Policymakers' Event 31.03.2021

Nutritious, safe, and sustainable seafood for consumers

Reliable seafood authentication

Sofie Derycke, ILVO

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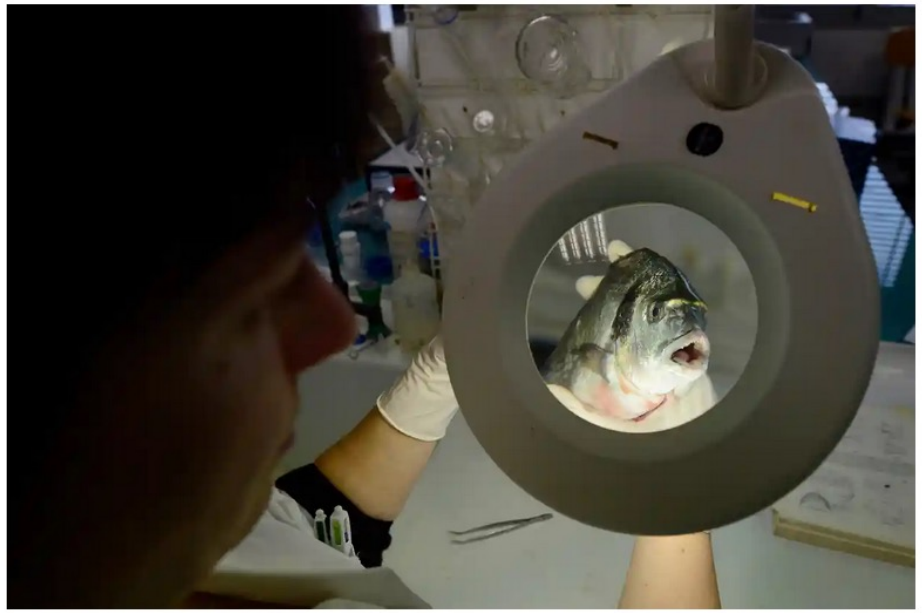
The Guardian

16 March 2021

SEAFOOD TOMORROW

Revealed: seafood fraud happening on a vast global scale

Guardian analysis of 44 studies finds nearly 40% of 9,000 products from restaurants, markets and fishmongers were mislabelled



▲ A chemist working to identify a fish at a laboratory in Marseille, France. The Guardian analysed 44 studies on seafood fraud, many of which used DNA analysis techniques. Photograph: Anne-Christine Poujoulat/AFP/Getty

A Guardian Seascape analysis of 44 recent studies of more than 9,000 seafood samples from restaurants, fishmongers and supermarkets in more than 30 countries found that 36% were mislabelled, exposing seafood fraud on a vast global scale.

Substitution of fish:

- Economic gain/loss
- Limited availability
- Visually similar species
- Conceal IUU fisheries

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Consequences of seafood fraud

Here: substitution of species

- Economic consequences
- Conservation efforts are threathened
- Fraud and illegal fisheries infringe quota
- Health risk for consumers (allergies, toxins)
- Consumer loss of confidence

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Seafood authentication

Unprocessed

Processed

Problem with processed food: visual identification no longer possible

DNA-based identification

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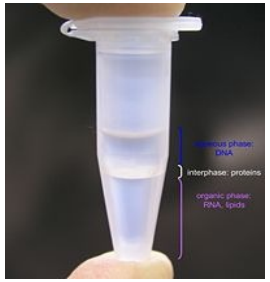
DNA-based identification

