Freshwater Fishes Introduced in Spain and Relationships with Autochthonous Species

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Eighteen exotic fish species have been introduced into Spanish waters. They represent about 29% of the present freshwater fish fauna. Most of them were brought into Spain during the 20th century (13 species) and mainly stocked for sport fishing. Although many introductions were administrative decisions, environmental impact studies were never conducted.

Results and Conclusions

Since the 17th century, 18 exotic fish species belonging to 10 families were introduced into Spanish mainland fresh waters (Table 1). The guppy *Poecilia reticulata* currently present in the Canary Islands, is not included in the list. Allochthonous species represent about 29% of the actual freshwater fish fauna (Doadrio et al. 1991).

Besides the tench *Tinca tinca,* presumably introduced during the Middle Ages, but here considered as native, two other cyprinids (carp and goldfish) are known to have been brought into Spanish waters during the 17th century. The other 16 species were stocked since the late 19th century, with a significant exponential rate during the present century (Figure 1).

Europe is the principal origin of acclimatized fishes with eight species, followed by North America with seven species. Sport fishing (eight species) was the first purpose for introductions. The purpose for the recent introduction of two species is still unknown. Introductions of the highest number of species (12) were administrative decisions, but recently, one species was released by anglers and four species were suspected to be stocked by anglers or aquarists.

Many of the exotic species are large fish predators — fishes originally excluded from the Iberian fauna. Their occurrence in Spanish waters can negatively affect autochthonous species such as small minnows and loaches. Likewise, successful introductions of *Gambusia holbrooki* and *Fundulus heteroclitus* are a potential threat of competition to the endemic toothcarps, *Aphanius iberus* and *Valencia hispanica* (Elvira 1990).

Studies of interactions between allochthonous and autochthonous fish fauna are rare. Nevertheless, Rincón et al. (1990) researched the negative effects of pike *Esox lucius* introduction on the native fish assemblages in the Duero River basin. The pike also was the main cause of extinction of autochthonous fish fauna in the National Park of Daimiel (central Spain). Introduced in the 1950s, it extinguished the original fish community and eventually itself in 1986. Nowadays, the only common fishes of the area are carp and mosquito fish.

TABLE 1.—List of exotic fishes acclimatized in Spain, including time, origin, purpose, and authorship of introduction

Family	Species	Date of Introduction	Country of Origin	Purpose of Introduction	Originator of Introduction
Salmonidae					
	Hucho hucho	1968	Czechoslovakia	Angling	National Fisheries Service
	Oncorhynchus mykiss	late 19th cent.	USA	Angling	National Fisheries Service
	Salvelinus fontinalis	late 19th cent.	USA	Angling	National Fisheries Service
Esocidae					
	Esox lucius	1949	France	Angling	National Fisheries Service
Cyprinidae					
	Carassius auratus	17th cent.	Asia	Ornamental	Unknown
	Cyprinus carpio	17th cent.	Asia	Ornamental	Unknown
	Gobio gobio	late 19th cent.	France	Trout farming	Escaped from fish farms?
	Rutilus rutilus	1910–1913	France	Fish stocking	Catalonia Regional Fisheries Services
	Scardinius erythrophthalmus	1910–1913	France	Fish stocking	Catalonia Regional Fisheries Services
Siluridae					
	Silurus glanis	1974	Germany	Angling	Anglers
Ictaluridae					
	Ameiurus melas	1910–1913	USA	Fish stocking	Catalonia Regional Fisheries Services
Cyprinodontidae					
	Fundulus heteroclitus	1970–1973	USA	Unknown	Aquarists?
Poeciliidae					
	Gambusia holbrooki	1921	USA	Combat malaria	National Medical Services
Percidae					
	Perca fluviatilis	1970–1979	France	Angling	Anglers?
	Stizostedion lucioperca	1970–1979	France	Angling	Anglers?
Centrarchidae					
	Lepomis gibbosus	1910–1913	USA	Fish stocking	Catalonia Regional Fisheries Services
	Micropterus salmoides	1955	USA	Angling	National Fisheries Service
Cichlidae					
	Cichlasoma facetum	1980–1986?	Brazil?	Unknown	Aquarists?

