

**GFCM Scientific Advisory Committee**

**Transversal workshop on European Eel in the GFCM area**

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**Elements of biology of the European eel and factors affecting its population in the Mediterranean and Eastern Atlantic**

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The European eel (*Anguilla anguilla*, Linnaeus 1758) is a widespread species which is largely distributed from the coast of Iceland to the North African coast. It is presumed there is just one single spawning stock and that the spawning occurs in the Sargasso sea in the western North Atlantic, as the smallest eel-larvae ever seen have been found in this zone. However no ready-to-spawn individuals nor the spawning have never been observed. It is assumed that the population is panmictic and that the species is a shared resource by practically all Northern European and Mediterranean countries (however recent molecular work on European eel indicated a genetic mosaic consisting of several isolated groups, calling into question the panmixia theory).

From their size distribution (fig 1) the life history of the larvae (leptocephali) of European eels has been built: after they appear in the Sargasso sea they are supposed to travel during one to three years with the Gulf Stream across the Atlantic ocean and they reach the coasts of Europe during the springtime at a size of 75 – 90 mm. The common name for this recruitment stage of eels is “glass eel”, based on the transparency of the body. Once they recruit to coastal areas they migrate upstream in the rivers. In freshwater they develop pigmentation, turn into “elvers” (young eels) and feed on small crustaceans, worms and insects. They grow up in 10 or 14 years to a length of 60 to 80 cm. In this stage they are called “yellow eels” because of their golden pigmentation. In summer some individuals mature and then they migrate back towards the sea back to their spawning grounds at a travel speed in the ocean assumed to be 15 km per day (fig 2). By the time they leave the continent their gut dissolves the eyes start to enlarge in size, and the sides of their bodies turn silvery. These migrating eels are typically called "Silver Eels" or "Big Eyes" they leave the rivers of Europe and North Africa in autumn and it is supposed that they swim across the North Atlantic to spawn in the Sargasso Sea in the first half of the following year

In the Mediterranean the eel exploitation is mainly small-scale and occurs exclusively within national boundaries, mainly in continental waters (estuaries, lakes and rivers) and in coastal lagoons where the eel is exploited together with other euryhaline species. The silver stage is reached earlier in lagoons compared with river/estuarine systems. Target stages for eel fisheries in the Mediterranean are glass eel, yellow eel and silver eel.

Today the panmictic population is considered in decline and in numerous countries the current fisheries are considered outside sustainable limits. Worldwide, eel populations have been dwindling from the mid-1980s (fig 3). All life cycle stages have declined severely in fisheries throughout most of their distribution area; steep declines of 90-99% have been reported for European eel glass eel arrival in the spring on the European coasts dropping drastically to around

10% of their previous levels (fig 4). In the following years catches shown fluctuations but in general a decreasing trend has been observed. Recruitment is at a historical minimum and most recent observations do not indicate recovery. The decline in production has been confirmed for yellow and silver production in the Mediterranean area, excepted for Egypt (table 1).

The exact cause for the decline is unknown, but possible causes include various factors like exploitation as well as other anthropogenic impacts: habitat loss, migration barriers by power stations & power plants, pollution i.e. heavy metals, PCBs, organochlorine pesticides, brominated flame retardants, volatile organic compounds, fluorchemicals), but also natural impacts like predation by birds or ocean climate (It has been suggested that changes in oceanic conditions are contributing to the decline of eels worldwide by disrupting their spawning areas and the transport of their larvae) and parasites.

Since the early 1980s the European eel populations are from 30% to 100% infected with the bloodsucking parasitic nematode indigenous to Eastern Asia *Anguillicola crassus* probably introduced with aquaculture eel shipments from Japan. Since 1995 it also appeared in the United States (Texas and South Carolina). The eggs of the adult nematode are spawned in the eel's swimbladder, pass through the digestive tract and the larvae emerge in the water and settle onto the substrate. They are ingested by an intermediate host, which is often a copepod or other crustacean but may also be a fish. The nematode larva reaches its infective stage within this intermediate host. When the host is eaten by an eel, the nematode larvae finds its way from the eel's digestive tract to its swimbladder. The main effects of parasite causes a decrease of the rate of growth of the eel and above all a swimbladder collapse. Since the swimbladder is the buoyant which allows the eel to swim, a severe parasite infestation can hamper its ability to reach its spawning grounds. Such a disease is now very common in the Mediterranean area; it appeared during the eighties in Italy, in 1982 in Germany and in 1984 in the French mediterranean lagoons. From 1985 to 1994 it has invaded the whole Europe and Nort Africa : the early nineties it appeared in the continental waters of Morocco, in Tunisia and Algeria.

