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The Status of the Freshwater Pearl Mussel *Margaritifera margaritifera* L. in the South of Its European Range

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ABSTRACT

The freshwater pearl mussel Margaritifera margaritifera *L. has declined markedly in the south of its European range. Of 12 rivers from which the mussel was formerly recorded, only three are still occupied. It could no longer be confirmed from the Vosges (France) and from Portugal. The most important cause of extinction was probably eutrophication. Two of the three populations which were found in Galicia (Spain) are still reproducing and stable, due to the very low pollution levels in this area. This is of more than just local significance since all over Central Europe the pearl mussel populations are declining. If further deterioration can be prevented, Galicia will therefore be one of very few places in Europe where the freshwater pearl mussel is able to survive.*

INTRODUCTION

Surveys on the status of the freshwater pearl mussel *Margaritifera margaritifera* show that this species has declined markedly since the beginning of this century (Baer, 1969; Jungbluth, 1971; Valovirta, 1977; Bauer, 1980; Dettmer, 1982; Wells *et al.*, 1983; Young & Williams, 1983). In Central Europe it is now on the verge of extinction, having decreased by more than 95% (Bauer 1979, 1980) and, as far as we know, none of the present populations are able to reproduce since juveniles do not survive in the polluted rivers (Bauer *et al.*, 1980).

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In the past, destruction of many habitats might have been prevented if the occurrence of the pearl mussel had been known precisely: information on distribution, abundance and reproductive status is the basis for conservation measures. It is particularly important to note and conserve populations which are still reproducing in order to create reserves for the protection of breeding stock.

In the last two decades a great deal of work has been done on pearl mussels in Northern and Central Europe, but little is known about southern populations. The last reliable record from the Vosges (France) dates back to the year 1863. In Galicia (North-West Spain) and Portugal, the southernmost locations of the pearl mussel in Europe, apparently nobody has checked the rivers since 1878 and 1913, respectively. We therefore carried out field surveys concerning occurrence, reproductive status and threats to survival of pearl mussel populations in these regions.

METHODS

The data were collected during an excursion in June 1985.

Distribution

Information on the former distribution is given in the following papers: Vosges (France), Godron (1863); Galicia (Spain), Velado (1878); Portugal, Nobre (1913).

These data were examined and if the exact locality (the next village) was not evident from the literature, the river was checked at as many places as possible.

Reproductive status

Instead of estimating density or number of mussels, the age structure was investigated. This is a suitable parameter for describing the status of a population as it allows conclusions about the further trend (Bauer, 1983).

We obtained the age distribution by measuring the ligaments of randomly sampled mussels in the field. In the laboratory a growth curve for the ligament was established for each population using Hendelberg's method (1961) and with this the age of the mussels was calculated.

Water chemistry

In rivers where we could not find any mussels, only temperature and electrical conductivity were measured. The latter parameter depends on the geological substrate and on the pollution level. Since there is a similar substrate in the three study areas (primary rocks, mainly granites and porphyrites) conductivity can serve as a general indicator for eutrophication (Bauer *et al.*, 1980).

If there were mussels present, we analysed the following parameters: temperature, electrical conductivity, pH, BOD_5, dissolved phosphate (P), chloride, calcium, nitrate and ammonia.

RESULTS

Distribution

Figure 1 shows that the pearl mussel has disappeared from a number of places. Twelve rivers were searched but living specimens were found in only three. We can no longer confirm the species from the Vosges or Portugal. In Galicia it was abundant in the Rio Landro near Chavin, in the Rio Mandeo upstream of Muniferal, and in the Rio Tambre upstream of Ponte Carreira.

Reproductive status

Ligament growth is much the same in Rio Landro and Rio Mandeo (Table 1). However, a linear equation gave the best fit for Rio Tambre. As Fig. 2 shows, life expectancy also differs considerably between the populations: in Rio Landro the mussels are very short lived, whereas in Rio Tambre they attain an age of up to 60 years.