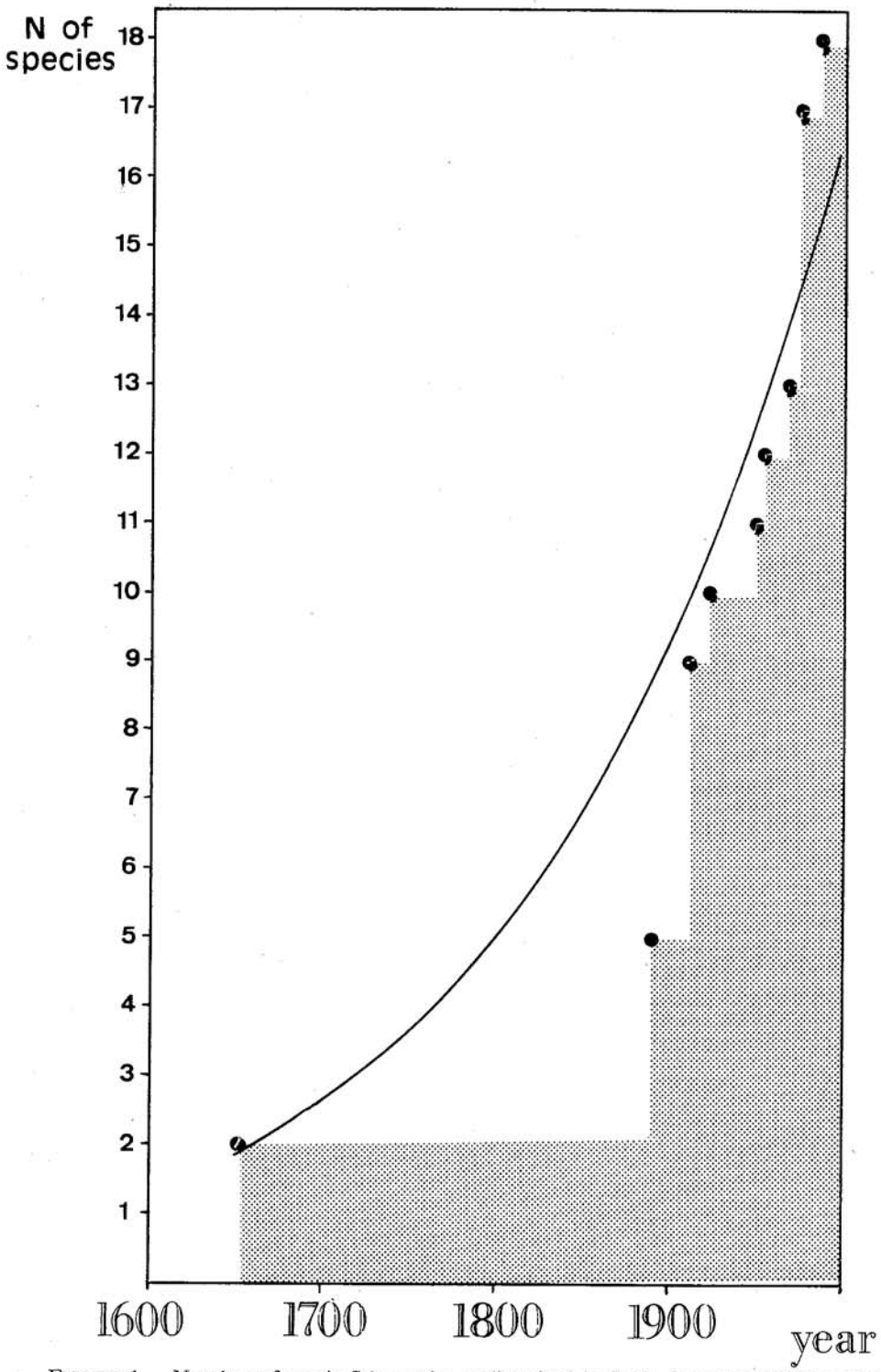

FIGURE 1.—Number of exotic fish species acclimatized in Spain from the 1600s to the present. The distribution fits an exponential regression model: $y = e(\exp(-9.924 + 0.006x))$, $R^2 = 0.91$, $p < 0.001$.

A similar case was observed in the Natural Park of the Ruidera Lakes (central Spain). Here, the original fish fauna consisted of nine species (including eight Iberian endemic species). This native fauna still exists, but now is mixed with eight exotic species. Allochthonous fishes presently occupy the medium and lower lakes and streams. Meanwhile, autochthonous species are restricted to higher lakes and springs.

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