

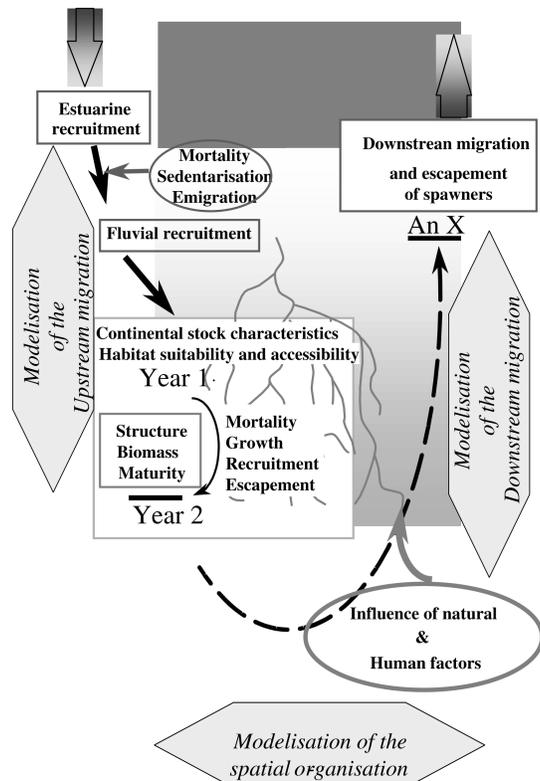
# The number of male silver eels (*Anguilla anguilla*) is decreasing

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## The Context



1. The European eel (*Anguilla anguilla* L.) has steadily declined throughout its distribution range. Consequently, the current effective population size is low and the population has undergone severe contractions.

A stock recovery plan is urgently needed, especially for silver eels. Monitoring methods already exist and have been used for glass eels and yellow eels in a range of systems throughout Europe (for example in the Frémur, Legault *et al.*, 2004; Laffaille *et al.*, 2005), but little work has been conducted for silver eels (Feunteun *et al.*, 2000).

The objectif of the Frémur program is to assess effects of recruitment restoration on inland population dynamics of European eel (see for example Feunteun 2002) and produce relevant indicators for regional eel report car.

Principle of the Frémur program aiming to assess effects of recruitment restoration on inland population dynamics of European eel populations (Modified from Feunteun 2002).

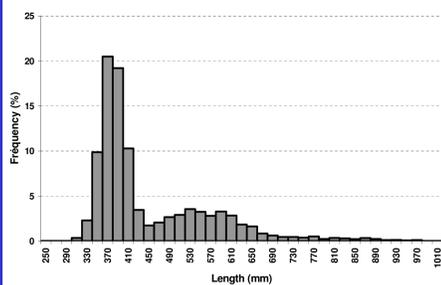
## Material and methods



2. Yearly changes in the numbers of migrating silver European eels were examined over an 8-year period in the river Frémur (a 60 km<sup>2</sup> catchment in Brittany, France). Downstream migration was monitored daily using an eel trap. Seasonal trends in silver eel abundance and the proportion of eels > 450 mm (only female) were analysed.

## Results and discussion

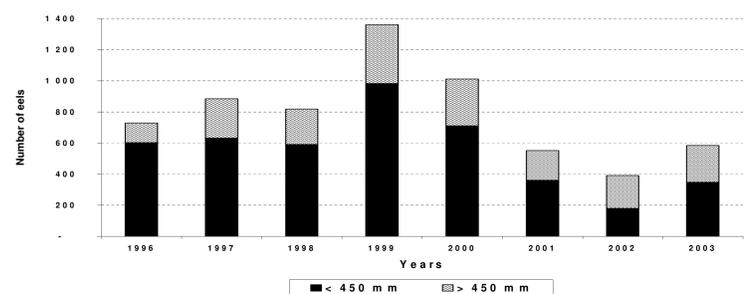
3. A total of 6 336 silver eels were caught in the downstream migration trap. The mean length of descending eels was 440 ± 116 mm (min: 270 and max: 1112 mm). Each year, the size structure of silver eel appears to be bimodal: < 450 mm and > 450 mm. The first mode represents males and females (mainly males) and the second exclusively female.



