JUNE 1 - 3
SKAGEN
DENMARK

Einar Eg Nielsen

Professor, National Institute of Aquatic Resources, Section for Marine Living Resources

Is DNA-testing the Future of Species Control?


DTU

Is DNA-testing the future of species control?

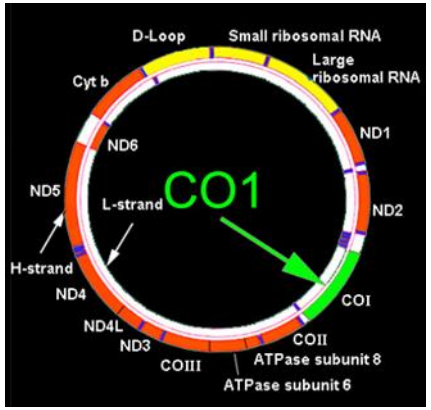
Einar Eg Nielsen, Paulina Urban, Dorte Bekkevold, Jos Kielgast, Magnus Jakobsen

Mixed industrial catches

- Large mixed quantities (>200 tonnes)
- Generally few species
- Uneven distribution of species in catch (hauls/tanks)
- No fixed EU standards (level playing field)
- **Current control by manual counting and weighing (buckets)**
- Problems with bycatch (e.g. herring)
- Problems with documenting catch
- Minimum reporting 50 kilos

DNA-Mix project, Danish Fisheries Agency, industry and fishermen. Funded by **European Maritime and Fisheries Fund**

DNA based species-identification –“Barcoding”



- “Barcoding of life” database www.boldsystems.org
- One gene COI (cytochrome c oxidase subunit I)
- 650 bases ACTG…..
- Separates 98% of studied fish species
- 21.073 species (25.05.2022)
- Simple as it relies on categorical differences
- Single species samples (filets, fins) easily identified without taxonomic expertise

GGTAACATCCCGAAAGTC GGTAACATCACGAAAGTC

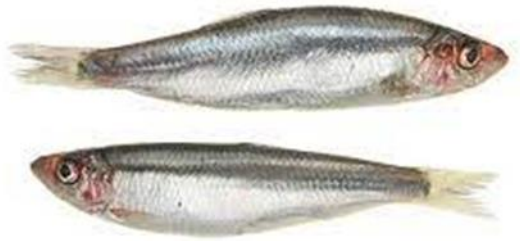
Species 1 Species 2

Can DNA testing be used for mixed catches?

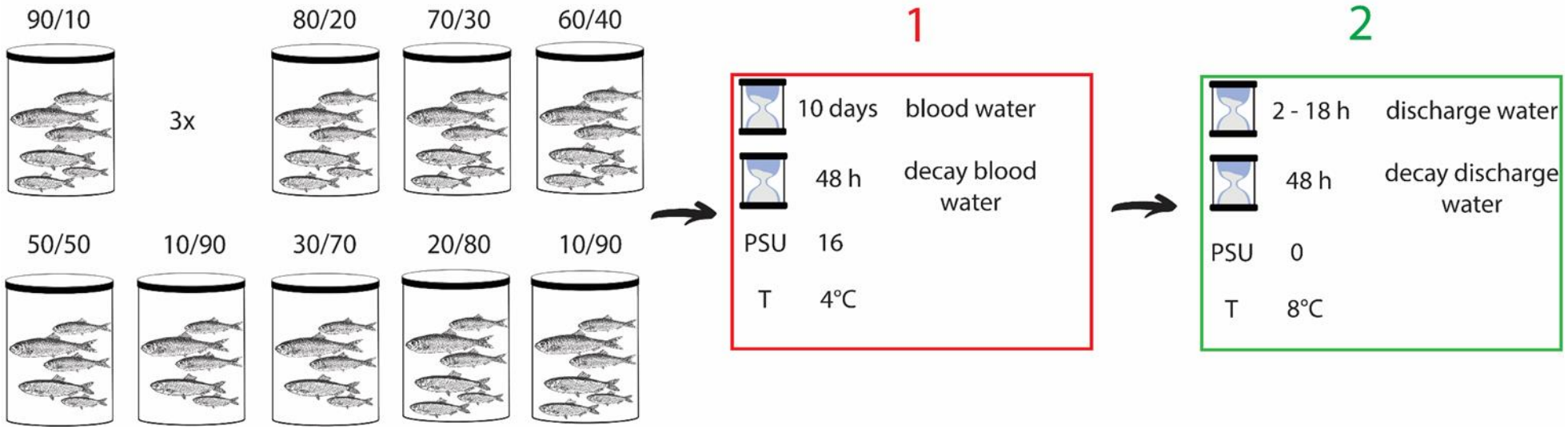
- **Challenges**:
  - How to sample large inhomogenous mixtures?
  - Do some species give more DNA ≠ weight?
  - Is the precision high enough?