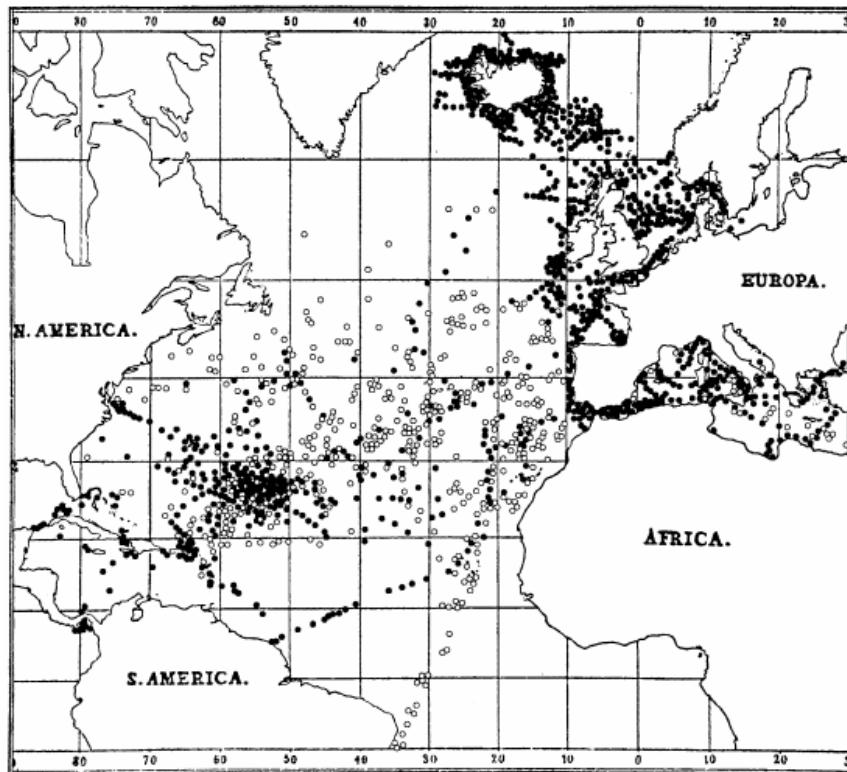
Endurance swimming of eels and the ability to migrate are also negatively influenced by infections with viruses like the rhabdovirus EVEX.

The scientific advice from the International Council for the Exploration of the Sea (ICES) concerning European eel and from the European Iland Advisory Commission (EIFAC) is that the stock is outside safe biological limits and that current fisheries are not sustainable. This situation has led to the intention of putting the European eel as an endangered species listed in Annex II of the Convention on International Trade of Endangered Species (CITES).

ICES recommends that a recovery plan be developed for the whole stock of European eel as a matter of urgency and that exploitation and other human activities affecting the fishery or the stock be reduced as much as possible. The EU has aswered to this recommendation by giving to each European country a mandate to write an Eel Management Plan for each of its basins representing a natural habitat for eels by the end of 2008. The objective of each Eel Management Plan “shall be to reduce anthropogenic mortalities so as to permit with high probability the escapement to the sea of at least 40% of the silver eel biomass relative to the best estimate of escapement that would have existed if no anthropogenic influences had impacted the stock”. The idea is to reconstitute the panmitic stock, the main objective being to increase the escapement of the potential spawners (silver eels) in each basin allowing them to leave the European coast for the Sargasso Sea in order to reproduce. This implies a need for action on all mortality factors

(fishing, obstacles to migration, contaminants, pathogens, etc.). However, there are relatively few studies on silver eel escapement and production, and no recent measurement of escapement in lagoons, habitats which support large silver eel sub-populations in the Mediterranean region (apart a mark-recapture study carried out in 2007 in order to estimate the number of silver eels migrating from the Bages-Sigean lagoon in the South-West of France). One key issue in meeting the 40% objective is the estimation of the pristine biomass of migrant eels but for most river basins, historical data are missing and estimates are mostly impossible.

