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Recovery of the stocks of the European eel (*Anguilla anguilla*) by spawner enhancement

Erholung des Bestandes des Europäischen Aals (*Anguilla anguilla*) durch Stützung der Laichfische

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Abstract

Recovery of the stocks of the European eel (*Anguilla anguilla*) by spawner enhancement

The production of healthy high quality female European eel in recycle systems is proposed as a means to secure sufficient numbers of silver eel for spawning migration in order to meet the requirements of the European Commission's proposal for a Regulation for the recovery of the stock of the European eel. Main advantages besides checks for parasites and viral diseases and avoidance of elevated levels of specific pollutants are the easily controllable numbers of spawners to be released and a reduction of labour and costs that will occur when acting along the lines of the Commission's proposal.

Kurzfassung

Der Bestand des Europäischen Aales ist seit 3 Jahrzehnten rückläufig. Sorgen bereitet dabei der sehr starke Rückgang der in die Binnengewässer einwandernden Glasaale. Dem will die Europäische Kommission mit einer Erhöhung der in die Sargassosee abwandernden Blankaale begegnen und hat einen Vorschlag für eine Ratsverordnung zur Wiederauffüllung des Bestandes des Europäischen Aales vorgelegt. Danach muß die Abwanderung von 40 % derjenigen Biomasse der adulten Aale sichergestellt werden, die existierte, wenn es keine Eingriffe des Menschen gäbe, die sich auf die Fanggebiete oder den Bestand auswirken. Dazu werden verschiedene Einschränkungen für die Fischerei genannt wie eine Schließung an 15 Tagen pro Monat, um dieses Ziel zu erreichen. Eine alternative Möglichkeit die Abwanderung einer ausreichend großen Zahl von Laichern sicherzustellen ist ihre Aufzucht unter kontrollierten Bedingungen in geschlossenen Kreislaufanlagen mit anschließendem Aussetzen im Meer. Dieses könnte im besten Fall die von der Europäischen Kommission vorgeschlagenen Maßnahmen ersetzen. Sowohl die Zahl der so erzeugten Tiere wie auch ihre Qualität in Hinblick auf Krankheiten, Parasiten oder Schadstoffgehalte kann so leicht überwacht werden. Anhand einer überschlägigen Beispielrechnung wird gezeigt, dass dieser Vorschlag durchaus realisierbar ist.

Introduction

Since three decades catches of the European eel have been declining as we know from catch statistics. Similarly, the stocks of the European eel have been decreasing as well. As we know since long there is nothing extraordinary with variations in catches of eel in the long range. However, the unique and alarming very strong decrease of the number of glass eel arriving in the European continental waters after their oceanic migration asks for precautionary measures to counteract this development. So far we do not know the exact reasons for the decline. Besides a number of reasons, which will not be discussed here and which are primarily related to inland waters, we cannot exclude large-scale climatic events to be responsible for this. Strong variations in stock size coupled to long-term climatic events are similarly known for e. g. small pelagics of the Pacific and Atlantic oceans. With eel, there is sometimes also the opinion that a decrease in number of spawners is due to high fishing pressure on yellow eel and even more on silver eel stages, which will finally result in lower numbers of spawners, and subsequently lead to low numbers of glass eel. In future we may probably have data from different fisheries that do not support a generalized hypothesis of overfishing. There may, however, be some other factors leading to increased mortality and reduced reproduction and, in fact, strongly influence the numbers of glass eel.

To support a stock a sufficiently high number of spawners are necessary to produce enough offsprings. In the case of the eel, enough offspring means a sufficient number of glass eel. Prior to reaching the glass eelstage there could be events – during the Atlantic ocean crossing of the larvae – that are the origin of the stock de-

cline. The question then remains whether an increased number of ready-to-migrate silver eel could counteract the glass eel decrease. The European Commission has assented to this thought and recently proposed a respective Council Regulation (CEC 2005). Even if we agree to this assumption the real effort to be undertaken to obtain measurable effects remains yet unknown.

Again, it should be noted that some scientists believe that the stock variations can barely be compensated for, because they are largely due to oceanic events caused by human activities, but are outside of our immediate influence.

The Commission's approach for a recovery

Despite the difficulties to answer the question of the importance of the oceanic events we could influence the number of spawners hoping that an increase in spawning capacity will also result in higher numbers of glass eel. This is the approach of the Commission's proposal. The 40 % escapement target for silver eel stipulated there can be secured by different means. On the other hand the possibilities to secure that all the animals are of good reproductive quality are limited and may differ between river catchments. Pollutants, parasites and viral diseases can pose a severe problem with regard to the spawning migration and subsequent reproduction. This we know from the recent the EU EELREP research project (EU 2005) (http://www.fish-biology.net/EELREP_final_report.pdf).

The proposal of the Commission for a Council Regulation for the recovery of the stock of the European eel mainly consists of the above mentioned 40 % goal for spawner escapement with reference "to the biomass of adult eel… in the absence of human activities affecting the fishing area or the stock". This demand is linked to the threat of a 15 day closure per month of the fishery on all stages of eel or the request to develop national management plans for the eel.

