Pollution and parasites in eel

impact on reproduction potential

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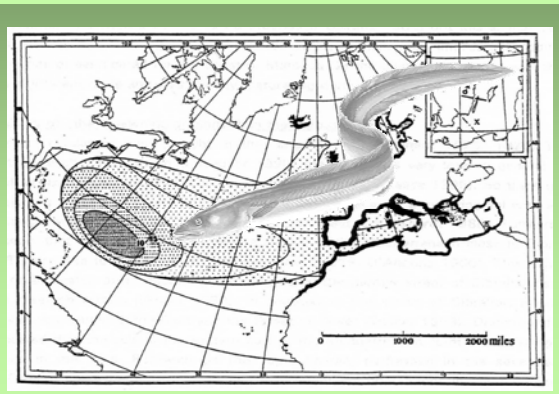
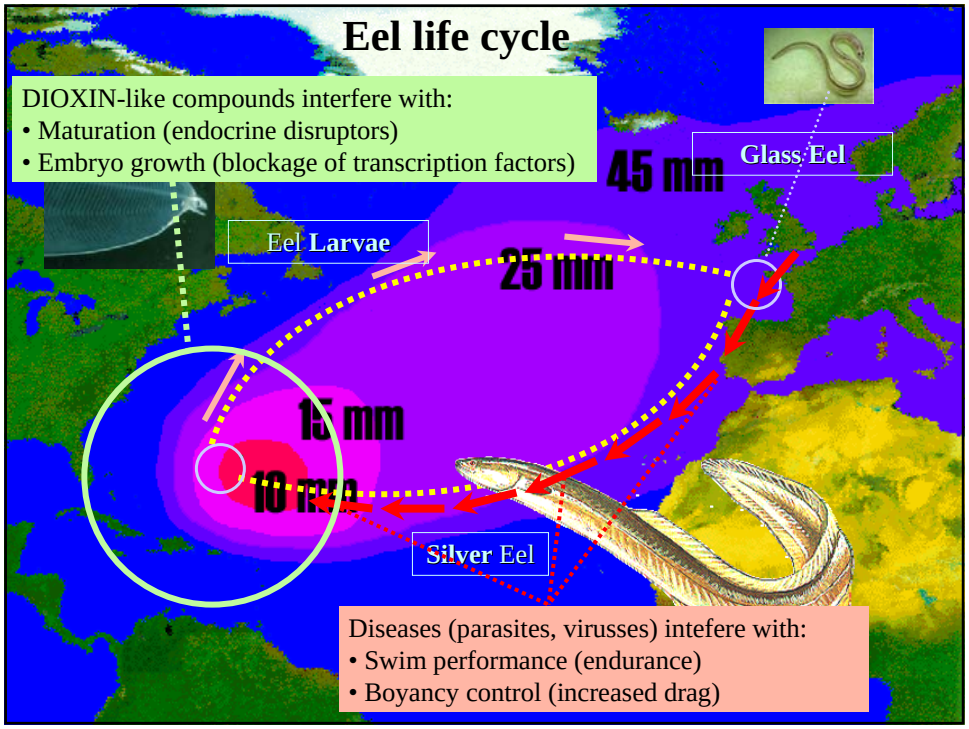
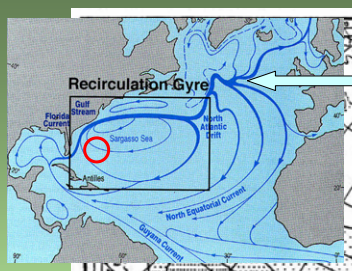




How far, how long, how fast?



Major Currents

6000-km/6 months =

33 km/day = 1.4 km/h =

0.38 m/sec = 0.48 BL/s

for female silver eel of 80 cm

Silver eels swim back
About 6000-km

Swimming at what cost?

