Haringvliet - Kier

Problem

Problem statement: Enhancing fish migration leads to salt intrusion into fresh water reservoir. How to manage the salt water intrusion and maintain the fresh water supply to drinking water, agriculture and industry (Port of Rotterdam) is the challenge.

Problem impact: Bringing together nature and conservationist ambitions with practicalities of fresh water demand.

Client: Rijkswaterstaat (district West Nederland Zuid)

Team

Project owner: Meinard Tiessen & Wouter Kranenburg

Team members: Theo van der Kaaij, Julien Groenenboom, Stendert Laan, Remi van der Wijk, Remco Plieger

Partners: Rijkswaterstaat, Hydrologic, Svasek

Theme(s)

SURFACE / INFRA

Content

The river Rhine is a fish migration route under stress of human intereference. Building of dams, locks and barriers as well as canalization of both the main river and its tributaries has had a degrading effects on its habitat suitability for migratory fish. A European wide agreement has led to the removal of many obstacles for fish migration. However, the river mouth (in the Netherlands) remains a bottleneck. The Afsluitdijk and Haringvlietsluices block migration up the IJssel-branch and Haringvliet, respectively. The main-branch (via New Waterway) is not blocked by infrastructure, but here the river flows through the industrial Port of Rotterdam with limited habitat for (migratory) fish.

To allow more fish to migrate from the North Sea into the Rhine river, it was decided to open the Haringvlietsluices during flood-tide. The sluices are already opened during ebb to allow excess river water to flow out to sea, but strong (outward) currents limit fish migration during this stage. By also opening the Haringvlietsluices during high-tide, fish can more easily enter the Haringvliet as currents are reversed and seawater flows into Lake Haringvliet.

The inflow of sea water into Lake Haringvliet leads to salt intrusion into a fresh water lake, which is used for various purposes such as agriculture and irrigation, drinking water (further upstream) and for industry in the Port of Rotterdam. To guarantee fresh water supply to these stakeholders, salt intrusion is only allowed to occur in the western part of Lake Haringvliet, leaving the eastern part fresh and available for human purposes. How to manage salt intrusion into the western part of the Lake Haringvliet whilst maximising fish migration opportunities is the challenge that we together with other partners try to solve.

Method

Rijkswaterstaat (district West Nederland Zuid) has set up a research programma called "Learning by doing" (Lerend Implementeren), lasting around 10 years. Over this period, RWS will carry out experiments in the field to gather data and analyse it to gain insights into the fish migration and salt intrusion dynamics in (and outside) Lake Haringvliet under various management options. On top of that a 3D hydrodynamic model is being developed to support the findings from the salt-intrusion data. The model development goes hand in hand with the data-collection, as the model is validated based on data collected during the experiments. Once the reliability and accuracy of the model is characterized, it can then be used for scenario studies expanding the knowledge gained by experiments alone (as the field- experiments have limited scope and duration).

Result and Impact

- New insights into the ways to manage salt intrusion in a weakly dynamic fresh-water lake. The salt accumulates in the deeper parts (mainly former tidal channels) and only gets eroded away under high flow conditions.
- Insights into mixing and spreading of saline water inside the Haringvliet: Both measurements and model results have contributed to knowledge regarding the mixing and spreading of saline water under various wind and flow conditions.

Reports and Publications

- Kranenburg, W., Tiessen, M., Blaas, M., van Veen, N. (2022). Circulation, stratification and salt dispersion in a former estuary after reintroducing seawater inflow. Journal: Estuarine, Coastal and Shelf Science. https://kennisbank.deltares.nl/repos/EP5308.pdf
- Tiessen, M.C.H., Kranenburg, W.M., van der Kaaij, T., van der Heijden, L.H. (2023). D-HYDRO Haringvliet: modelontwikkeling en toetsing ter ondersteuning van het Lerend Implementeren onderzoek voor het Kierbesluit. Deltares rapport 11208051-004-ZKS-0002. https://kennisbank.deltares.nl/repos/11208051_004_0002.pdf