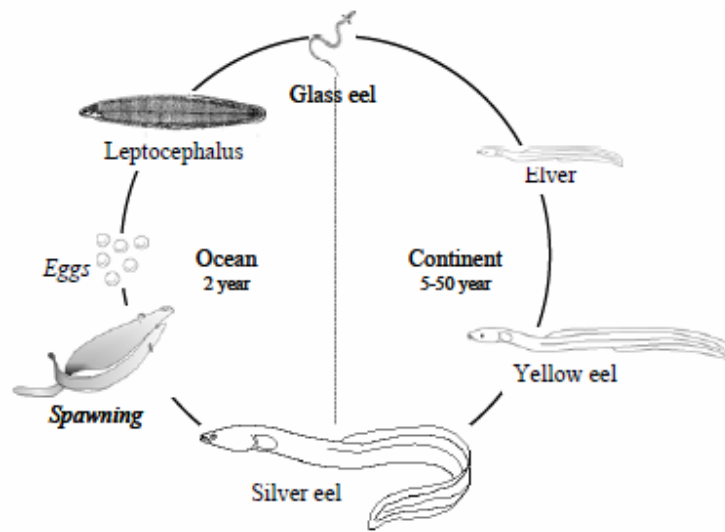
fig 1



Principal Danish collection stations of eel larvae, 1903–1922 (After: Schmidt 1925). Closed circles indicate stations by research ships and open circles those by other ships (source: Vladykov 1964)

(in Van Ginneken *et al.* 2005)

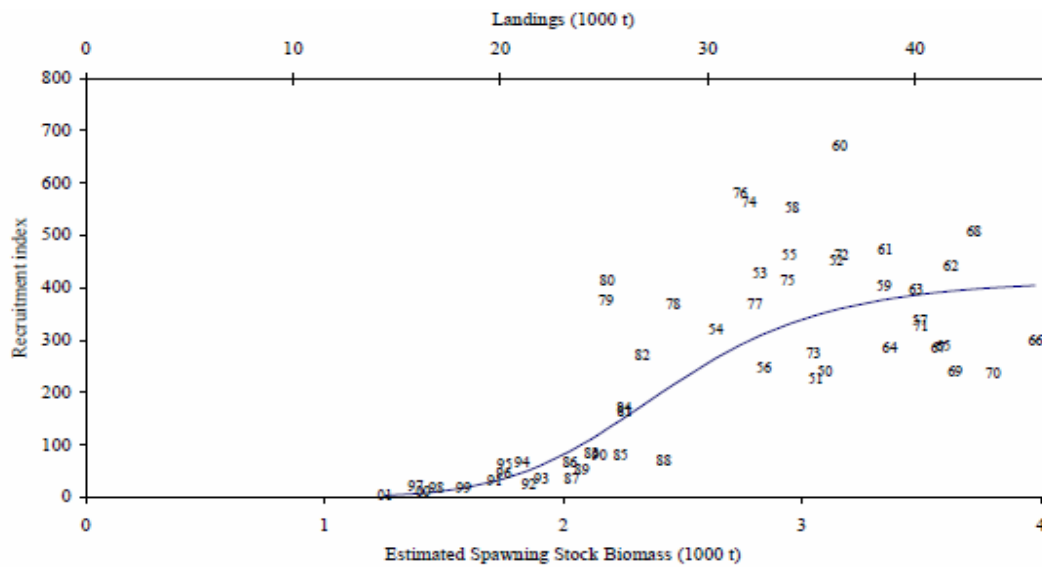
fig 2



The life cycle of the European eel. The names of the major life stages are indicated. Spawning and eggs have never been observed in the wild.

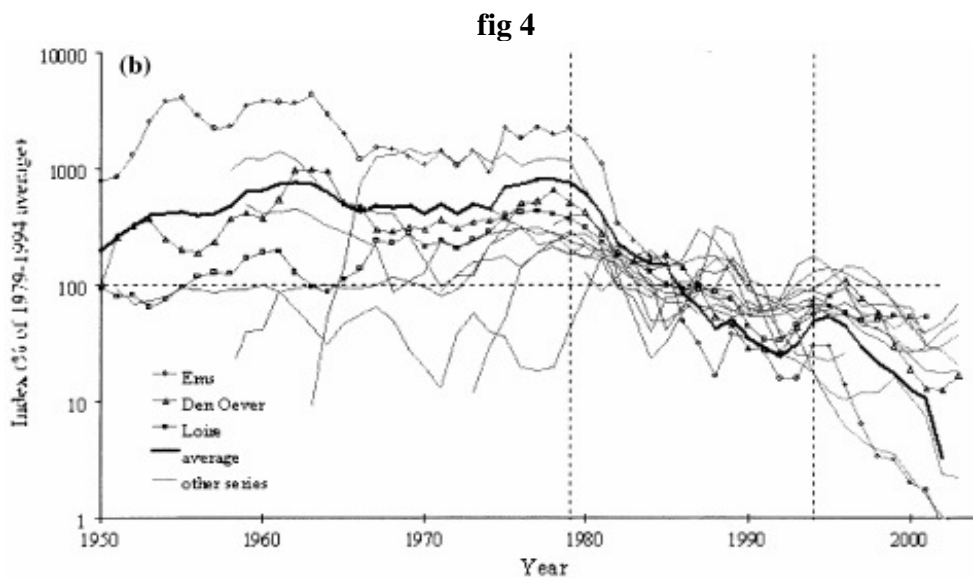
(in Van Ginneken et al. 2005)