Cost of transport for salmonids 2 kJ/kg/km

(Schmidt-Nielsen,1973)

6000 * 2 / 39.5 = 304 g fat /kg

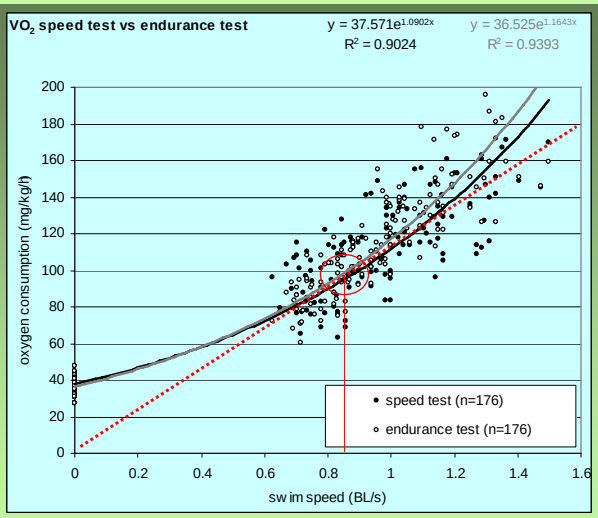
- ***silver eels have about 200 g fat/kg***
- ***Eels must swim far more efficiently!***

Swim tunnels to test migration capacity

(water flow 0-2 m/s)

most eels are eager to swim.

Swim fitness



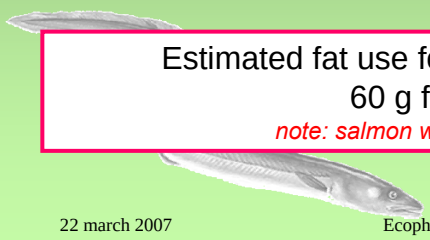
→ ***No difference between speed test (2h) and endurance test (12h)***
→ ***Most eels (>80%) are excellent swimmers***

Calculated Fat oxidation

Experiment I			3 months	distance 2980-km		
length	mean VO2	speed	COT	COT	fat use	
m	(mgO2/kg/h)	km/d	mgO2/km	J/km	mg/km	g/6000km
0.73	36.90	31.41	28.20	386.88	9.79	58.77

Experiment II			6 months	distance 5580-km		
length	mean VO2	speed	COT	COT	fat use	
m	(mgO2/kg/h)	km/d	mgO2/km	J/km	mg/km	g/6000km
0.75	42.26	32.27	31.43	431.21	10.92	65.50

Estimated fat use for 6000-km swimming
60 g fat/kg eel
note: salmon would use 300 g/kg



Swimbladder parasite (*A. crassus*)

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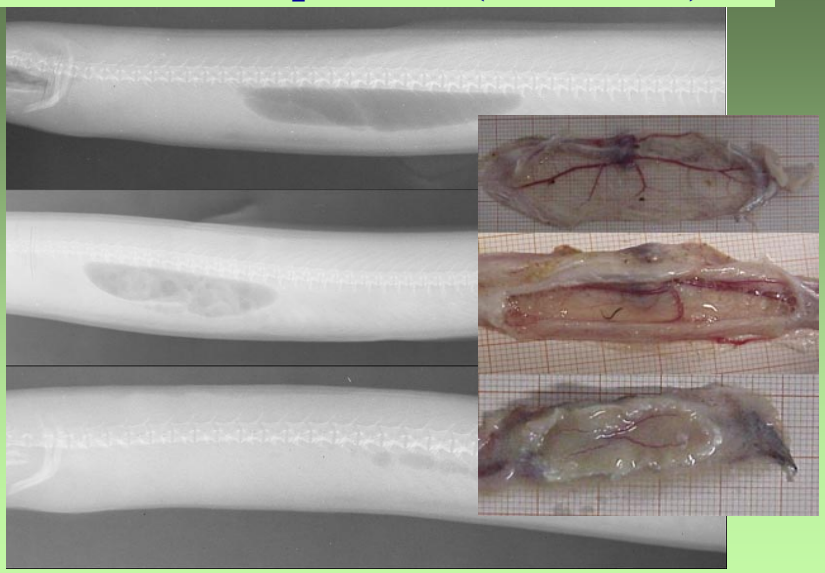
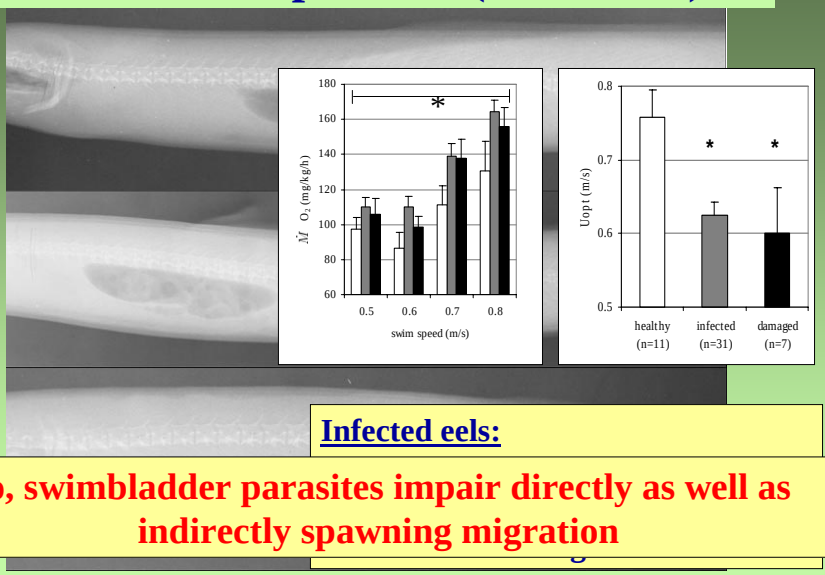


