COMPLETED PROJECT CASE STUDY

SMOOTHMOVE: A LOW-DENSITY FISH LOADING SYSTEM FOR ENHANCED SALMON WELFARE

PARTNERS

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BACKGROUND

Farmed Atlantic salmon undergo several transfers throughout their life cycle, often during grading, treatment, or harvest. Traditionally, transfers often rely on crowding fish at high densities (300–500 kg/m³) toward a suction bell connected to a pump. This approach brings fish into close contact and can result in heightened stress and occasional injury or mortality. It has been documented that salmon can lose interest in food for several days following a transfer, leading to growth delays and welfare concerns. The sector is therefore working to develop innovative transfer systems that are closely aligned with salmon health and welfare.

East Coast Innovation (ECI) set out to address these challenges by developing a novel fish loading system that allows transfers at much lower biomass densities. By reducing crowding, the device aims to minimise stress and improve overall welfare, while maintaining transfer efficiency. After designing and testing the device within Canadian farms, ECI sought to adapt and test the innovation in Scottish waters.

AIMS

The primary aim of the project was to demonstrate that transferring salmon at lower biomass densities reduces stress without compromising operational efficiency.

Specifically, the objectives were to:

- Design and build the SmoothMove fish loading device;
- Test the device in a live harvest setting with a Scottish farming partner;
- Collect and analyse data on fish behaviour and quality;
- Produce a final report on the system's performance.

PROJECT OVERVIEW AND METHODS

CONCEPT AND DESIGN

The SmoothMove system makes use of salmon's natural tendency to swim against currents. By creating a controlled flow in front of the transfer zone, salmon are encouraged to move voluntarily toward the device. Once inside, they encounter a secondary suction current that moves them through to the pump. Unlike traditional methods, this process eliminates the need for high-density crowding. The target biomass density for SmoothMove transfers is 100–150 kg/m³, well below conventional levels.

To aid farmers' decision-making, the device incorporates underwater cameras. These provide live footage of fish behaviour, allowing operators to adjust crowding and handling strategies in real time.

Initial development involved laboratory testing and computational fluid dynamics (CFD) modelling to refine the design. Early prototypes revealed issues that required redesign, but this process ultimately produced a functional unit suitable for field trials.

COLLABORATION AND PLANNING

The project was delivered in partnership with Cooke Aquaculture Scotland. ECI worked closely with the company to define requirements, agree on success metrics, and plan the trial phases. Ancillary equipment, such as hoses and pumps, was sourced locally in Scotland to reduce shipping costs.

The trial programme included two phases:

- Baseline trials using the traditional suction bell to record current practice;
- SmoothMove trials to compare performance directly.

The baseline trials took place in May 2024 in Orkney, where cameras were mounted on the suction bell to capture video of biomass densities and transfer behaviour. These recordings provided a benchmark for evaluating the SmoothMove's performance.

The SmoothMove 350 unit was then fabricated, shipped to Scotland, and installed on a harvest vessel. Before live fish trials, a full water-only test ensured the system functioned correctly.

TRIAL EXECUTION

Four live harvest transfers were conducted with the SmoothMove. Each trial was monitored closely, with data collected on biomass density, transfer rates, and fish behaviour. Weather and vessel conditions significantly influenced scheduling and performance, and adjustments to equipment were made between trials to improve reliability.

RESULTS

TRIAL OUTCOMES

The SmoothMove system consistently achieved lower biomass densities during transfers, within the 100–150 kg/m³ target range, while maintaining transfer rates comparable to the traditional suction bell. Fish had room to swim freely, and no fins were visible at the water surface. In most cases, the transfers met RSPCA Level 1 crowding standards.

- Day 1: The first trial day was highly successful, confirming that fish could be loaded efficiently with reduced crowding. However, subsequent days revealed challenges.
- Day 2: Performance was inconsistent due to issues with the supply water pump, which caused fluctuating flow rates. Restarting and re-priming the pump temporarily resolved the problem, but the last portion of each pen's transfer was less efficient.
- Day 3: Following modifications to the pump system, instrumentation, and user interface, operations ran smoothly under varied settings, without significant impact on efficiency.
- Day 4: Early operations were promising but were cut short by rough seas, which exacerbated pump installation issues. The trial was concluded using the traditional funnel.

Video evidence showed salmon swimming calmly during transfers, with no signs of excessive stress. Fish were transferred at target rates without the surface crowding typical of suction bell methods.

TECHNICAL CHALLENGES

Several limitations were identified:

- Pump placement: The supply water pump was positioned too high above the waterline, reducing reliability, particularly in rough seas.
- Scaling effects: The SmoothMove system had been tested extensively with 200–250 mm fish pumps in laboratory and Canadian settings. The Orkney trials required scaling up to 350 mm for a continuous flow pump, which revealed unforeseen design issues and affected efficiency, especially during the final stages of each transfer.

Despite these challenges, all harvests were completed without negative downstream impacts on fish or farm operations.

Adverse weather and farming schedules limited the number of trials. Although fewer transfers were completed than originally planned, the data gathered demonstrated that the SmoothMove was capable of operating in full-scale commercial settings. Lessons from the Orkney trials are now informing design improvements ahead of broader rollout.

Blood sampling was considered but ultimately excluded due to concerns about confounding variables. Instead, post-harvest analysis had to be focused on anecdotal evidence. Results were therefore not conclusive, but existing literature suggests that reducing stress during handling improves product quality. More testing with data analysis was identified for the future.

IMPACT

The SmoothMove represents a significant advance in salmon transfer technology. By reducing the need for high-density crowding, it enhances fish welfare, aligns with RSPCA standards, and mitigates risks associated with traditional high-density methods. The ability to load fish efficiently and at a desired rate while maintaining lower biomass densities gives farmers greater control over handling, reducing stress-related growth delays and potential mortality.

For producers, this innovation offers both welfare and commercial benefits. Less stressed fish are less prone to injury and disease, and improved product quality enhances market value. Operationally, the system reduces pre-loading crowding time, which can improve efficiency during harvest.

The project also strengthened collaboration between ECI and the Scottish salmon sector, demonstrating the value of joint innovation. While technical issues with scaling and pump integration remain, these challenges are being addressed, and ECI is on track to deliver a fully operational solution to the Scottish market in 2025/2026.

In summary, the SmoothMove has shown it can transfer salmon at comparable rates to conventional methods while reducing biomass density by more than half. This approach has the potential to reduce stress and improve welfare, which could in turn result in heightened product quality and farm sustainability. With further refinement, the system could become a standard tool for modern salmon farming.