When analysing the age structure of a pearl mussel population, two factors must be considered:

(1) young pearl mussels (especially those < 10 years) are burrowed deeply into the substrate (Bauer *et al.*, 1980; Young & Williams, 1984) and therefore sampling is inefficient until mussels are *ca* 20 years old.
(2) there is evidence that in unpolluted rivers mortality increases in the second half of the maximum life span, whereas it is low in the first age classes (Bauer, 1983).

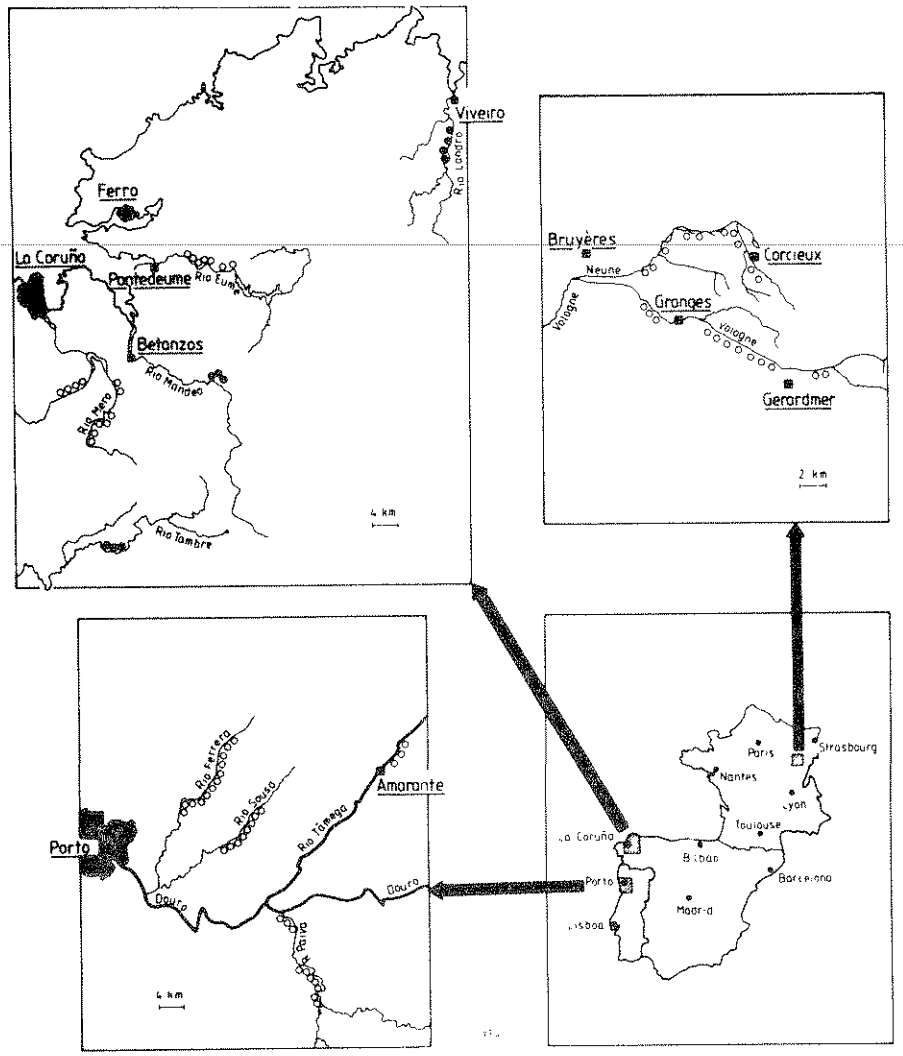

Fig. 1. The distribution of the pearl mussel in the Vosges (France), in Galicia (Spain) and in Portugal. ○, Rivers where mussels occurred formerly—no mussels found at marked sites. ●, Mussel population.

TABLE 1
Ligament Growth in Three Mussel Populations from Galicia
(y, Ligament length (cm). x, Age (years).)

