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WG 8 – Fishes
CASE STUDY 2
Anguilla anguilla
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NON DETRIMENT FINDINGS FOR THE EUROPEAN EEL - THE SWEDISH CASE

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I. Background information on the taxa

1. BIOLOGICAL DATA

1.1 Scientific and common names

European Eel (*Anguilla anguilla* (L.)

1.2 Distribution

The European Eel is continuously distributed from North and Northwest Africa in the South, to northern Norway and the White Sea in the North. They occur from islands as Iceland, Madeira and the Canary Islands in the Atlantic to Turkey and Egypt in Eastern Mediterranean Sea (see the map). Despite their unique capabilities to migrate upstream they occur more and more sparsely with distance from the sea and with the number of dams and other obstacles. Therefore today's distribution is very much reduced compared to pristine conditions.

1.3 Biological characteristics

1.3.1 *Life history characteristics of the species*

Anguilla anguilla is a amphihaline, demersal, catadromous species that occurs in many different environments from pure freshwater lakes and streams to fully marine areas. Brackish water areas as estuaries are commonly occupied by eels. They reproduce in the Sargasso Sea which is situated between Bermuda and Puerto Rico (very roughly). After

spawning at considerable depths during early spring in the Sargasso Sea the adults die and the larvae (*Leptocephalus*) are transported by the Gulf Stream and the North Atlantic Current towards the European and North African Coasts. This transport is believed to take between one and three years. When arriving at the Continental Shelf in winter they metamorphose into glass eels, i.e. small but transparent eels of about 0,3 gram each. When water temperatures increase during spring some glass eels settle in coastal areas while others continue towards estuaries and freshwater environments (Figure 1).

After growing as pigmented yellow eels for many years they metamorphose to fat silver eels, i.e. a pre-pubertal stage prepared for a long migration back to the Sargasso Sea. The distance varies, but e.g. from the Baltic Sea eels have to swim about 7500 km to reach the spawning area. Their optimum temperature for growth is about +25 °C although they are found and survive in low temperatures as in Northern Scandinavia and at high temperatures as in North African lagoons. Under good conditions for growth they will reach the silver eel stage in about 5 years (for females), while in Scandinavia silver eels are often from about 15 to 25 years old. A few individuals become very old and large. Male eels are much smaller than females and do seldom reach more than 40 cm in length, compared to more than one meter in the largest females. With that male silver eels are usually younger than females and thus have a shorter generation time. Sex differentiation in eels is probably influenced by environmental conditions as temperature, growth rate and population densities with males dominating in heavily populated environments (often estuaries) while females normally dominate in upstream freshwater sites.

As a catadromous, slow growing species eels are exposed to many threats as fishing for all stages, upstream migration obstacles as innumerable dams, weirs and sluices, downstream obstacles as hydropower turbines and a general decrease in accessibility to former feeding areas. As a fat, long lived, semelparous fish species eels also accumulate a wide range of persistent organic pollutants (POPs) as DDT, PCBs, and dioxins, which is known to disturb their reproductive success.

1.3.2 *Habitat types*

Anguilla anguilla occupies a wide range of habitats from cool oligotrophic freshwater systems in Scandinavia to warm, hyper-saline eutrophic lagoons in the Mediterranean area. As a sub-tropical species of origin warm and productive waters are preferred. Eels, in particular small eels have a unique capability to pass obstacles as dams and water falls. However, every obstacle decreases the number of recruits passing upstream.

1.3.3 *Role of the species in its ecosystem*

Eels are omnivorous and feeds on what is easily available. Common food items for small eels are benthic animals as small crustaceans, molluscs and insect larvae, while in larger eels fish most often dominates as food. It seems quite few species predates on the night-active eel, particularly on large eels. Otters, seals, belugas, cormorants and bitterns are often mentioned as predators on eels. As omnivorous, no particular species seems to be threatened by the European eel, except the European crayfish (*Astacus astacus*, L.) which is shown to suffer from predation by eels.