- **Potential solutions**:
  - Sample production water on vessel or in factory = more homogenous DNA composition than the fish
  - Calibrate for DNA/weight, with respect to different species
  - Test the robustness of inferences with ”mock” mixture samples (species proportions and size etc.)

Case 1 Sprat and herring mixed catches

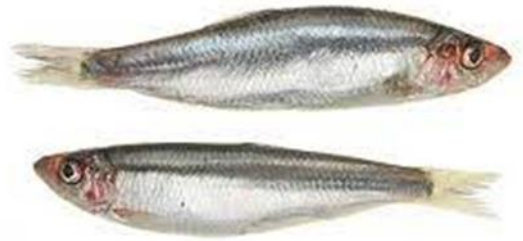


- Experiment:

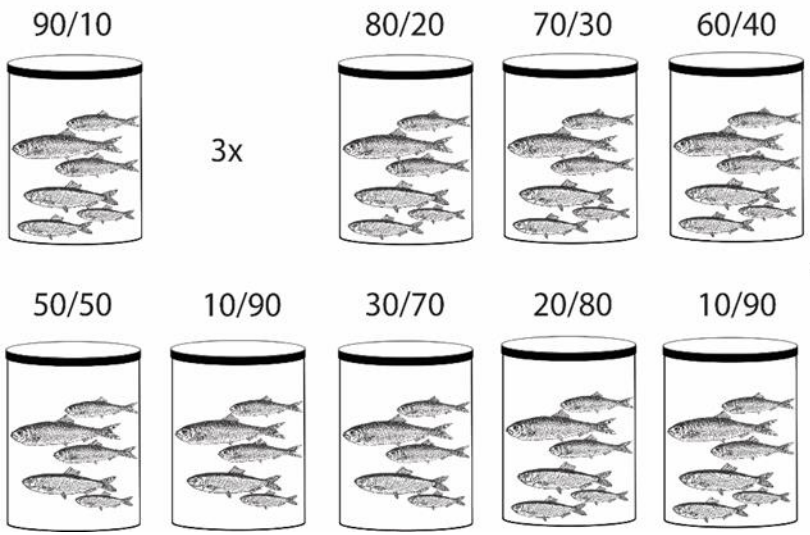


5 kilos in each bucket

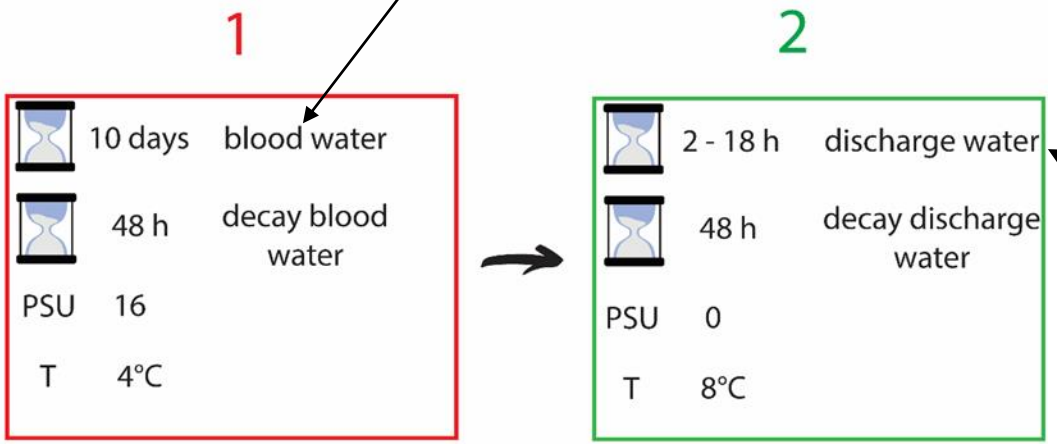
Case 1 Sprat and herring



- Experiment:

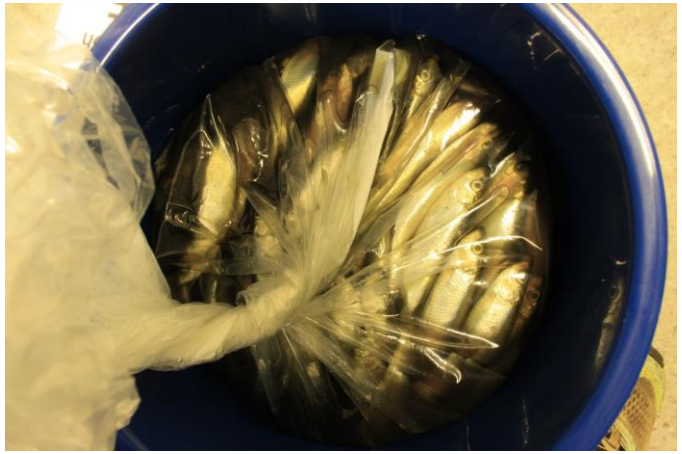


”Sampling ship”

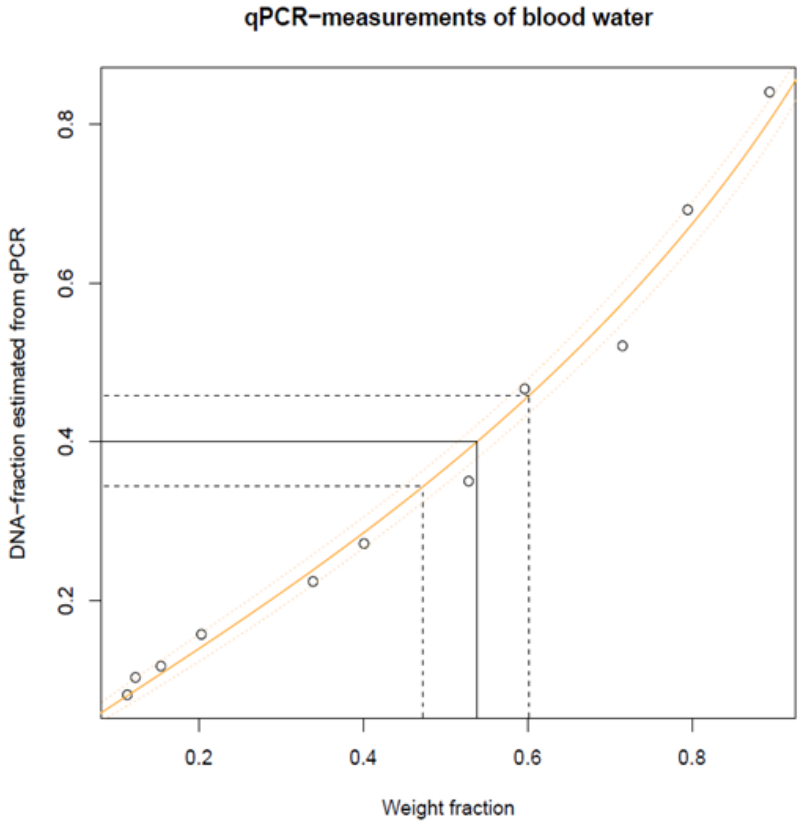


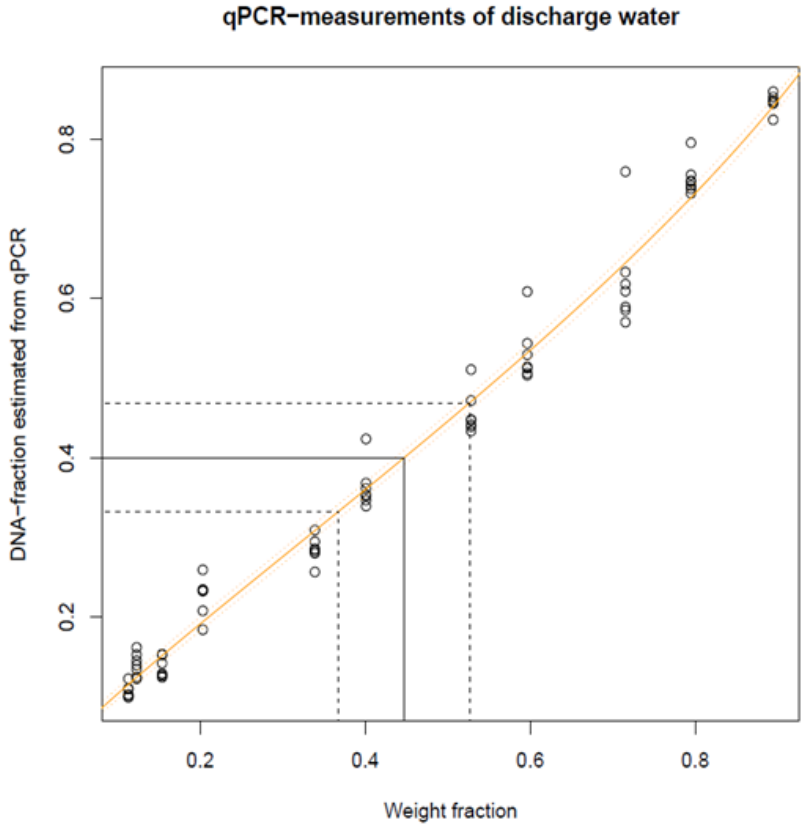
”Sampling factory”

5 kilos in each bucket



