

The application of eDNA technology in the assessment of pelagic by-catch of Atlantic salmon (*Salmo salar* L.)

Jens Carlsson and Ken Whelan

Salmon and People in a Changing World

Fisheries Management Scotland
Annual Conference, National Museum of Scotland, Edinburgh
29th March 2019



eDNA – Atlantic Salmon

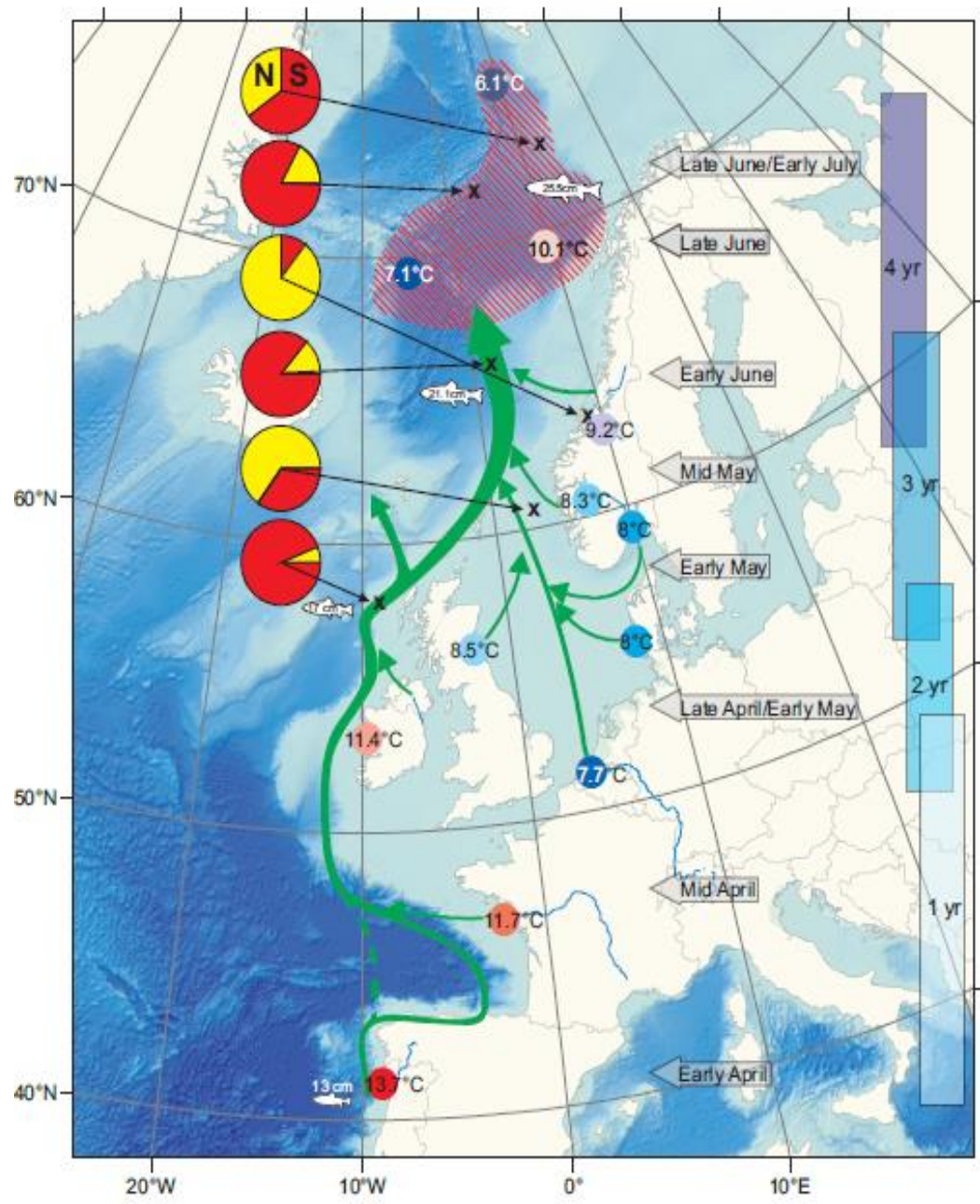


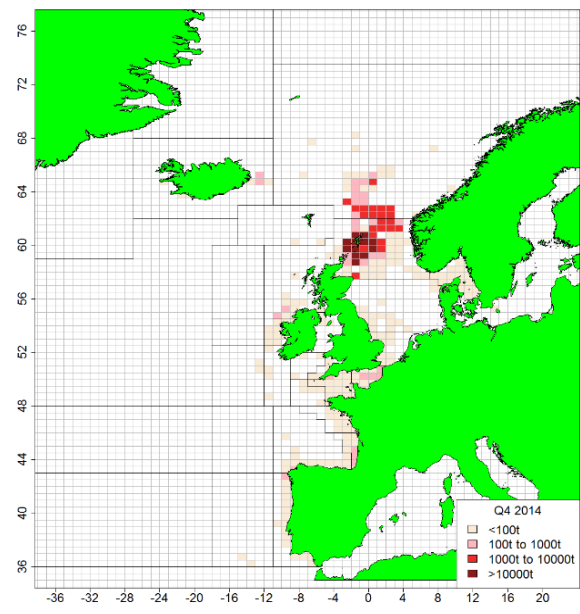
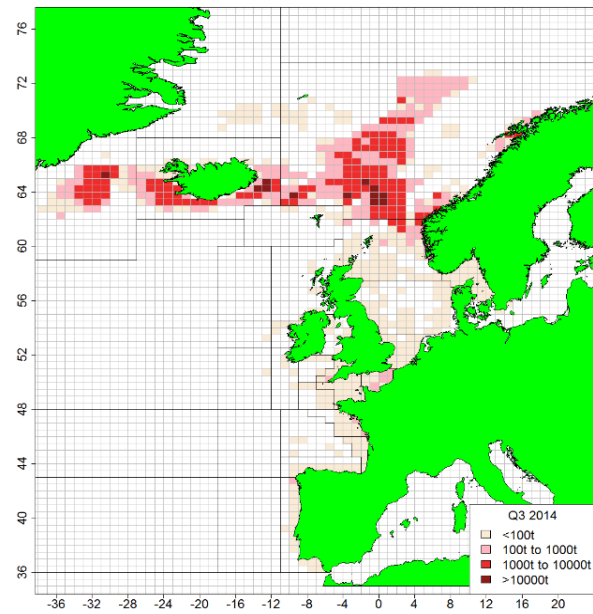
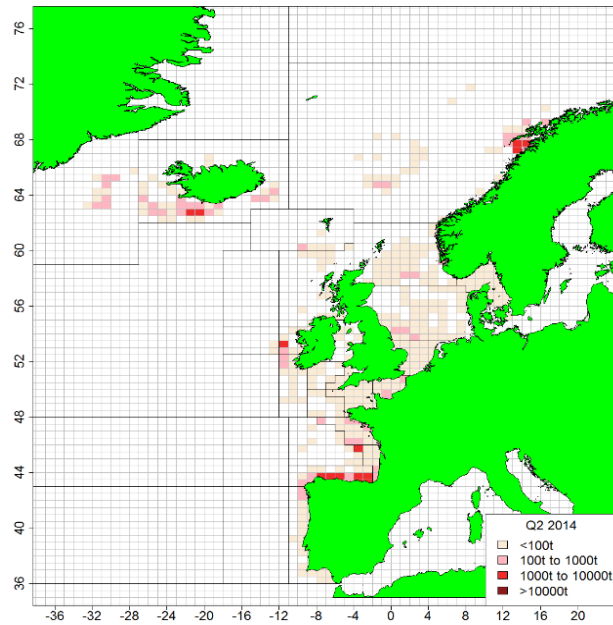
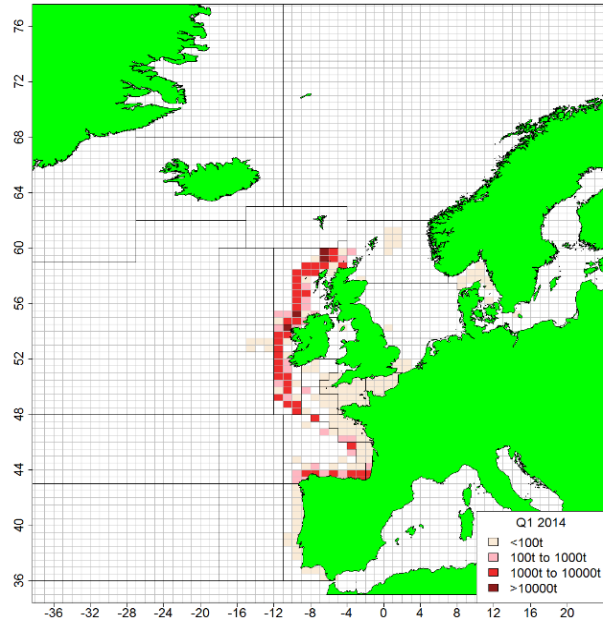
- Serious concern that northeast Atlantic pelagic fisheries may inadvertently take a significant by-catch of juvenile Atlantic salmon, specifically in areas where salmon are migrating at particular times of the year.
- There is a need to identify, quantify and monitor the level of by-catch in order to develop mitigation measures.
- Difficult and costly to visually inspect the catches from these pelagic fisheries.
- Locating individual post-smolts, between 12cm and 20cm long, amongst the large catches is almost impossible.
- New and innovative approaches were urgently required to resolve this.