1.4 Population

1.4.1 *Global Population size*

Anguilla anguilla is considered as one panmictic population. However, there are some weak genetic differences on a temporal scale, between different cohorts recruiting from the Sargasso Sea to continental Europe. The global population size of *Anguilla anguilla* is not known, although there are a few estimates of Ne (the effective population size) that indicates an alarmingly low global population size. However, trends in recruitment and in commercial catches and also some CPUE-series clearly demonstrate a dramatic decline since the late 1970s. EIFAC/ICES WGEEL has estimated that recruitment to continental Europe is now down to a few percent of the figures from the late 1970s.

1.4.2 *Current global population trends*

___increasing _X___decreasing ____stable ____unknown

1.5 Conservation status

1.5.1 *Global conservation status (according to IUCN Red List)*

_X_Critically endangered ___Near Threatened
___Endangered ___Least concern
___Vulnerable ___Data deficient

1.5.2 *National conservation status for the case study country*

Anguilla anguilla is listed in Sweden as critically endangered (CR) since 2005. In a future one might consider also to ammend Anguilla anguilla in the national legislation; the Species Protection Act 2007:845, as a species of national interest. The Species Protection Act 2007:845 prescribes that operations trading live specimens listed on annex A or B to the Council regulation EG no 338/97 (CITES appendix I or II) must have a license of operation. When having this license of operation you

are obliged to once a year send in a report over the trade carried out the year before, to the County Administrative Board. This will be in place when the regulation comes into force the 13 of mars 2009.

1.5.3 *Main threats within the case study country*

In Sweden the eel is under the same threats are as in most countries, viz. a high fishing mortality, inaccessibility to suitable growing areas, obstacles for both up- as downstream migration and high mortalities on hydropower screens and in turbines. In addition come POPs and several diseases and parasites. Among the latter, the introduced swim bladder parasite, *Anguillicola crassus*, does probably pose a significant hazard to a successful reproduction.

In contrast to countries in the core area of recruitment as France, Spain, Portugal and the UK, there is no fishery for glass eels in Sweden. The export of glass eels to countries outside the natural distribution area is otherwise considered as one major threat to the population of the European eel.

___No Threats
_X_Habitat Loss/Degradation (human induced)
_X_Invasive alien species (directly affecting the species) Parasites as A. crassus
_X_Harvesting [hunting/gathering]
___Accidental mortality (e.g. Bycatch)
___Persecution (e.g. Pest control)
_X_Pollution (affecting habitat and/or species)
_X_Other__Mortalities on hydropower screens and in turbines. Predation, mainly from a growing population of cormorants. _____
___Unknown

2. SPECIES MANAGEMENT WITHIN THE COUNTRY FOR WHICH CASE STUDY IS BEING PRESENTED

2.1 Management measures

2.1.1 *Management history*

In Sweden there were few management measures in force before 2007, when fishing for eel was prohibited for most fishermen, recreational as commercial. One important exception to this general rule includes commercial fishermen who can prove that eels constitute a significant part of their total catch and income. Freshwater areas above three hydropower turbines were also exempted from this ban as eels from such areas would suffer very high mortalities if and when migrating downstream towards the sea and the spawning site. In addition to this

general ban, also minimum legal sizes are in force as well as some restrictions in the number of fishing gears allowed per fisherman.

2.1.2 *Purpose of the management plan in place*

Today's management plan aims at breaking the negative trend in recruitment by allowing more spawners to reach the Sargasso Sea. The recent eel regulation set up by the European Council (EC 1100/2007) requires in the long run the release of 40 % in biomass of the silver eels that left each country or river basin district during a hypothetical pristine condition without mortalities induced by man. Each member state has to give in an Eel management Plan (EMP) before the end of 2008 describing how to reach this target.