Relationship between weight and DNA fractions (herring)

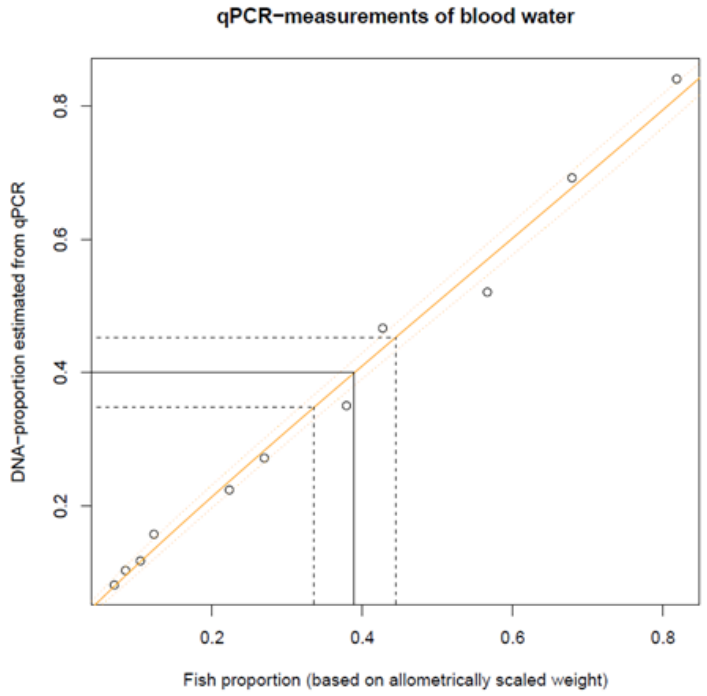


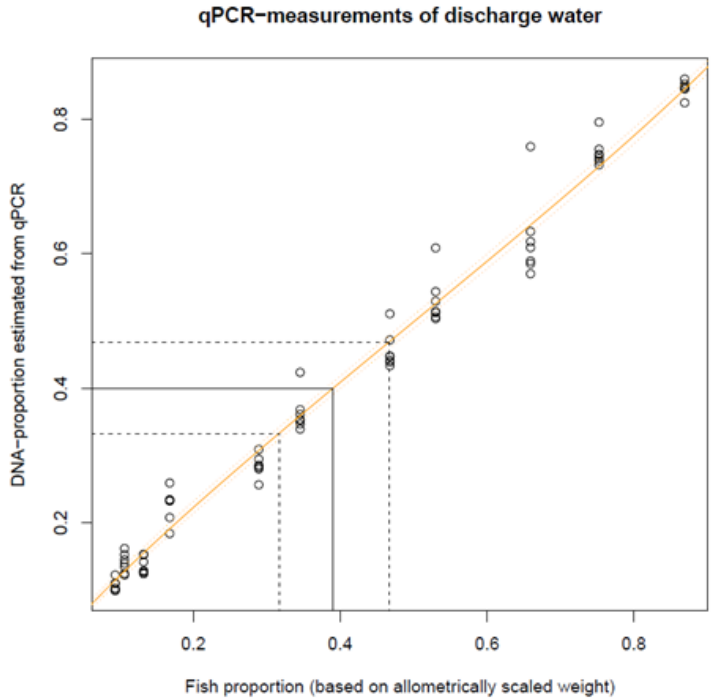


DNA-fraction measured (μi) = 0.4 (95% *CI*)