eDNA – Atlantic Salmon

eDNA Screening of Pelagic Fishery

- Given the migration routes of salmon, as reported by the SALSEA-MERGE project, the main pelagic fisheries of concern for potential by-catch are those which target Atlantic mackerel (*Scomber scombrus*), Atlantic herring (*Clupea harengus*), horse mackerel (*Trachurus trachurus*), blue whiting (*Micromesistius poutassou*) and boarfish (*Capros aper*) and are conducted by fleets from the EU, Iceland, the Faroe Islands, Russia and Norway .





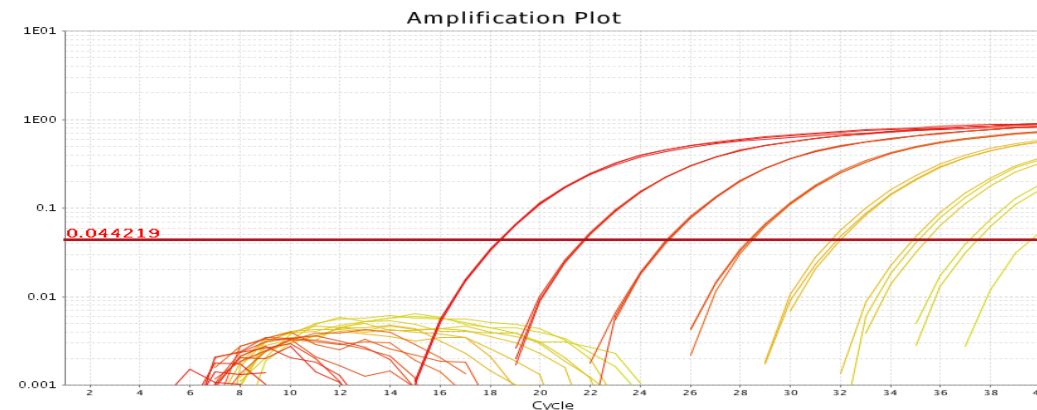
eDNA – Atlantic Salmon

- One potential tool for screening large numbers of high-volume commercial catches for the presence of juvenile salmon is through the use of environmental DNA (eDNA).
- Environmental DNA is the collective term for DNA molecules that are released from living or dead organisms into the environment, which can come from sources as diverse as blood, skin, mucous, sperm and ova etc.



eDNA – Atlantic Salmon

- Dr Jens Carlsson and his team at University College Dublin (UCD) developed and tested a species-specific molecular probe for use in salmon eDNA assessments.
- Undertook a pilot study of eDNA sampling in commercial salmon nets and boats along the west coast of Ireland.
- Developed a draft sampling protocol to guide the collection of samples from pelagic trawlers.