2.1.3 *General elements of the management plan*

The Swedish Eel Management Plan (EMP) that covers the whole country is based on three fundaments, namely reduced fishing mortality, restocking with glass eels from areas with local surplus (in this case, the River Severn in UK) and by improving conditions for eel migration, both up- as down stream.

2.1.4 *Restoration or alleviation measures*

The hydropower industry has promised to improve the survival of downstream migrating silver eels passing intake screens (trash racks) and turbines in order to allow a mortality of 40 % only and that on the national scale. This will probably be done by cost-efficient measures at some selected hydropower stations while others have to wait before taking care of. These measures will be taken on a voluntary basis, instead of going through a number of slow legal processes in the Water-Rights Court. Also the upstream migration will be enhanced by the use of artificial eel passes enabling young eels to pass man-made dams.

2.2 Monitoring system

2.2.1 *Methods used to monitor harvest*

With today's legislation the fishermen still allowed to catch eels are obliged to report their catch using a logbook system. From the recreational fishery that still is allowed, i.e. upstream three hydropower turbines only eels that are sold in any quantities are reported to the Board of Fisheries. In parallel with the logbook system there is also a system based on contract notes drawn up by wholesale traders buying eels from the fishermen.

Besides monitoring harvest, recruitment is also monitored, mainly by collecting data on numbers of young eels caught in special traps

(eel passes) when ascending rivers. From such data a national recruitment index is built. This kind of monitoring is believed to react more directly to increased numbers of spawners leaving from Sweden, rather than waiting for higher abundances of juvenile and adult eels.

2.2.2 *Confidence in the use of monitoring*

Since 2007 when today's general ban of eel fishing came in force, most of the recreational and small scale eel fisheries is stopped and a fisherman who would like to continue with his eel fishery has to apply for a special permit or license each year. This permit is based on catch in preceding years and therefore most eel fishermen are quite concerned about reporting their correct landings.

2.3 Legal framework and law enforcement

From July 2009 the new EMP will come in force, i.e. if and when approved by the European Commission. The EMP will probably include an additional reduction in fishing efforts, increased restocking and improved possibilities for migration. The EMPs will also require different monitoring systems estimating the compliance with the 40% target set up by the European Council. The Data Collection Regulation (DCR) (EC No 199/2008) does also require a certain level of monitoring, not only of harvest/catch but also effort, capacity of the fleet etc.

3. UTILIZATION AND TRADE FOR RANGE STATE FOR WHICH CASE STUDY IS BEING PRESENTED

3.1 Type of use (origin) and destinations (purposes)

Eels are used for human consumption and there is a large-scale international market where Japan, followed by Korea and Hongkong are the main consumers of most eel species taken together. From Sweden most eels are exported live, fresh or frozen to The Netherlands, Germany and Denmark. At the same time there is also a considerable import from Norway and from Denmark. The trade between countries is complex and difficult to follow. Also other species than *Anguilla anguilla* occur on the market, as well as *Anguilla anguilla* produced in aquaculture. Eel aquaculture is totally based on glass eels caught in nature and an extensive artificial production of eels is still to wait for. EIFAC/ICES WGEEL has estimated that aquaculture and capture fisheries for *Anguilla anguilla* in Europe are of equal size where both produce about 10 000 tons per year.

Several tons of pre-grown glass eels from aquaculture are also used for restocking purposes.

3.2 Harvest:

3.2.1 *Harvesting regime*

Eels of all sizes and stages are fished for. Where glass eels were and still are common there is a commercial fishery for them, traditionally for direct consumption. Today there is a large demand for European glass eels to be used as seed in aquaculture both in Europe and in e.g. China. Migrating silver eels are the main target for the traditional eel fisheries that are performed in Northern Europe as e.g. the Baltic Sea. Yellow eels of all sizes are also exploited in most countries where they occur. In Sweden the smallest minimum legal size that applies is 350 mm and thus there is no glass eels fishery. Characteristic to all eel fisheries are that they are often small-scaled and scattered, performed by single fisherman from small boots.