fig 3



Estimated stock-recruitment relationship for the European eel. Numbers indicate the year of recruitment. The spawning stock is assumed proportional to the landings from the continental stock (after Dekker 2004).

(in Van Ginneken et al. 2005)



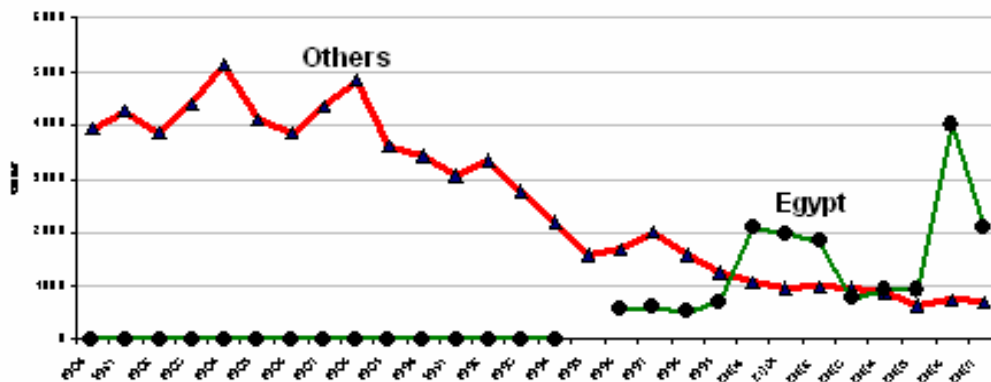
Trends in glass eel recruitment to the continent. Individual data series are given in grey; common trend (geometric mean of the three longest data series) in black. Data from ICES (2004) and Hågström and Wickström (1990) (source: Dekker 2004)

(in Van Ginneken et al. 2005)

**Table 1 : European eel production in the Mediterranean (from FAO FISHSTAT database)**

Country	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Italy	2264	2340	2087	2076	2361	1907	1928	2076	2155	1301	1199	1106	1662	1307
France	1012	1090	934	1251	1810	1501	1224	1362	1565	1306	1398	1265	941	589
Turkey	224	374	424	588	616	583	517	543	756	472	230	262	245	261
Tunisia	423	441	306	349	298	116	160	120	140	280	340	234	224	373
Albania								177	194	143	165	81	188	150
Spain								59	25	78	70	65	60	55
Greece			14	22	13	13	25	5	10	4	31	41	15	17
Morocco			86	121	33	5		5		1				
Albania														
Slovakia														7
Croatia													7	5
Romania														
Algeria														
Cyprus														
Montenegro														
Slovenia														
	3923	4245	3851	4407	5131	4125	3854	4347	4845	3585	3433	3054	3342	2764

1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007		
986	886	883	1010	682	645	549	446	402	458	387	115	64	109	Italy	33391
261	20	126	307	307	77	65	105	105	106	105	2	2	2	France	18838
329	390	342	400	300	200	176	122	147	158	165	176	162	179	Turkey	9341
390	130	192	202	150	206	108	135	202	166	108	181	250	250	Tunisia	6474
100	6	10	21	58	63	70		23		50	102	190	116	Albania	1907
50	45	37	33		21	47	11	72	31	33	27	23	21	Spain	863
23	31	21	21	34	16	24	24	16	19	18	15	18	15	Greece	505
														Morocco	251
	33	40					98	2		2	3	3	3	Albania	184
20	13	7	8	8	8	4	6	7	5	7	5	4	3	Slovakia	112
5	7	6	7											Croatia	37
			1	1		26								Romania	28
				10										Algeria	10
									6	2				Cyprus	8
													2	Montenegro	4
								2					2	Slovenia	2
2164	1561	1664	2010	1550	1236	1069	947	978	949	877	626	718	700		
		537	585	501	709	2064	1979	1802	781	916	924	3983	2055	Egypt	16836



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