Swimbladder parasite (*A. crassus*)



Infected eels:

So, swimbladder parasites impair directly as well as indirectly spawning migration

Does swimming stimulate maturation?

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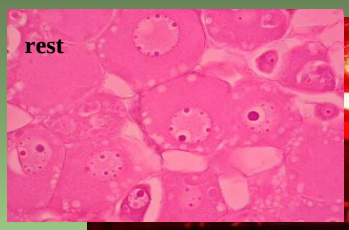
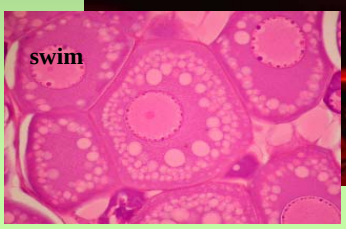
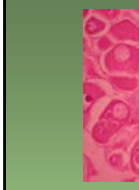
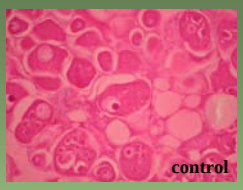


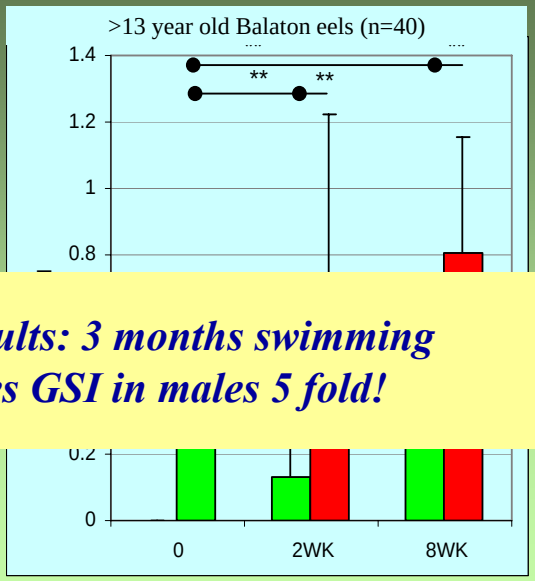


1. **Concentration LH & estradiol in plasma increases**
2. **Oocytes increase in size and fat droplets are incorporated**
3. **Eye diameter increases**
4. **Older and larger animals respond faster**



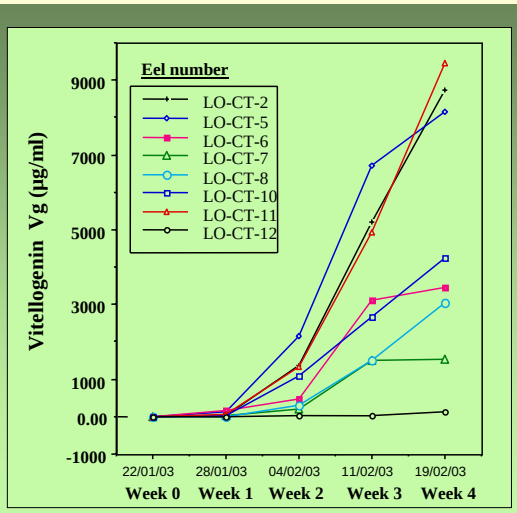
Swimming indeed stimulates maturation!