3.2.2 *Harvest management/ control (quotas, seasons, permits, etc.)*

As already described the main management tools includes a legislative demand for a special eel fishing permit and there are also minimum legal sizes and a restriction in effort (number of fishing days and fishing gears) in force. However there is no quota system in action applied.

The Swedish EMP in progress will most probably introduce additional restrictions from 2009 to increase the production of healthy silver eels allowed to leave for their spawning migration to the Sargasso Sea.

3.3. Legal and illegal trade levels

Being a fairly well paid species, eels are often traded outside the legal frames or that the legal demand for e.g. catch statistics does not cover small and/or recreational fisheries. From several questionnaires it has been estimated that recreational catches of eel (both from simple rod and line fishing as well as from fishing where professional fishing gear like fyke nets were used) added 50 % to the known and reported commercial catch of eels. However, the new legislation in force since 2007 has probably improved the situation quite considerably. Additional restrictions that will come in force in 2009 as a result of the EC Regulation 1100/2007 will furthermore reduce the amounts of eel traded outside the system. Official figures show that in 2077, 348 tons of live eel were exported at the same time as 125 ton was imported to Sweden. The trade with 3rd countries (i.e. outside EU) is monitored by Swedish Customs while Eurostat monitors the trade within the EU.

II. Non-detriment finding procedure (NDFs)

1. IS THE METHODOLOGY USED BASED ON THE IUCN CHECKLIST FOR NDFS?

_X_ yes ___ no

So far most actions towards the restoration of the European eel have been done outside the concept of NDF. Not until very recently this concept was raised and is now discussed within the Scientific Review Group of the European Commission and its Ad hoc Eel Working Group. Some preliminary attempts have been made using the criteria in the IUCN checklist for NDF evaluations, including the preparation of "radarplots". When assessing the risk of extinction the IUCN Red list criteria were used. The European eel was listed on the National Swedish Red list as Critically Endangered (CR) in 2005 and that was followed by Norway and Germany. In the autumn 2008 also IUCN entered Anguilla anguilla as CR to their Red list.

2. CRITERIA, PARAMETERS AND/OR INDICATORS USED

Most of the following points refer to the red-listing procedure, but some of them are valid also when trying to formulate a NDF. In lack of absolute data on the population size Sweden used trends in recruitment series and commercial catch data as proxies for the stock. The following criteria were mainly used when assessing the status of the European eel from a national Swedish perspective, a reduction in recruitment of more than 90 % in less than three generations (60 years) and the fact that Sweden hosts more than 2 % of the total population of the panmictic European eel. The resulting classification then became CR *A2bcd+3d+4bcd* (ArtDatabanken, SLU 2006). One important indicator when assessing compliance with the management targets is recruitment indices, as the number of ascending young eels in rivers.

3. MAIN SOURCES OF DATA, INCLUDING FIELD EVALUATION OR SAMPLING METHODOLOGIES AND ANALYSIS USED

The trend in a national recruitment index was used when evaluating the decline in the Swedish part of the panmictic eel population. Corresponding data on the "Swedish" proportion of the total population were based on the commercial catch compared to the total catch of eels within the whole distribution area. As a panmictic species with a very wide geographical distribution, the eel population can only be managed and conserved on an international level. Both WGEEL, which is a joint EIFAC/ICES working group and the European Commission

work on these issues and WGEEL collects and provides most data and gives advice both to ICES, EIFAC and the European Commission. When trying to apply the criteria in the IUCN checklist input data mainly comes from what is available within each country and from what is compiled by this WGEEL and presented in their comprehensive reports. No single country has a complete overview of this panmictic species.

