the main threats, which face the Guadiana river fish populations, are mainly related to habitat loss and degradation. Thus it is essential to adopt conservation strategies that aim to improve environmental conditions for all life stages and remove the bottlenecks to natural recruitment, survival and growth, and promote the stabilization of the fish communities. These involve a complex matrix of factors, dealing with both abiotic and biotic relationships, and consequently demand a multidisciplinary approach to habitat restoration (Cowx, 1994, 1998; Cowx and Welcomme, 1998). Actions that can be undertaken include rehabilitation of degraded habitats, prevention of indiscriminate abstraction of water for agricultural purposes during the drought months, especially through awareness campaigns, banning of the introduction of exotic fish species, and, where possible, active removal programmes for exotic predatory fish species.

In relation to removal of bottlenecks, although information about reproductive and demographic strategies of *A. hispanica* is lacking, dispersion and migration along the water courses were evident, making the maintenance of longitudinal connectivity between the drainages a crucial point for the recovery of the species (Cowx and Welcomme, 1998). However, the region is facing increasing pressure to develop the water resources, and there are 13 new river impoundment proposals for the Guadiana in Portugal (including the Alqueva Reservoir). Considering *A. hispanica* is mainly found in Portugal, these reservoir development proposals may have serious adverse consequences for the conservation of the species and other native threatened species (Collares-Pereira et al., 1997).

Most of the measures proposed are long-term strategies to maintain and enhance the stocks. However, if action is not taken immediately the species is likely to be lost from Portuguese waters, and probably Spanish rivers, which suffer the same problems. There is therefore a need to establish appropriate conservation areas and nature reserves to protect the residual populations, especially where the species is relatively abundant, such as in the Chança, Carreiras, Vascão and Foupana.

Finally, a Portuguese–Spanish joint programme for flow regulation and water management, to develop a sustainable water policy, as suggested in the Proposal for a Water Framework Directive (EC Draft 25/02/97), as well as a code of practice, should be urgently implemented. If the native fish populations are to be conserved for future generations, as expected under Agenda 21 of the Rio Convention, active legislation must be prepared and enforced, and communication between the various water resources user groups, managers, scientists and general public must be improved. These are in addition to the active conservation measures suggested earlier which will be implemented under a European Union LIFE project recently started in the Portuguese sector of the Guadiana.

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