Downstream migration of radio-tagged silver eels

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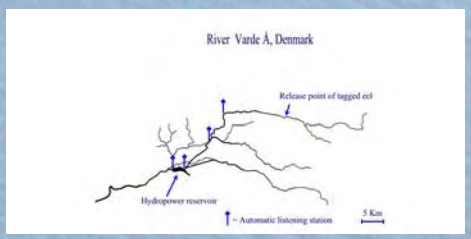
Michael I. Pedersen & Niels Jepsen
Danish Institute for Fisheries Research
Vejlsøvej 39,
DK 8600 Silkeborg
e-mail:mip@dfu.min.dk

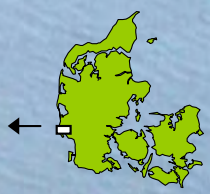
Introduction

The catadromous eel leave the feeding grounds in fresh water during late autumn to migrate to the spawning grounds in the Sargasso Sea. During the last decades the European eel population *Anguilla anguilla* (L.) has decreased to a historic low population level (Dekker 2004). One of the reasons for the population decline is past anthropogenic alterations of rivers for urban and agricultural development, including building of dams for water management. While upstream obstructions to migration have been mitigated by eel passes, little attention has been paid to downstream migration and the effect of obstructions causing e.g. migration delay or increased mortality.

Objective

The aim of this study was, to describe the migratory behaviour and fate of silver phase eel while migrating through a river and a hydropower reservoir.





Material and methods

The study site

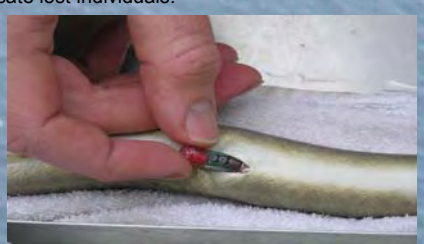
River Varde Å is a lowland river with a catchment area of 1090 km^2. Large parts of the river has been regulated by canalisation and hydropower was developed during the beginning of the 20th century.

Radio tagging migrating eel

Downstream migrating eels were captured with fyke nets. Captured eels were kept from 1 – 14 days in a holding tank before tagging. On the 19th September 2002 ten silver phase eel were anaesthetised in a 5 mg l^{-1} solution of methomidate and placed on a surgical table. Radio tags were inserted into the body cavity of the silver eels, through a mid ventral 8 – 10 mm incision. The antenna was run through a hole from the body cavity, pierced with a blunt needle (Jepsen et al. 2002). The incision was closed with a single suture. After one hour the eels were released in the river 1 km downstream from where they were captured. The transmitters used were ATS Fish Body Implant model 1530 weighing 1.7 gram in air, with a battery capacity of 36 – 72 days.

Tracking the eels

Four automatic listening stations (ALS) were placed in a distance of 18, 22, 33 and 35 km downstream from the point of release. The two lowermost ALS were placed at the inlet and the outlet of the hydropower reservoir, Karlsgårde Sø. Manual tracking was done with a mobile hand operated receiver in the area between release and the first downstream ALS, ca. once a week from 23 Sep. – 20 Nov. 2002. On two occasions manual tracking was done in the lake and other remote parts of the river system to locate lost individuals.



Inserting a radio tag in the body cavity of a migrating silver phase eel.

Automatic listening station tracking bypassing fish

Results

Migration speed in the river vs. the hydropower dam

The tagged fish resumed downstream migration 7 - 28 days following release. The speed of migration was relatively high and within 11 - 13 hours the eels arrived at the hydropower dam. The mean migration speed (Table 1) in the river was 0.6 m *s-1 or 0.9 * total length *s-1.

Only five eels passed the first automatic listening station and four of these eels entered the hydropower reservoir. Eel no 161 pass the listening station at the inlet of the reservoir at 7.22 in the morning and leave the dam at 22.57 hour the same night. Eel no 232 spent 6 days passing the reservoir. The other two eels disappeared in the reservoir!

Non migrating eels

Five tagged eels never passed the first downstream listening station situated 18 km downstream the site of release. Of these five eels, one was found seriously injured supposedly by a weed cutter and was killed. Another eel was obviously eaten by a mammal as the transmitter was found on the riverbank. Three eels stayed in the area of release hiding in drain pipes and under a concrete weir.

Eel no	Fish size cm	River m*s^{-1}	Reservoir m*s^{-1}
161	70	0.52	0.045
182	63	0.45	-
232	64	0.54	0.005
253	59	0.76	-

Table 1: Individual migration speed.

Conclusion

Once the migration was resumed the speed was swift, 0.9* eel length*s^{-1} in the river. After entering the reservoir the speed was reduced by 90 %.

Only four eels (40 %) entered the hydropower reservoir and only two eel bypassed the hydropower station and migrated toward coastal waters. The other two eels were lost.

Two eels (20 %) were killed (presumably one by a predator and the other by a weed cutter).

The combined effect of capture, handling and tagging may be part of the reason that 30 % of the tagged eels did not resume migration but stayed in drain pipes throughout the study period. However, it may be “normal behaviour” of silver eels to “over winter” such places and then continue their migration in the spring. These, preliminary results indicate that the seaward migration of silver eel, like it is the case with salmonid smolts, may be adversely effected by man-made obstacles like dams and weirs.

References

Dekker W. 2004. Eel stocks dangerously close to collapse. www.ices.dk/marineworld/eel.asp

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