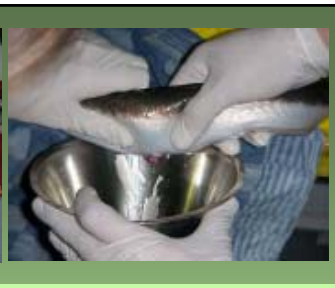


Recent results: 3 months swimming increases GSI in males 5 fold!

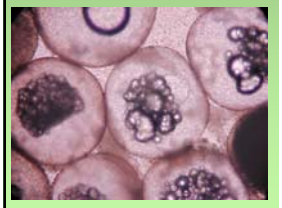
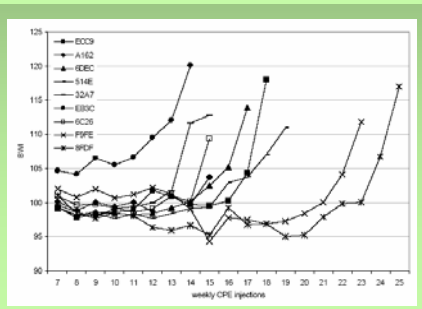
External silver parameters indicate reproduction capacity



Silver stage	length cm	fat %	Vtg rel
I	-	-	0
II	-	-	0
III	-	-	0
IV	-	<13	x
Va	<70	13-20	xxx
Vb	>70	>20	xxxxx

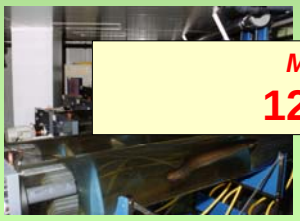

eel reproduction in Leiden

Energy requirements for reproduction

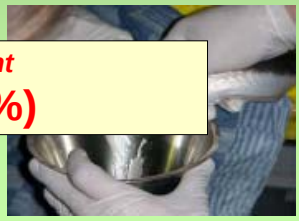
• Total Fat of untreated female silver eels (n=13)	200 ± 50 g fat / kg eel
• Eggs of untreated silver females (n=13)	5 ± 1 g fat / kg eel
• Eggs of treated silver females (n=12)	58 ± 21 g fat / kg eel

• migration (6000-km)	60 g fat / kg eel
• production of eggs	60 g fat / kg eel

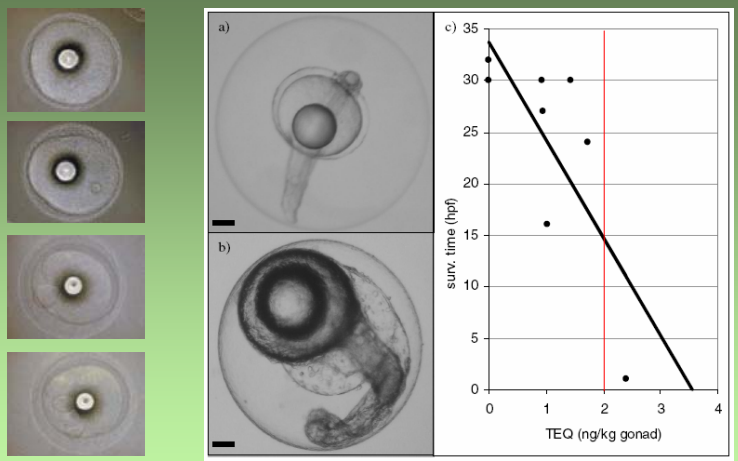


Minimal fat requirement

120g fat/kg (12%)