Premise: each species has a unique DNA profile

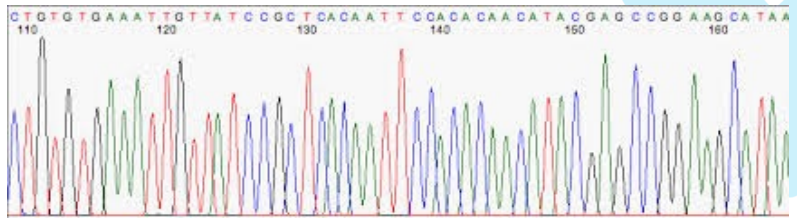
Unidentified specimen

DNA extraction

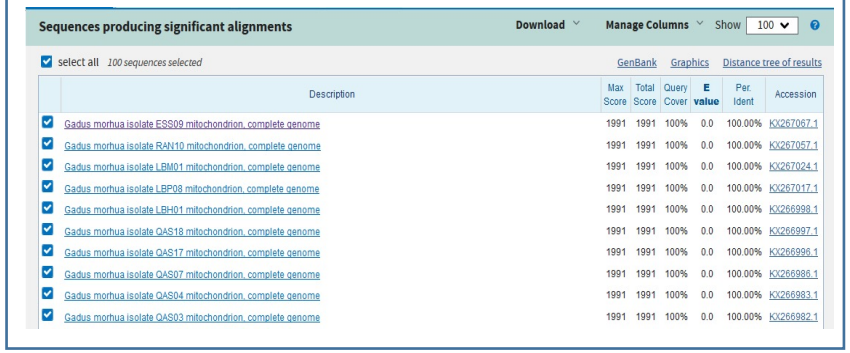


PCR

Sequence (Sanger)



Reference database



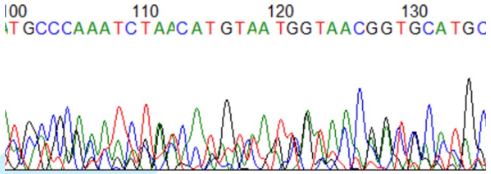
Sequences producing significant alignments — Download — Manage Columns — Show 100

select all 100 sequences selected — GenBank — Graphics — Distance tree of results

Description	Max Score	Total Score	Query Cover	E value	Per. Ident	Accession
Gadus morhua isolate ESS09 mitochondrion, complete genome	1991	1991	100%	0.0	100.00%	KX267067.1
Gadus morhua isolate RAN10 mitochondrion, complete genome	1991	1991	100%	0.0	100.00%	KX267057.1
Gadus morhua isolate LBM01 mitochondrion, complete genome	1991	1991	100%	0.0	100.00%	KX267024.1
Gadus morhua isolate LBP08 mitochondrion, complete genome	1991	1991	100%	0.0	100.00%	KX267017.1
Gadus morhua isolate LBH01 mitochondrion, complete genome	1991	1991	100%	0.0	100.00%	KX266998.1
Gadus morhua isolate QAS18 mitochondrion, complete genome	1991	1991	100%	0.0	100.00%	KX266997.1
Gadus morhua isolate QAS17 mitochondrion, complete genome	1991	1991	100%	0.0	100.00%	KX266996.1
Gadus morhua isolate QAS07 mitochondrion, complete genome	1991	1991	100%	0.0	100.00%	KX266986.1
Gadus morhua isolate QAS04 mitochondrion, complete genome	1991	1991	100%	0.0	100.00%	KX266983.1
Gadus morhua isolate QAS03 mitochondrion, complete genome	1991	1991	100%	0.0	100.00%	KX266982.1

PROBLEM:

- errors in public databases
- does not work for food products with multiple species



=> Need for

- high quality reference database
- fast screening tools, also for mixed food products