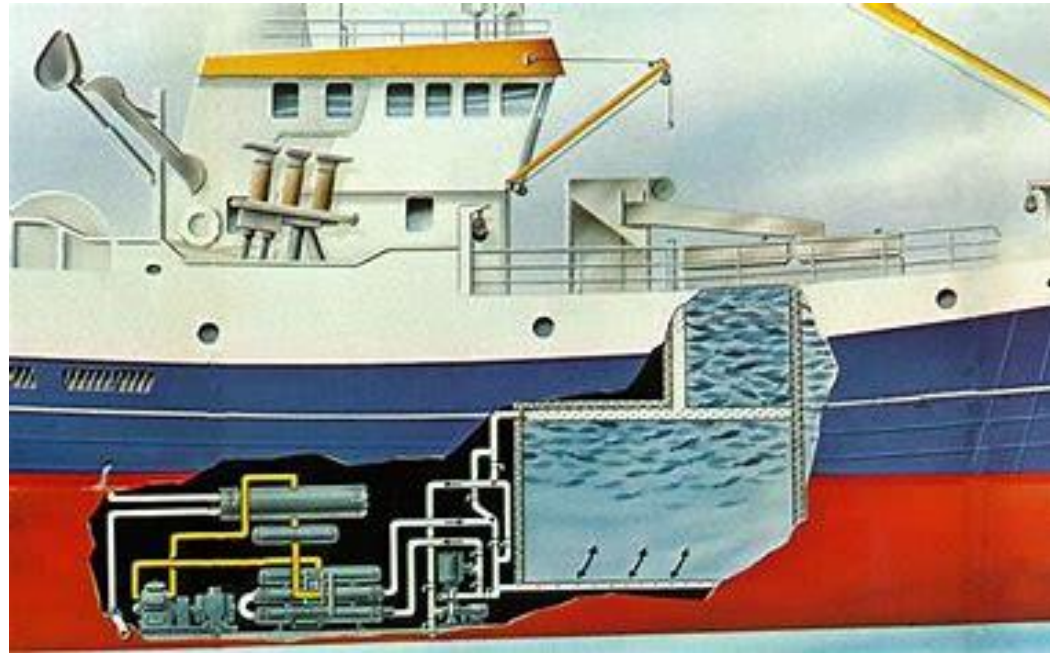


eDNA – Atlantic Salmon

- The RSW (Refrigerated Seawater Systems) tanks of pelagic vessels are suitable for screening total on-board catches.
- Tanks are interconnected through the RSW system and if multiple hauls from different areas are on-board at a single time it may not be possible to distinguish hauls by sampling tank water.
- Depending on the species being fished, large scale movement between different areas between hauls may not occur and thus may not be an issue.
- Specific information should be gathered from the vessel in question.