4. EVALUATION OF DATA QUANTITY AND QUALITY FOR THE ASSESSMENT

The lack of reliable and absolute data on the eel population is a constraining factor and generally indirect and relative trends and indices have to be employed. When trying to use the IUCN checklist it becomes clear that the population is in bad status mainly with concern to a low human tolerance, negative population trends, major threats, no catch quotas, no protected areas, low confidence in harvest management and a lacking protection. However, more and better data will become available in Europe within a few years when the EMPs and DCR have been fully implemented and operational. The EC Eel Regulation and the coming national EMPs will hopefully improve the situation mainly through a better protection, monitoring and control.

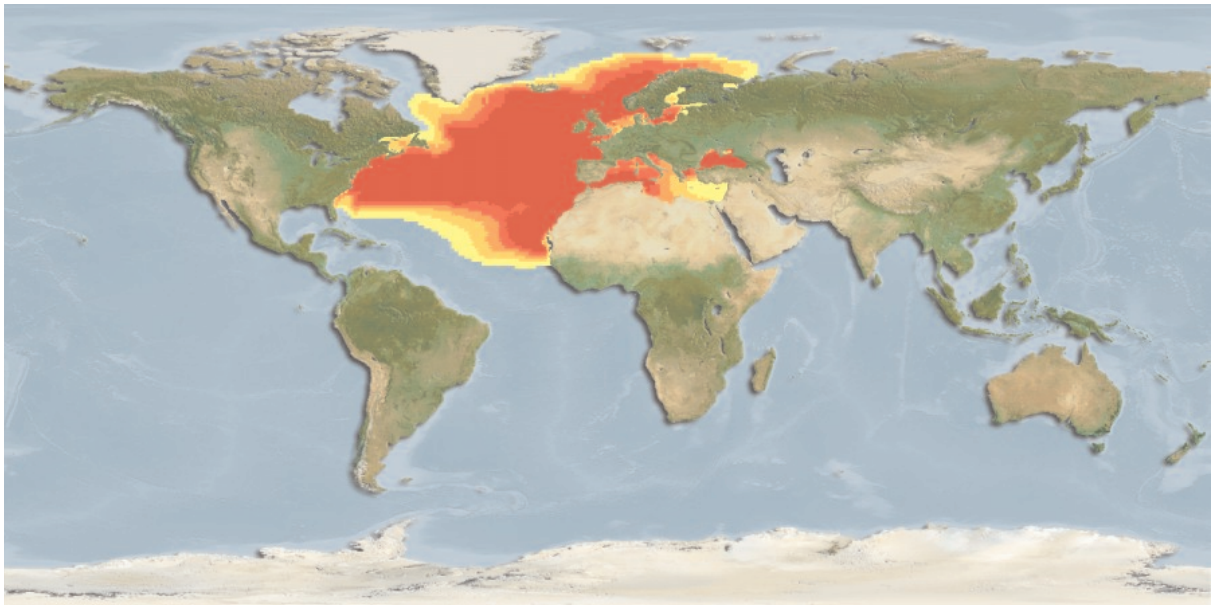
Main problems, challenges or difficulties found on the elaboration of NDF

Anguilla anguilla is widely distributed in Europe and in parts of Africa and the Middle East. That means at least 40 range states have to come to a common agreement and that on very different basis of knowledge and varying importance of eels in different countries, respectively. Within the SRG, (Scientific Review Group, established in accordance to EC Regulation 338/97 and consisting of representatives from the Member States' Scientific Authorities) and its ad hoc Eel Working Group, two quite different standpoints were recently taken. One advocate a local approach, i.e. to look at the situation at the river basin or country level, trying to estimate if there are local surpluses that could be exported out from the species' natural distribution range or not. The other view is to consider the whole population as such and weigh between deficits in some areas against surpluses in other areas and from that balance decide if there is room for exports without being detrimental to the survival of the species. In the first case a NDF might be possible, whereas in the latter case it is impossible and a stop for export is the consequence.