River	*Equation*	*r*	*P*	*n shells*
Rio Landro	$y = -0{\cdot}1 + 0{\cdot}25x - 0{\cdot}003x^2$	0·98	<0·001	8
Rio Mandeo	$y = 0{\cdot}6 + 0{\cdot}17x - 0{\cdot}002x^2$	0·98	<0·001	7
Rio Tambre	$y = 2{\cdot}66 + 0{\cdot}035x$	0·92	<0·001	10

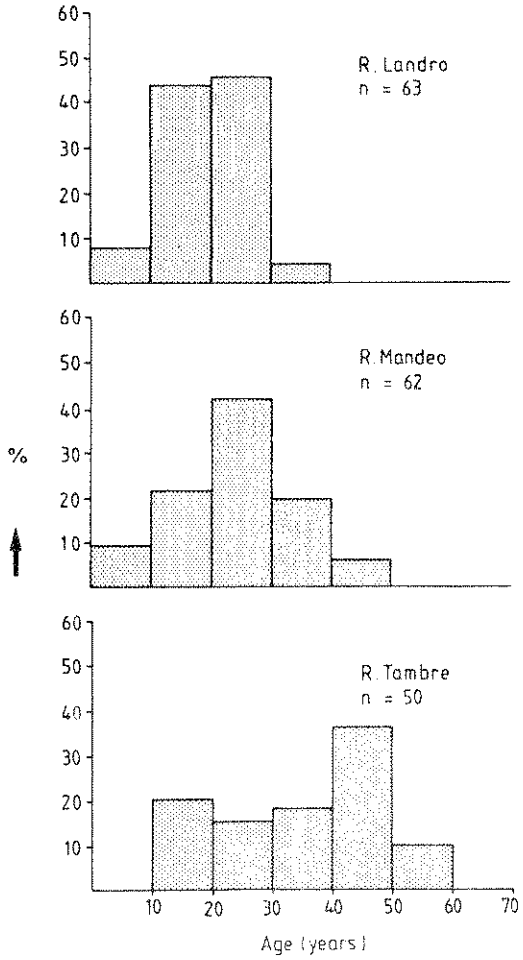

Fig. 2. Age structure of three Galician mussel populations.

The age structure of a healthy, reproducing population should therefore show a preponderance of mussels aged between 20 years and half the maximum life span. If the life expectancy of the particular population is comparably short, the age distribution should be bell-shaped.

This is exactly what was found in the Rio Landro and Rio Mandeo (Fig. 2). Apparently these populations are reproducing and stable.

The age distribution in the Rio Tambre, on the other hand, suggests that this population no longer breeds. Although we searched carefully we were unable to find mussels younger than ten years of age, and the age distribution pattern is not at all bell-shaped. Probably this population is frequently affected by threats to survival or it only exists because there is a reproducing population upstream, from which various numbers of animals are washed down every year.

Water chemistry

Pearl mussels are restricted to waters low in calcium and nutrients. The electrical conductivity therefore reflects some overall pollution factor, especially if the local geological features are similar. Our investigations on Bavarian pearl mussel rivers (primary rock) indicate that conductivity is smaller than 80 μS if there is hardly any pollution. Rivers where the mussels are affected by eutrophication show increased values (Bauer *et al.*, 1980).

According to Fig. 3 conductivity was considerably increased in five rivers where we could not find any mussels. Apparently eutrophication was the cause of extinction in these cases. The water quality of four of the rivers where we did not detect mussels is close to that found where mussels occur, suggesting that other causes may have operated there.

The chemical characteristics of rivers where the mussel still occurs (Table 2) show that Rio Mandeo is apparently hardly polluted. However,

TABLE 2
Chemical Data for Spanish Rivers Occupied by Pearl Mussels

	t (°C)		*Conductivity* (μS)	*pH*	BOD_5 (*mg*)	*P (diss.)* (*ppm*)	*Cl* (*ppm*)	*Ca* (*ppm*)	NO_3 (*ppm*)	NH_4 (*ppm*)
Rio Landro	18	(14°°)	85	6·25	2	0·07	15	1·5	1·4	0·02
Rio Mandeo	17·8	(11°°)	58	6·6	0·7	0·016	13	2·5	7·2	0·016
Rio Tambre	18·5	(12°°)	69	6·9	1·8	0·04	14	1·5	6·5	0·02

