European Offshore Wind Deployment Centre

Environmental Research & Monitoring Programme

North East Scotland Salmon and Sea Trout Tracking Array Study

River Dee Trust (RDT), Marine Scotland Science (MSS)

Interim Report 2018

VATTENFALL

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Overview

Migration routes of salmon and sea trout ("salmonids") from the Rivers Dee, Don and Ythan will be investigated over three years (2018-2020) through tagging and tracking of migrating juvenile salmonid smolts. The data derived from the tracked individuals will be combined with local current information, to estimate actual swimming vectors of smolts. The use of the hydrodynamic Scottish Shelf Model (SSM), developed by Marine Scotland Science, will therefore provide a view of smolt dispersion around NE Scotland. The predictive capacity of the proposed work would be transferable to other windfarm and major construction projects.

Salmon smolt tracking

2017 tracking overview

Salmon and sea trout smolts exit Scottish rivers each year in April and May to begin their marine migration. Whilst sea trout smolts tend to stay around the Scottish coastline, salmon smolts are destined to one of several feeding areas in the North Atlantic, possibly as far as Southern Greenland but also around Iceland, Faroe Islands and around and north of Northern Norway. Over the next three years, this project is focusing on the initial stages of smolt marine migration in Scottish waters. Prior to the smolt tracking in 2018, pilot studies were carried out by the RDT and MSS in 2017. These studies, although independent of the EOWDC project, have provided data that has helped to plan the EOWDC-supported tracking, and the MSS data will be analysed and presented jointly with the EOWDC tracking results.

In the MSS study in 2017, 65 smolts were tagged from the upper Dee catchment with acoustic tags (the same tags that are being used in the main tracking programme). With the deployment of 40 acoustic receivers, their migration was tracked through the river and harbour and to 4 km offshore. Four of these receivers were placed in the lower river (at 2, 15, 29 and 41 km upstream) and four were placed in the harbour (forming two 'gates', in the inner harbour and at the Old South breakwater). 34 receivers were placed in a semi-circular array, 4 km from Aberdeen Harbour, and spaced at 380 m intervals.

55% of smolts (33) were detected within the harbour, and 46% (26) were detected at the 4 km array. The detections of smolts on the 4 km array are shown in Figure 1. The average direction of travel of the smolts during the first 4 km after leaving the river mouth was easterly, although this was influenced by whether the smolts left the river on an ebb or flood tide. Previous range testing indicated that the 380 m spacing of receivers enabled the detection of over 90% of tags in the marine area.

It took the smolts on average, just over 2 hours (2.17 h) to reach the 4 km array after exiting the harbour.

Figure 1. Detection (numbers of tagged salmon smolts) on the receiver array 4 km from shore. Red lines show mean direction of travel by all smolts, and direction of travel for smolts leaving the river on an ebb tide and flood tide.

The second pilot study, carried out by the RDT, focused on smolt migration and survival in the river and through Aberdeen Harbour (http://www.riverdee.org.uk/f/articles/Smolt-tracking-2017.pdf). 100 smolts were fitted with acoustic tags. These tags were substantially smaller than the tags used in the previously described study for investigating migration routes at sea (0.38 g compared to 0.7 g). The smaller tag allowed smaller (more typical) smolts to be followed (smolts were 16.0-23.5 g for this study, and 22.0-

50.0 g in the previously-described study). The smaller tags also represented a smaller tag burden (tag weight was 3% of body weight) compared to the larger tags (3.9% burden), and therefore should have less impact on survival. However, the smolts fitted with the smaller tags had an estimated 52% survival to the same point in the harbour, indicating minimal difference in survival between the two studies. This equated to an in-river mortality rate of 0.45% km^{-1} traveled, and 7.3% km^{-1} in the harbour. The mortality is thought to be caused by predators, particularly fish-eating birds (goosanders) in the river. Predation in the harbour may be due to birds (goosanders, cormorants), seals or marine fish. Further work, by RDT, MSS, and other groups, are continuing to investigate this in 2018.

Equipment

VR2AR receivers were used for the MSS tracking study in 2017. These have an acoustic release which is activated by Bluetooth. To retrieve the receivers, a boat was taken to the GPS location of the receiver, Bluetooth connection was established and then the receiver was programmed to release from the seabed mooring. The receiver was collected from the water surface and then the seabed mooring (to which the receiver was attached with a line of rope) was pulled on-board.

33 of the 34 receivers in the marine array were retrieved in this study, but one was lost as it had disappeared from its recorded location. The most likely explanation for this loss is that the receiver mooring got tangled up in a passing vessel. To avoid this happening in future an alternative receiver – VR2Tx - can be deployed and these were subsequently purchased. It is the same model of receiver, but without an acoustic release. These receivers are less expensive but need to be located with an ROV. The ROV attaches a recovery line to pull the mooring and receiver back onto the vessel.