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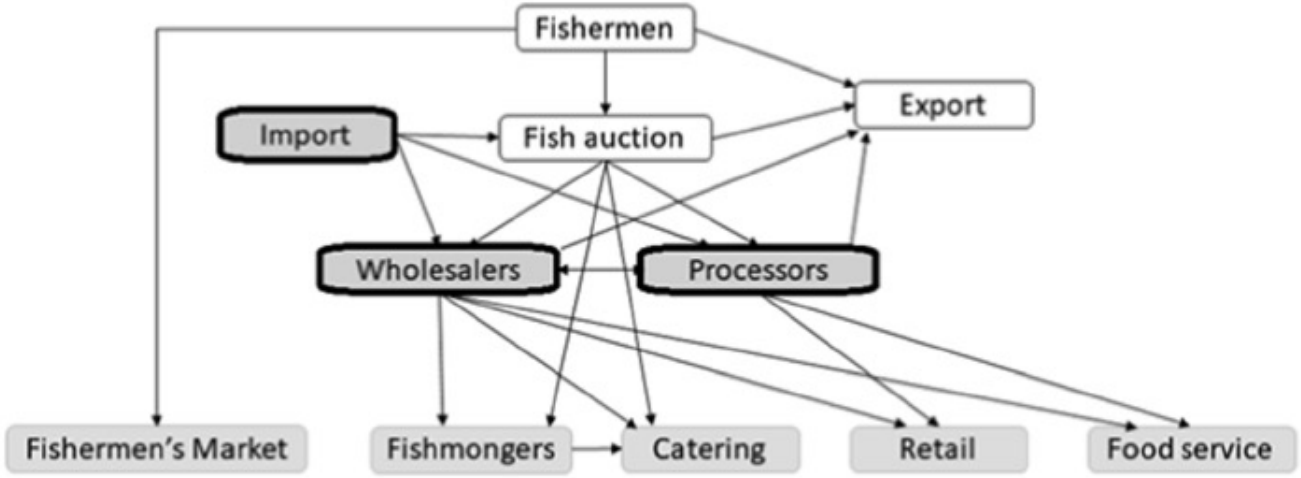
1/ A reliable reference database

- 42 commercially traded European fishes; 300 sequences
- Specimens, tissues, DNA, sequences are all linked
- Open access: www.seafoodtomorrowdata.eu/authentication/
- Video tutorial: https://drive.google.com/open?id=1B8rnQTgGPMDt6iJYe-GB1jV379zRiYIv

Market application: substitution of cod and sole along the Belgian supply chain



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1/ A reliable reference database

3/132 (2%)

Gadus chalcogrammus

Melanogrammus aeglefinus

Pollachius virens

7/41 (17%)

Cynoglossus sp.