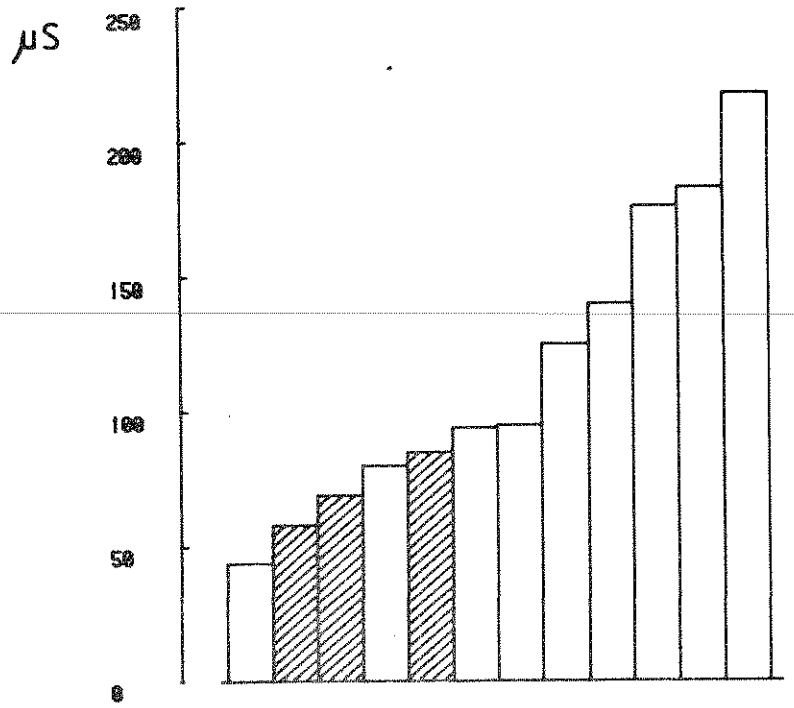

Fig. 3. Electrical conductivity in rivers occupied by mussels (hatched columns) and in rivers where mussels probably are extinct.

there is almost no difference between Rio Landro with its reproducing population and Rio Tambre, where the mussel no longer breeds. As Rio Tambre appeared polluted with heavy depositions of mud and abundant submerged vegetation, we assume that the long-term means in this river are higher than our values.

DISCUSSION

Undoubtedly a great decline has taken place in the study areas. The pearl mussel can be confirmed from only 25% of its recorded distribution. The decrease of southern populations, therefore, is of the same magnitude as that recorded for the remainder of Continental Europe (Baer, 1970, 1981; Jungbluth, 1971; Bauer, 1979, 1980; Dettmer, 1982; Wells *et al.*, 1983).

The causes contributing to the extinction of particular populations could not always be identified. Rio Paiva (Portugal), especially, with an electrical conductivity of 44 μŜ (!), remains doubtful. In some cases, parts of the rivers have been canalised, so altering the substrate (Rio Ferrera, Portugal) or hydroelectric dams have been built (Rio Eume, Spain). The most important cause of decline, however, seems to be pollution. Five out of the 9 rivers where no mussels were found are heavily polluted. Two more show slightly increased values of electrical conductivity, indicating that eutrophication was at least among the causes of decline.

So far, the situation is quite similar to Central Europe where domestic and industrial waste, intensive agriculture and stream canalisation have had serious effects. However, there is one important difference. As far as we know, all mussel populations in Central Europe are currently threatened by pollution. They no longer reproduce and, therefore, without conservation measures will become extinct in a few decades.

In Galicia on the other hand, two of the three populations we found are not in danger of extinction, the age structure indicating that numbers will remain stable. Some areas of Galicia are so sparsely settled that water pollution is still negligible. Rio Mandeo is one of the cleanest pearl mussel rivers we know of in Continental Europe. It may be the only river still reflecting the original conditions for the pearl mussel in the south of its range. Water pollution, however, might increase in Galicia as it did farther north. The Rio Mandeo and Rio Landro, including their drainage areas, should therefore be protected in order to prevent deterioration.

There are very probably populations which have not been discovered to date (perhaps in the Rio Tambre farther upstream of Ponte Carreira), and surveys are necessary to record all populations, especially those which are still reproducing. If these stocks can be protected, Galicia will be one of very few places in Europe where the freshwater pearl mussel can survive.

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