5. RECOMMENDATIONS

A panmictic population that has declined to very low levels as the European eel cannot be managed on a local or national scale. Instead

potential surpluses on a local scale may counterbalance deficits in other areas. This can be done through restocking suitable areas of high qualities for eel survival and growth with free access to the sea with glass eels from areas where glass eels still occur in abundance (above carrying capacity). Correspondingly, compliance with set targets (by the European Council) may well be assessed using both local indicators as well as stock wide indicators compiled by the EICAC/ICES Eel Working Group. A first natural checkpoint will be in 2012 when the EU Commission will make their first evaluation of the measures in action. This occasion seems appropriate also to reconsider if a NDF is possible on the species level making full use of all new data and experience made available through the monitoring required by the EC Regulation.



Distribution map (from FishBase 2008-11-03)

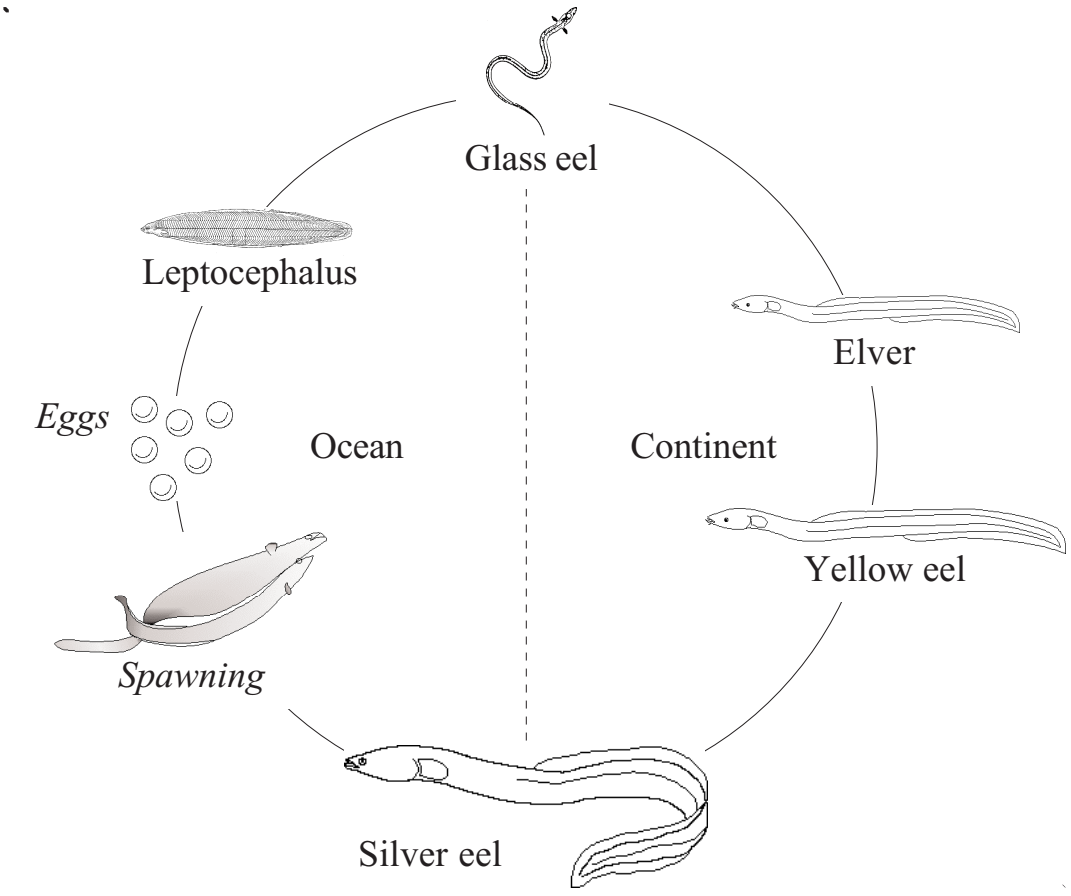


Figure 1. The life cycle of Anguilla anguilla (After Dekker 2000)

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