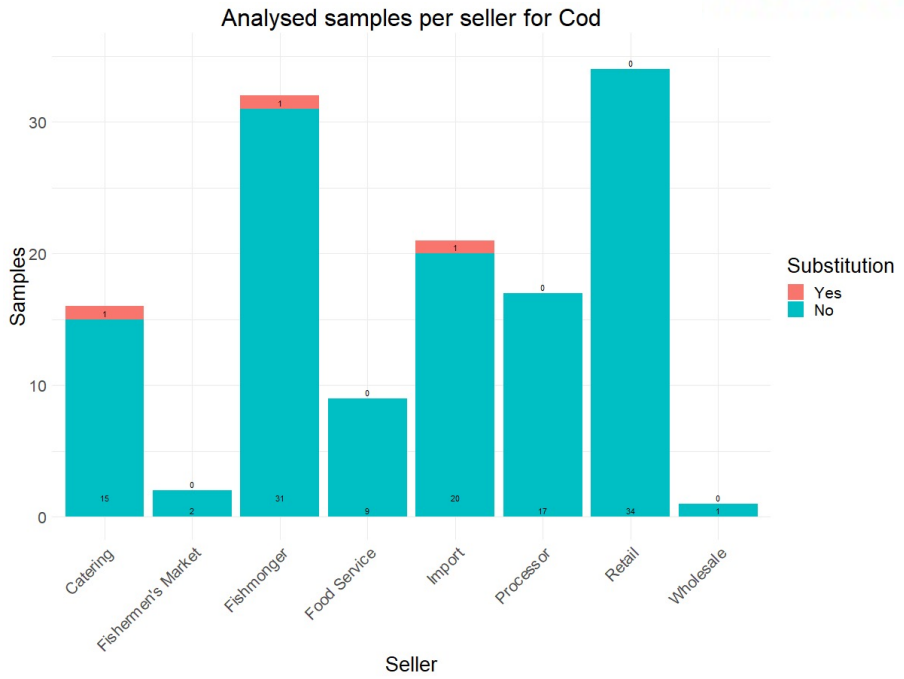
Lepidopsetta polyxstra

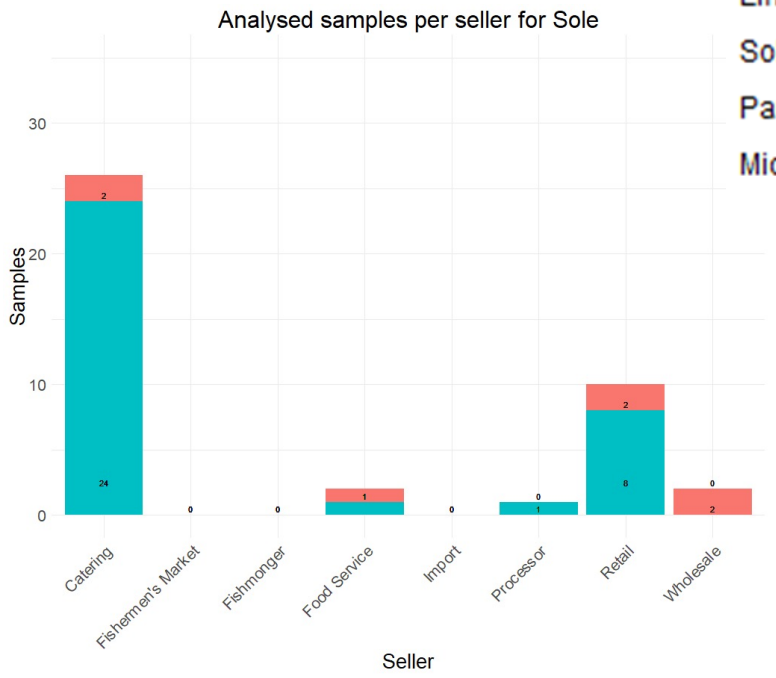
Limanda aspera

Solea senegalensis

Pangasianodon hypophthalmus

Microstomus kitt





Deconinck et al. 2020, Food and Chemical Toxicology 141

ILVO Institute for Agricultural and Fisheries Research

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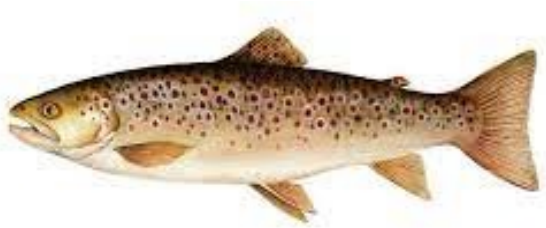
2/ Fast screening tool for salmon

ATLANTIC SALMONS
3 % substitution rate

Salmo salar

90% of the farmed salmon
50% of the global salmon market



Salmo trutta (brown trout)

PACIFIC SALMONS
17 % substitution rate

farmed

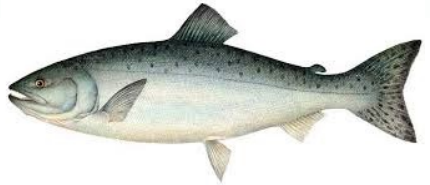
Oncorhynchus mykiss (rainbow trout)

wild caught

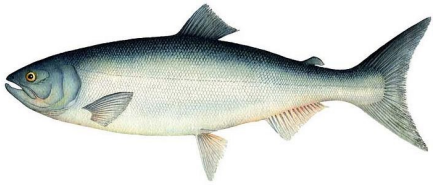
O. tshawytscha (chinook)