Weight fraction estimated = 0.53 ± 0.07

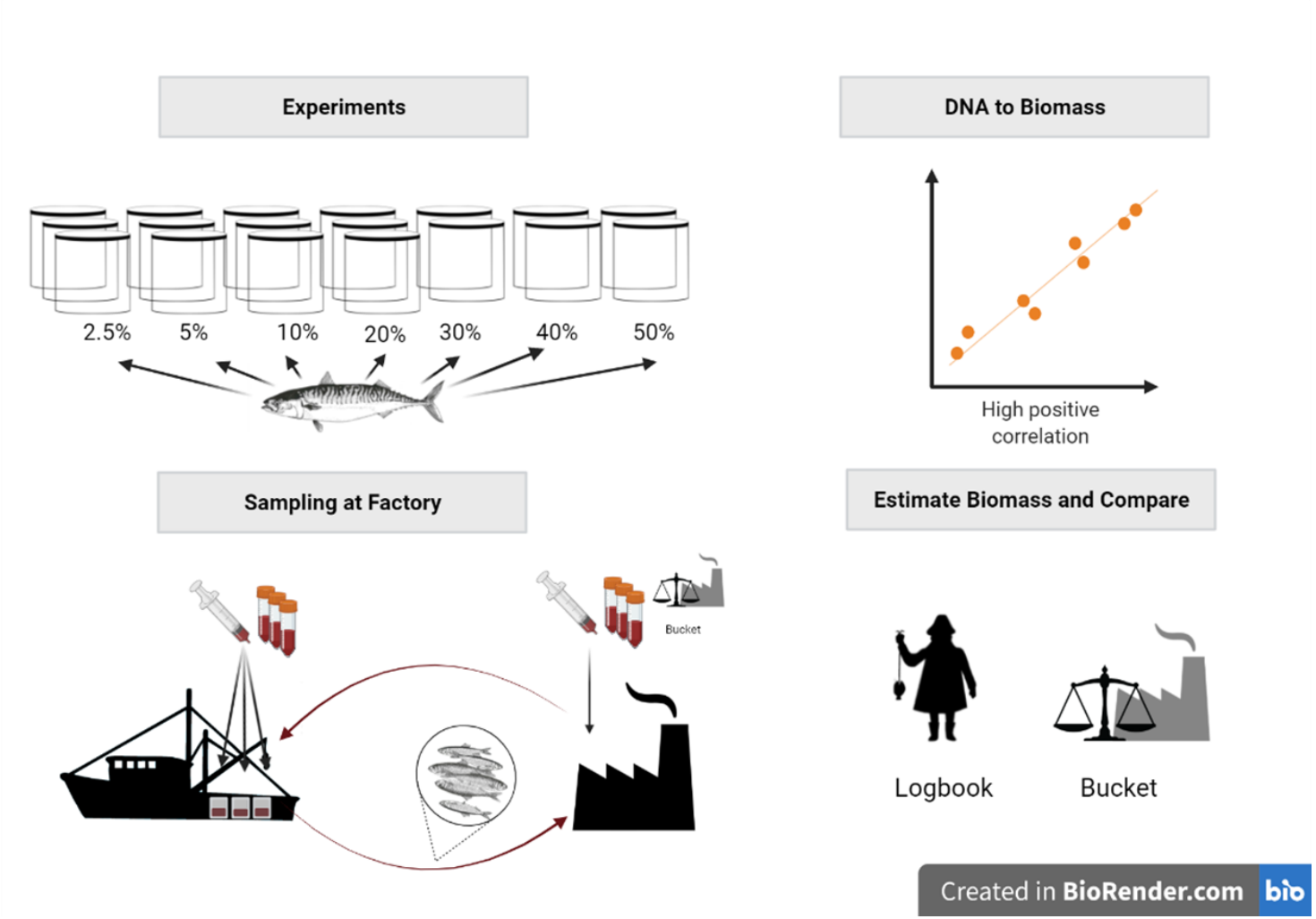
Relationship between weight and DNA fractions corrected for relative size of fish (herring larger = less DNA per weight)