Three aspects are noteworthy with respect to this request:

1. The glass eel fishery is practically exempted from the 15 day regulation through some stipulations.

2. A natural stock size, on which the calculation of the 40 % goal depends, is practically unknown due to stocking performed e. g. in Germany for more than a century. This interferes with the naturally occurring variations in the stock size.

3. There would be enormous expenditures for the use of the data collection programme established for marine fisheries for eel, which are caught mainly in freshwaters. Maybe there is a better use of resources.

Spawner enhancement

With regard to this it must be questioned if there are other possibilities besides the Commission's proposal to secure the return of a sufficient number of female spawners to the Sargasso Sea. The answer to this problem might be a controlled production of spawners, i. e. a real spawner enhancement. The idea is to produce a sufficient high number of female spawners of adequate size under controlled conditions and to release them into the sea. This would be a way of aquaculture based stock enhancement directly in favour of the spawning stock. A really high number of female silver eel produced in this way could make the measures proposed by the Commission, at the best, unnessecary. Furthermore it would be much more easily controllable than the 40 % of seagoing eel scattered over such a huge area and difficult to detect in the waters. Such an enhancement would be based on experience gained over decades in Europe with the aquaculture of eel and it links with recent knowledge communicated in the above-mentioned EELREP report. Relevant results from this report could be used immediately or after a quick adaptation to practice. Main components are:

- the controlled rearing from the glass eel stage in a warmwater recycle system on low pollutant feeds (the use of estradiol during a short early life stage for the production of all-female stocks should be considered as these animals are not for consumption !),

- the medication of the animals before introduction into a recycle system against *Anguillicola crassus*, if necessary,

- the possibility to determine the silver eel stage correctly and to use stimuli resulting in the preparation for the spawning migration,

- the transport of the animals by train/truck and ship into the sea for subsequent release.

There are further advantages besides the knowledge of the number of fishes. The migration could be examined by satellite detected swimming buoys fixed for some time to the back of a part of the animals. Feeding commercial eel feeds of known low contamination levels will result in fairly low contaminated animals. This is in contrast to eel from a considerable number of natural water bodies whith sometimes extremely high contamination burden, especially with dioxin-like PCBs and dioxins, that might result in a reduced reproductive capability (Palstra et al. 2006). Furthermore animals have to be examined for EVE (Eel Virus European) and EVEX (Eel Virus Europe X) and HVE (herpes virus of eel), which only recently have been identified as cause of lethal damage during migration. Therefore, a specific pathogen free (SPF) rearing needs to be aspired with regard to *A. crassus*, EVE, EVEX, etc.

Some figures

What are the numbers and biomasses of silver eel to be reared with regard to the anticipated Council Regulation for e. g. Germany?

- A simplified calculation – just to get an idea of the order of magnitude – assumes 200 000 ha inland water surface area, that can be used by eel, supporting 2.5 kg/ha ready-to-depart eel per year, which probably reflects a rather good productivity. 40 % of this would then be 1 kg/ha. At an individual body weight of 500 g there are 400 000 animals of a mean body weight of 500 g or 200 t of eel to be produced per year. The amount of glass eel needed – allowing for 25 % of losses mainly during glass eel rearing – is 530 000 animals. With 3000 glass eel/kg this means 180 kg at the beginning. At a mean price of 300,– €/kg glass eel they will cost 54 000 €. Depending on the action of the Commission perhaps a more favourable price can be achieved for the glass eel. It should be noted that prices for "big" eel from recycle systems are at present in the range of 11 to 12 €/kg. This means that a production at 10 €/kg seems reasonable for calculations. Total costs (incl. glass eel) for ready-to-migrate silver eel should then be about 2 Mio € in the case of Germany. Although this is a very rough and simplified calculation it is probably not too far from reality. Again, it should be stressed that these calculations are based on rough assumptions for inland water areas well suited for eel and a stock of ready-to-migrate female eel of 2.5 kg/ha per year.

- Other scenarios for such a female eel spawner enhancement are possible. Theoretically, it should be possible to accomplish the 40 % goal. The corresponding numbers of eel could be reared in a few systems while additionally natural migration continues as usual.

- In a scenario with continued fisheries activities the 40 % goal for silver eel might be missed by a certain portion. This could be filled in with spawners from the enhancement recycle systems, i. e. basically the stock will not be protected by regulation of catch etc., but will be supported by enhancement as necessary. This way to help to recover the eel stock with less control and labour and financial input might attain more agreement among member states and fishermen than the measures proposed by the Commission.

Finally, it is important that the animals are released directly into the sea in order to avoid infestation with *Anguillicola crassus*. In any case, it seems possible to considerably reduce the burden that will otherwise be imposed upon the fishery, and it would at the same time support the stock in a more practical and controllable way.

Nota bene

As the author favours the hypothesis that there are primarily oceanic events at the origin of the recent decline of the eel stocks and that factors related to the inland waters have an additional effect. Therefore he wants to stress that much more research efforts should be directed into the controlled reproduction and rearing of the European eel.

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