O. keta (chum)

O. kisutch (coho)



O. gorbuscha (pink)



O. nerka (sokeye)

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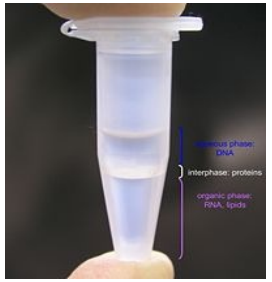
2/ Fast screening tool for salmon

iceta
Instituto de Ciências, Tecnologias e Agroambiente da Universidade do Porto

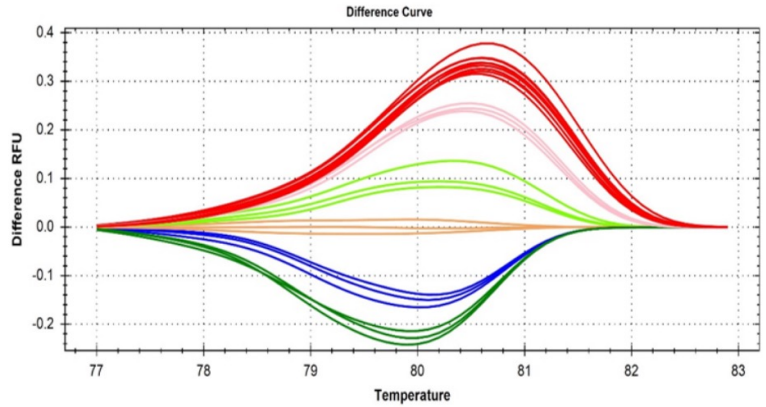
High Resolution Melting Analysis (HRMA) => TRL 7

Unidentified product

DNA extraction



qPCR



Advantages:

- Results within 4 hours
- 24 to 48 samples can be analysed simultaneously
- Food processing does not affect results, except for canning
- All 8 salmonids can be identified with the same kit (in contrast to other commercial kits)

Biorex food diagnostics

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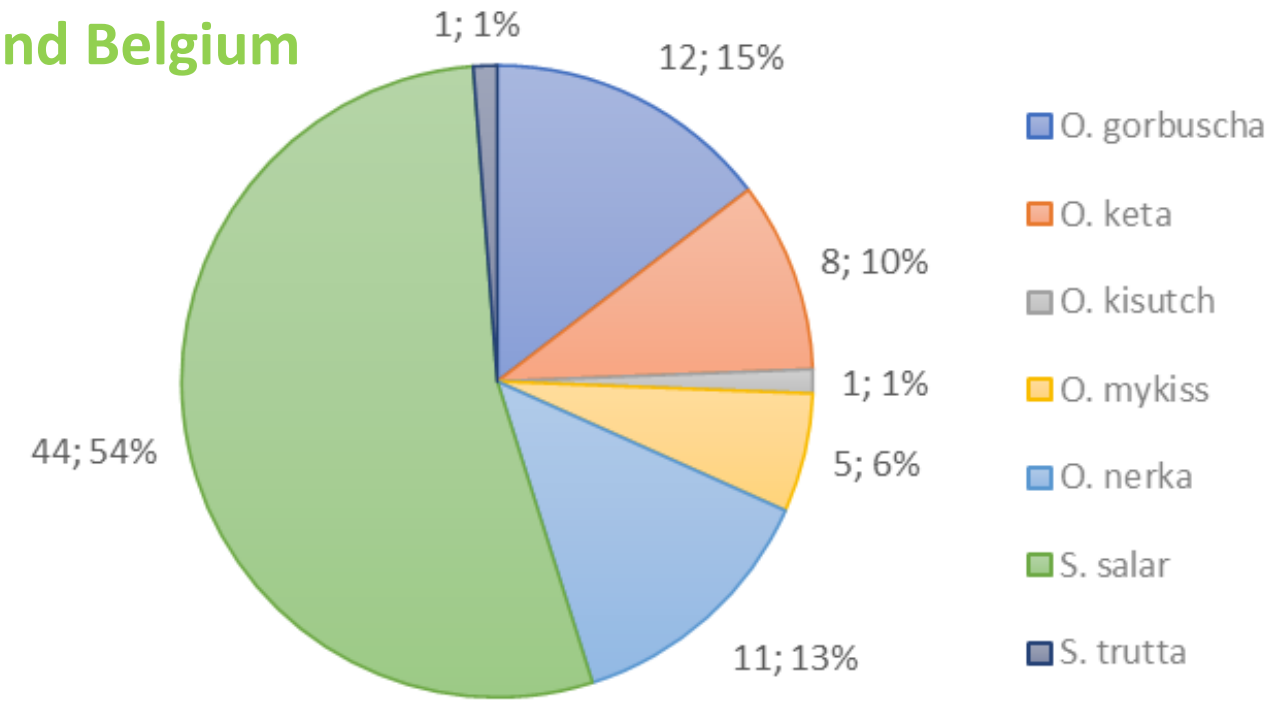
2/ Fast screening tool for salmon