70 of these VR2Tx receivers have been purchased, along with 10 VR2AR receivers. This has led to a saving of £20,000 in the allocated budget (compared to purchasing 45 VR2AR receivers), and this saving will be used for additional boat time and an ROV to locate and retrieve the receivers. We have also purchased 5 VR2W receivers which will be used in the river to enable more detailed comparison of survival rates of smolts with the different types of tags.

100 acoustic tags were purchased for 2018 as per the agreed budget. These included 70 ID tags and 30 Temperature-Depth tags. The tags are programmed to signal every 60 sec (with frequency randomly assigned between 30 and 90 sec), and on this basis have a battery life of approximately four months. In addition, MSS were able to donate a further 50 ID tags to the 2018 study, so 150 smolts will be tagged and tracked in 2018.

Deployment plans

The additional receivers purchased allow the tracking programme to be expanded at a greater rate than originally anticipated, and in particular to extend monitoring further out from the coast in 2018. This is beneficial given the speed at which smolts were found to travel the first 4 km of their migration route in 2017.

In 2018, 35 receivers will be deployed in the same semi-circular 4 km array as deployed in 2017. 87 receivers will be deployed in a second semi-circular array, 10 km from Aberdeen Harbour (Fig. 2).

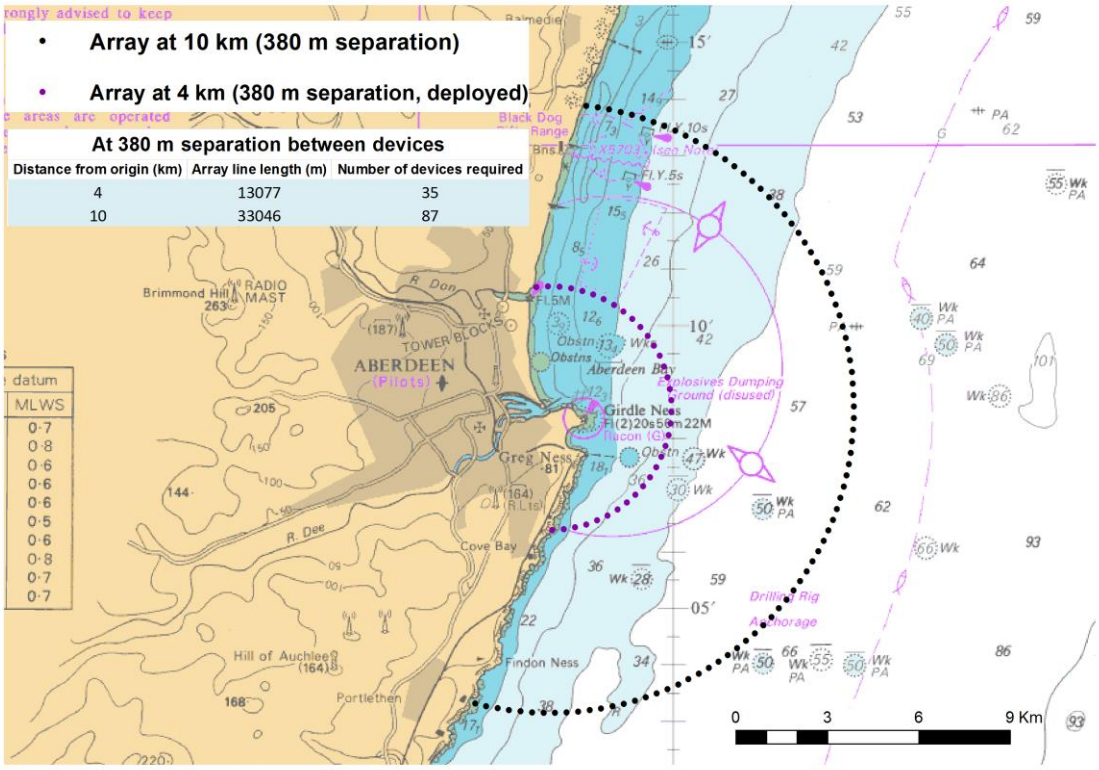

Figure 2. Deployment plan for acoustic receivers in 2018. The 4 km array (inner circle) and 10 km array (outer circle) are depicted with dots representing receivers.

Four receivers (forming two 'gates'; Fig. 3) will be installed in the harbour to confirm which smolts successfully exit the river. 12 receivers will be installed in the river to compare survival of smolts in this study, with smolts tagged with smaller tags in a separate RDT study.

Figure 3. Location of acoustic receivers to be deployed in Aberdeen Harbour in 2018, forming two 'gates'.

Hydrodynamic modelling and particle tracking

The project will aim to use simultaneous measurements of salmon smolt dispersal vectors and local currents to estimate actual swimming vectors. These data will then be combined with outputs from the Scottish Shelf Model (SSM), a hydrodynamic model developed by Marine Scotland Science, to provide a general picture of smolt dispersion. The SSM is now ready for local current data to be fed in. In March 2018 an acoustic Doppler current profiler (ADCP) was deployed at sea and this will provide local current information. This will refine the model for the local area and improve knowledge of current vectors for NE Scotland.