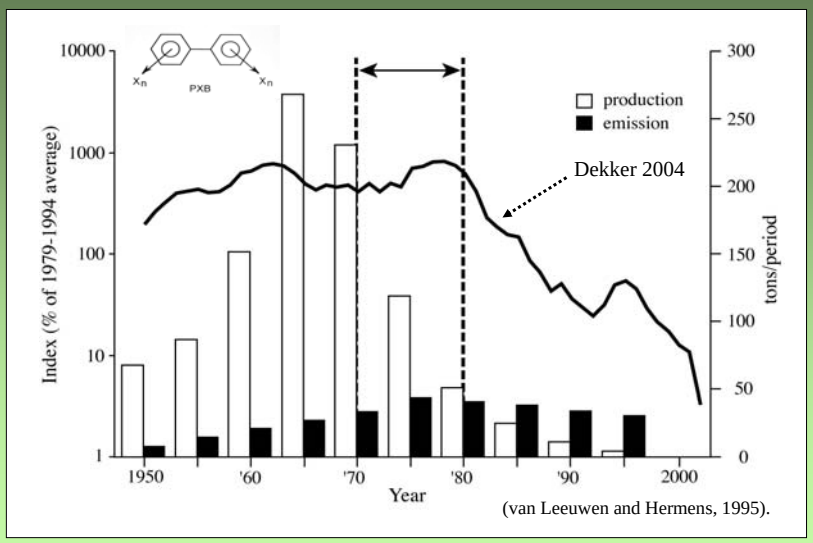


Inverse relation TEQ & embryo survival



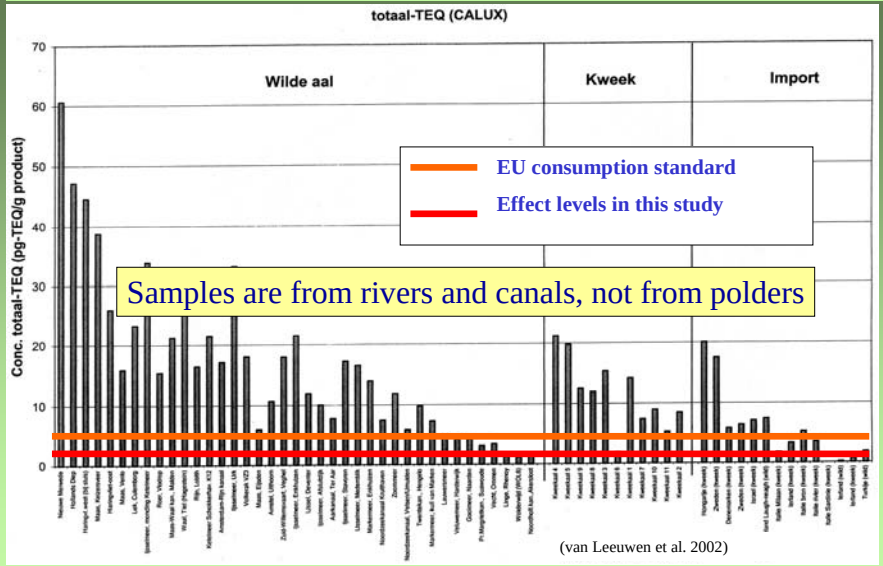
Eel is very sensitive to PCB's

PCB emission vs. eel influx



(van Leeuwen and Hermens, 1995).

TEQ in eel vs. reproduction effects



(van Leeuwen et al. 2002)

Eels are targets for dioxin-like contamination

- Embryonic malformations are typical for PCB-exposed eggs, same as observed in pike, carp, lake trout, rainbow trout. (Walker and Peterson 1991; Helder 1980; Stouthart et al. 1998; Walker et al. 1994)
- Similar symptoms found with fish-eating birds in USA and are known as 'Great Lakes embryo mortality, edema and deformities syndrome' (Gilbertson et al. 1991)

- Bottom fish
- High in ecosystem
- Long gerneration time
- Fatty fish
- TEQ increases during migration

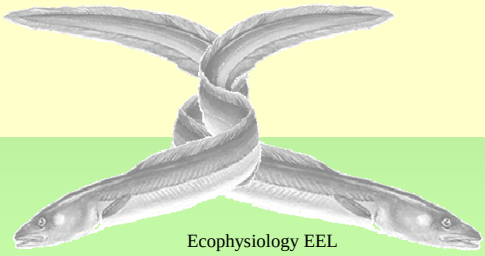
CONCLUSION

Current pollution levels likely impair reproduction

A dose-effect study is required for conclusive evidence.

Conclusions

- Eels can swim 5500-km without food for 6 months
- Eels swim 4-5 times as efficient as salmonids
- Eels need > 12% fat to cross the Atlantic and reproduce
- Swim bladder parasites interfere with long term swimming
- Swimming stimulates maturation
- PCBs inhibit fertilization at > 2.5 ng TEQ/kg
- Quality parameters should be used in management regulations



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- **Arjan Palstra (postdoc)**

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Dr. T. Murk - Toxicology, Wageningen University

Dr. P. Elie – CEMAGREF, Bordeaux

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Thanks for your attention

Hotel Atlantis