eDNA – Atlantic Salmon

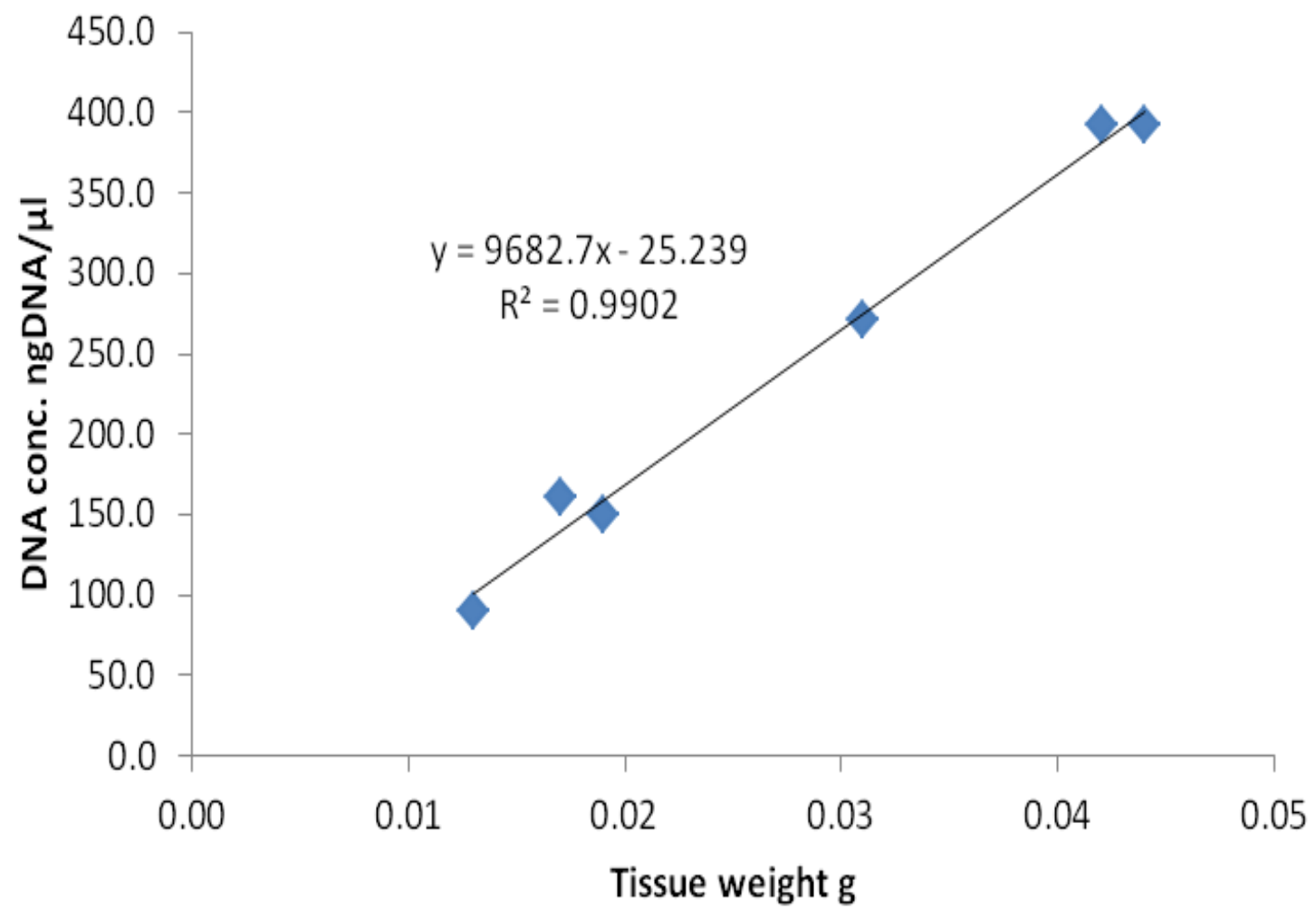
- **DNA Recovery from RSW Tanks**
- In order to assess if the RSW tank conditions were suitable for the extraction of DNA, samples were collected from RSW vessels during boarfish fishing operations in the Celtic Sea.



eDNA – Atlantic Salmon

Conclusions

- Studies carried out in UCD to date clearly indicate that DNA is present and recoverable from the environment a considerable time after the DNA has been shed (at least up to a year for equipment used when sampling / handling *S. salar*).
- Further, there is a clear relationship between the amount of tissue/sample used for DNA extraction and the resulting DNA concentration.
- This DNA can be detected at very low concentrations using qPCR.



eDNA – Atlantic Salmon

- Findings to date highlight the potential for using eDNA based methods to detect and quantify *S. salar* by-catch in commercial fisheries.
- A biomass of only 0.08g in a 500 tonne RSW tank can be detected.
- At this stage it is not known how much of the biomass present in the water is actually shedding tissue in a form suitable for DNA recovery.
- The Atlantic Salmon eDNA probe is being used as the basis for WP4 in the Norwegian SeaSalar Programme - assessment of the impact of pelagic by-catch.
- ATLANTIC SALMON AT SEA - factors affecting their growth and survival (SeaSalar) - <https://www.nina.no/Aktuelt/Nyhetsartikkel/ArticleId/4400/Skal-avslore-villaksens-liv-i-havet>

eDNA – Atlantic Salmon and Other Species

- Bar code of Life project, funded by the Environmental Protection Agency and the Atlantic Salmon Trust, uses environmental DNA analysis to detect the presence of salmon above barriers in freshwater – Reconnect & Amber Projects.
- Sampling of eDNA has already been used in [Ireland](#) to detect the presence or absence of the endangered **pearl mussel**, as well as **brown trout** and **sea lamprey**.



