

### “SILVER EEL”

## The impact of fisheries and hydroturbines on the European eel population

*Over the last two decades, a substantial decrease in the European eel (*Anguilla anguilla*) population has been observed in Europe. It remains unclear which factors play a crucial role in and to which extent they contribute to this decline. Several critical factors have been recognised however, such as fisheries, which, at different life stages of the eel, hamper the immigration of glass eel or emigration of silver eel. Other factors, such as mortality due to hydropower stations, water quality issues, parasites (e.g. *Anguillicola crassus*) or oceanic processes are largely suspected to contribute to this phenomenon as well.*



ANCHOR STOW NET FISHERIES IN THE TAILWATER OF HYDROPOWER STATION AT ALPHEN, RIVE MEUSE, NETHERLANDS. SOURCE: KEMA, 2002.

The **SILVER EEL** project investigated **to what extent damage to eel caused by hydropower stations and the impact of withdrawal of eel by commercial fisheries are a threat to the downstream migrating silver eel population in the river Meuse**. This was done by monitoring downstream migrating silver eel using three different methods:

- monitoring of 150 tagged silver eels by means of a novel telemetry system, the Nedap Trail System®;
- monitoring of eel catches of three commercial fisheries (monitoring daily yield and recapture of tagged eels); and
- monitoring of turbine passage including assessment of damage and mortality at a hydropower station.

Based on the results of this monitoring phase, two models were applied to calculate the impact of fisheries and hydropower stations on downstream migrating silver eels. This yielded the following findings for the silver eel's downstream migration periods in 2001 and 2002:

- Each individual downstream migrating silver eel has a chance of at least 30% and

probably 40% to reach the North Sea.

- The impact of hydropower stations on eel mortality is smaller than that of commercial fisheries: fisheries mortality in the river Meuse was estimated up to a factor 2 higher than the hydropower mortality.
- Silver eel show a clear hesitation to pass the trash racks of hydropower plants, as well as an upstream oriented escape movement in front of the trash racks.
- The majority of downstream migrating silver eel migrate during a limited number of nights.



MONITORING OF SILVER EEL PASSAGE THROUGH THE TURBINES OF HYDROPOWER STATION LINNE, RIVER MEUSE, NETHERLANDS. SOURCE: KEMA, 2002.

The latter two observations are very important from a fisheries manager's point of view, since the eels' behaviour in the vicinity of trash racks could aid in the diversion of eel into the direction of bypasses, whereas the ability of predicting the eel migration events could help save two thirds

**Project acronym:**

SILVER EEL

**Full title of Project:**

Management of silver eel: Human impact on downstream migrating silver eel in the river Meuse.

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of the migrating eels by stopping the turbines during migration events.

For this reason, SILVER EEL also investigated the applicability of a novel **Early Warning System, the Migromat®**. By comparing the system’s detection of increased activity, i.e. of pre-migratory restlessness of silver eel prior to the start of migration events, to the monitored migration events, it was verified that the Migromat® accurately measured the pre-migratory restlessness of eels, thereby predicting the downstream migration events of silver eels with high precision. The Migromat® would thus enable an eel-friendly turbine operating management of hydropower facilities.

The resulting positive effect of the Migromat® system is however reduced by the fisheries, meaning that an increased number of eel successfully passing by the turbines is reduced by increased

fishery catches. In order to have an overall better effect, it would therefore be necessary to have a reduction of fishery catches by at least the number of eel saved from turbine mortality due to improved turbine management.

To conclude, both hydropower and commercial fisheries in the Dutch section of the river Meuse substantially reduce the number of silver eel that reach the sea. Therefore, management measures taken in each of these impacts will directly contribute to a higher number of eel reaching the North Sea and hence an increased size of the spawning population. The results of the SILVER EEL project provide increased knowledge of the European eel’s downstream migration behaviour and will therefore contribute to a sustainable eel fishery and a sustainable production of electricity by hydropower in European waters.

“BOTH HYDROPOWER AND COMMERCIAL FISHERIES IN THE DUTCH SECTION OF THE RIVER MEUSE SUBSTANTIALLY REDUCE THE NUMBER OF SILVER EEL THAT REACH THE SEA”

RIGHT: STOCKING OF THE MIGROMAT SYSTEM WITH PIT-TAGGED SILVER EELS. SOURCE: KEMA, 2002.



LEFT: MIGROMAT SYSTEM AT HYDROPOWER STATION ALPHEN. SOURCE: KEMA, 2002.