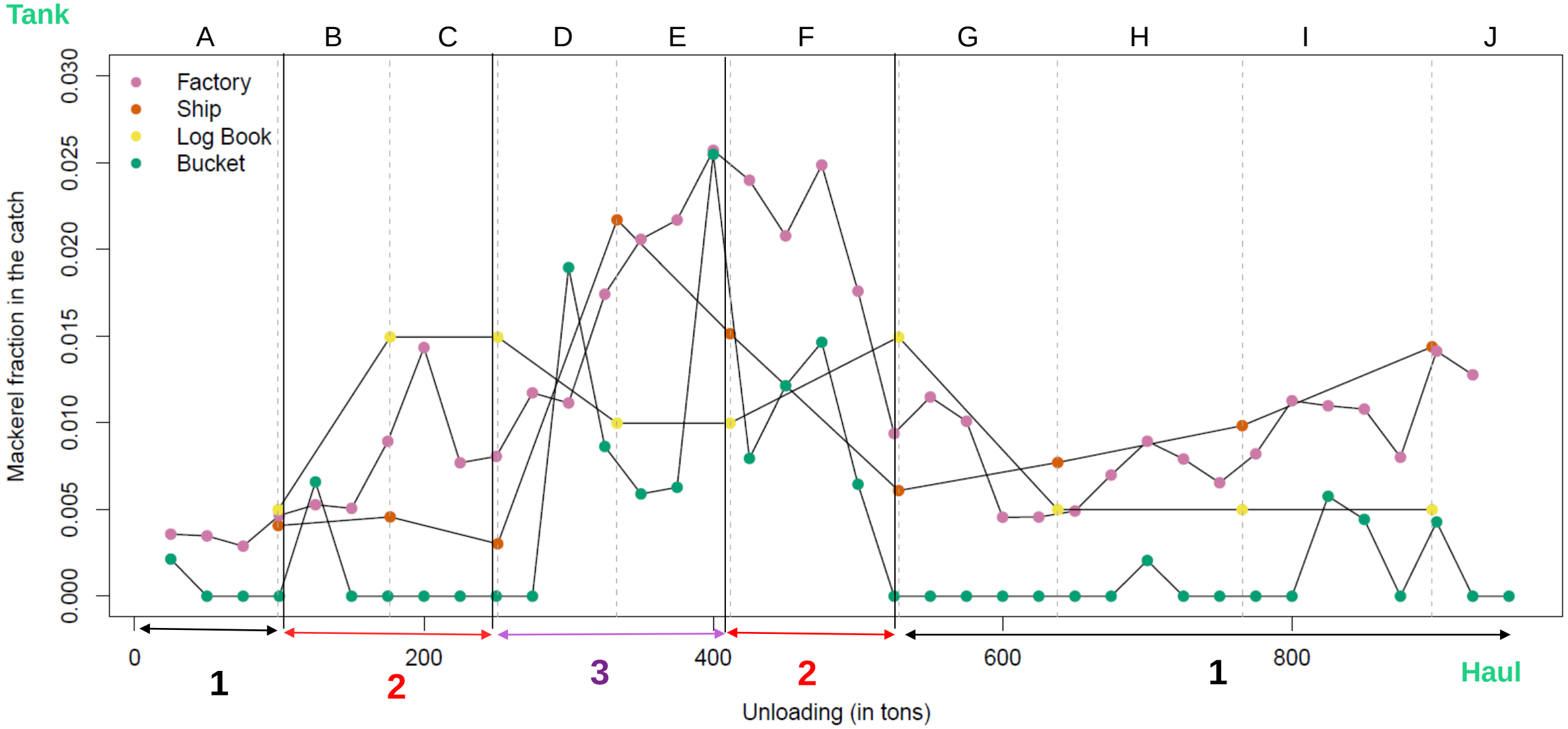


DNA-fraction measured (μi) = 0.4 (95% CI)
Corrected weight fraction = 0.4 ± 0.05

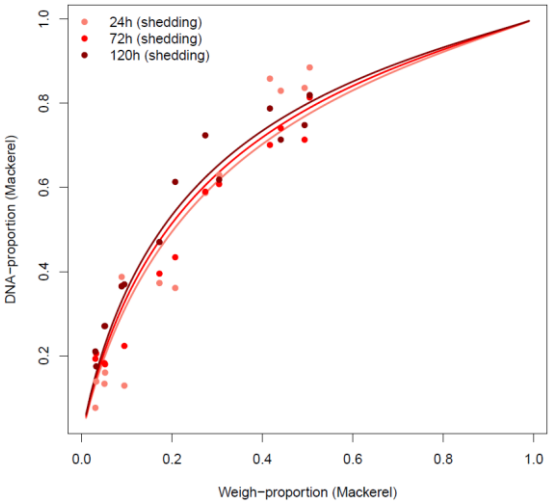
Case 2 Bycatch of mackerel in herring fishery