High Resolution Melting Analysis (HRMA) => TRL 7

Market application: authentication of salmon in retail samples from Portugal, Poland and Belgium

- 81 samples tested
- 12 samples with no results (all were canned)
- 1 substitution of *O. nerka* by *S. salar* (1.2 %)



Monteiro et al, in preparation

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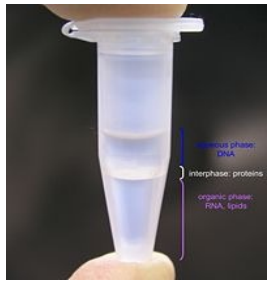
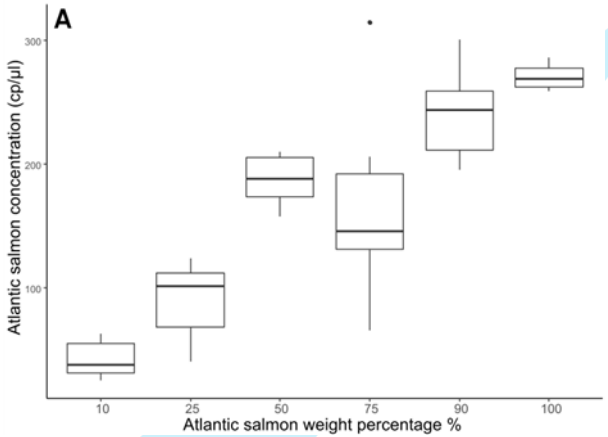
3/ Quantification of *Salmo salar* in mixed seafood

Mixed and processed food product

DNA extraction



ddPCR assay



- Allows to semi-quantify the amount of *S. salar* in a food product
- Can also be used to identify *S. salar* in mixed food products (including other salmonids)
- 42 samples can be analysed simultaneously, within 5 hours

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3/ Quantification of *Salmo salar* in mixed seafood

Market application: authentication of salmon in retail samples from Belgium and Poland

- 46 samples tested
- 3 samples with no results (all were canned)
- Many retail samples were poorly labelled (no scientific name, wrong common name, general name)
- No evidence of substitution (0 %):
  - All *S. salar* food products were correctly identified
  - No *S. salar* detected in food products labelled as pacific salmon
- Quantification in fully homogenised samples semi-quantitative

Deconinck et al., submitted, Food and Chemical Toxicology

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Conclusion

- Can we reliably identify single species food products?

  => yes, without need of prior knowledge of the species in the product

- Can we quickly identify salmon samples?

  => yes, within 4 hours

- Can we reliably identify and quantify *S. salar* in mixed food products?

  => identification: yes, within 5 hours

  => quantification: only semi-quantitative

- Market studies confirm that substitution occurs, with large differences between species (1 – 17%)

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Thank You

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