Silver eel population structure caught in the downstream trap during the 8-year study.

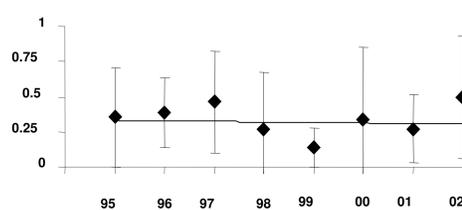


4. The emigrating eel population appeared to be dominated by eels < 450 mm (mainly males) during the study period; on average 68% of eels < 450 mm and 32% of females. However, the proportion of females (eels > 450 mm) increased significantly (Chi-square test, Chi-square = 1333.80; p < 0.001) over the year. The Simultaneous Test Procedure showed three year groups: 1996 when females represented 17% of the total silver eels, from 1997 to 2000 when females represented 28%, and from 2001 to 2003 with 43% of females. In 2002, female silver eels were dominant (54% of the total silver eels). The total number of descending eels increased from 1996 to 1999 and has decreased rapidly since 1999. The number of female silver eels remained stable from 1999 to 2003 (Pearson r = 0.59; p=0.13). However, the number of male silver eels decreased significantly from 1999 to 2003 (Pearson r = 0.78; p=0.04).

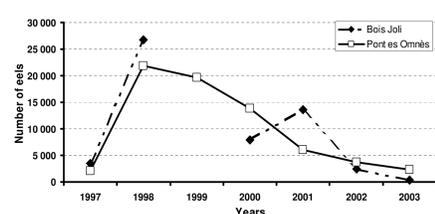


Number of silver eels caught in the downstream trap during the 8-year study according to the length structure.

5. Sex ratios have been related to latitude, catchment characteristics and eel densities. Generally, male silver eels are more abundant at high densities and in downstream areas of the catchment whereas females predominate at low densities and in upstream areas. The Frémur is a small river with high yellow eel densities in the whole catchment (mean density 0.5 eel.m<sup>-2</sup>; Laffaille *et al.* 2003). In agreement with the relationship between yellow eel densities and the sex ratio, male silver eels predominated in the downstream trap, but the number has decreased. However, no significant decrease of yellow eel densities was showed was found throughout the period, except in the most upstream area (Laffaille *et al.* 2005).



Change in eel density +/- sd (number.m<sup>-2</sup>) with year in the 8 river sections of Frémur (Laffaille *et al.* 2005).



Number of eels captured per year in the two downstream traps (Legault *et al.* 2004).

6. But, as the result of the general decline in recruitment, the number of ascending eels has decreased since 1998 with a significant annual slope of -34% (Legault *et al.*, 2004).

7. Given the life cycle and relative longevity of the eel, declining recruitment will have a delayed effect on eel densities in freshwater systems and the resulting spawning escapement. Thus recent declines in recruitment could lead to a continuing reduction in the number of spawners such as in the Frémur River. The problem is the depensatory processes that operate at low stock levels, if for example silver eels find it difficult to find mates at low spawner densities in the Sargasso Sea. Different studies suggested that both freshwaters and spawning stocks must have declined in parallel, and insufficient spawning stock biomass might have caused the recruitment collapse currently observed. Consequently, the observed decrease of the silver eel stocks and gradual shift of silver eels sex ratio from male to female are probably a rapid functional response to the general decrease of the eel recruitment. This trend is certainly general throughout the European eel distribution range. These consequences should be taken into account in the global and local management plan. European eel is outside safe biological limits, and therefore, application of the precautionary principal approach for the management of the European eel is necessary. This study contributes to the establishment of relevant silver eel indicators use with the local eel report card, which in turn will lead to a global management plan.

### References

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Programme Anguille Frémur

Maîtrise d'ouvrage : Fédération des AAPPMA d'Ille et Vilaine

Maîtrise d'œuvre : FISH-PASS

Financement : CSP, Communauté Européenne, Fédération des AAPPMA 35, Ministère Environnement, Région Bretagne

Collaborations scientifiques : Université Rennes 1, Université de la Rochelle, ENSAR

Programme réalisé dans le cadre du contrat de plan état-région 2000-2006. Coordination Ouest Grands Migrateurs.