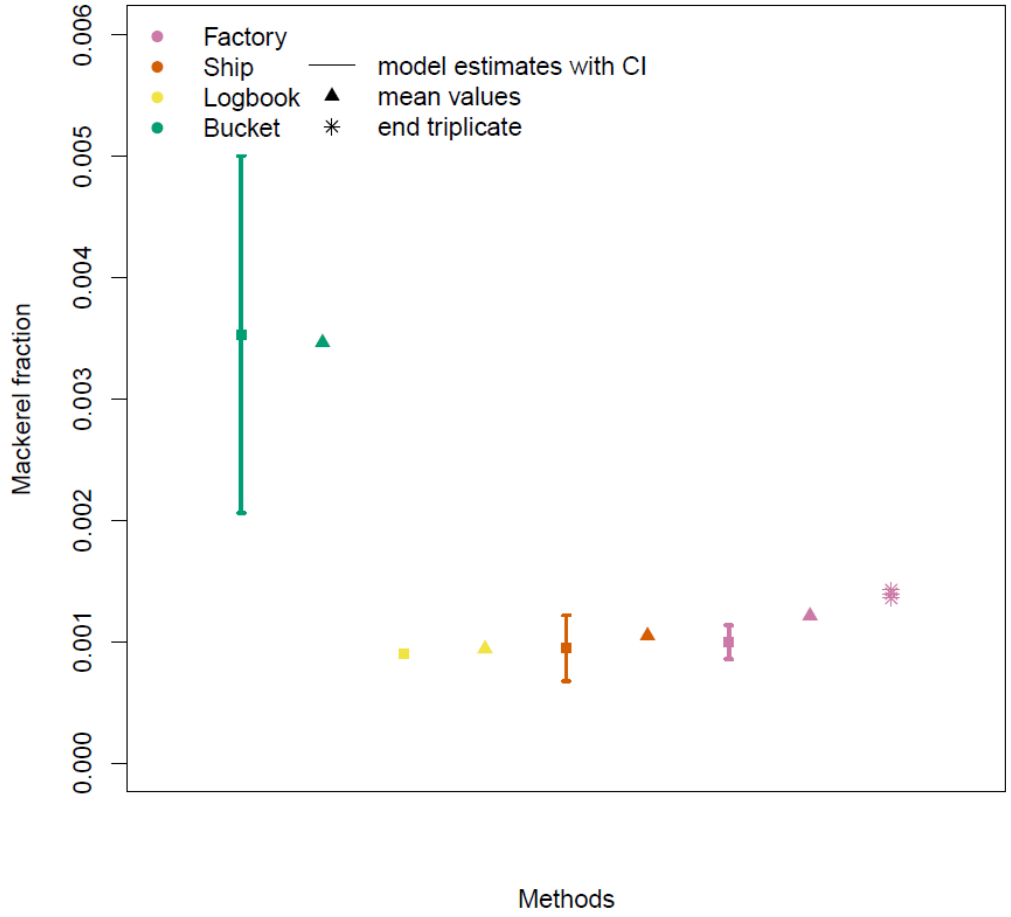


Landing – the unloading process



Mackerel fraction estimated with different methods





Conclusions and what's next

- DNA based species control from production water has high sensitivity and precision = large potential for practical implementation
- Factors like species and relative fish size has to be (and can) be accounted for in relation to DNA proportion
- The process of unloading the fish and reuse of discharge water in the factory is complex and has to be known for DNA testing
- Sampling water from ship tanks before landing may be the best solution

- More industrial scale trials with known weight proportions have to be conducted
- Robustness to factors like maturity, sea-area and time of year should be investigated
- Practical implementation trials can be conducted now using visual and DNA based methods in parallel
- The frequency for updating the relationship between DNA and weight should be assessed
- DNA methods for more complex mixtures are under development