

Genetics in support of fisheries and aquaculture management

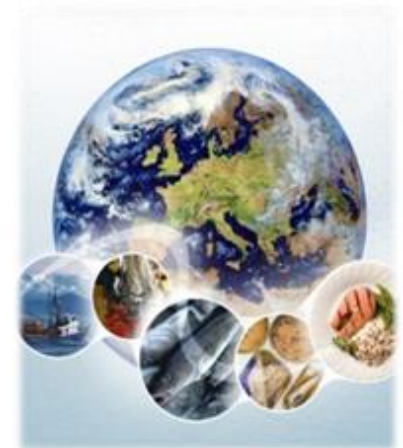
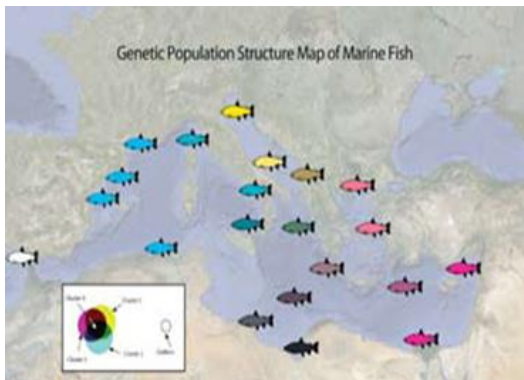
17-19 September

Faro, Portugal



Traceability of fish and fish products

Advances and Significance



Threats to wild fish



Pollution Spill, South Florida



Over-exploitation



Habitat destruction - bottom trawler



Climate change- melting sea ice

**Other less recognized threats,
including.....**

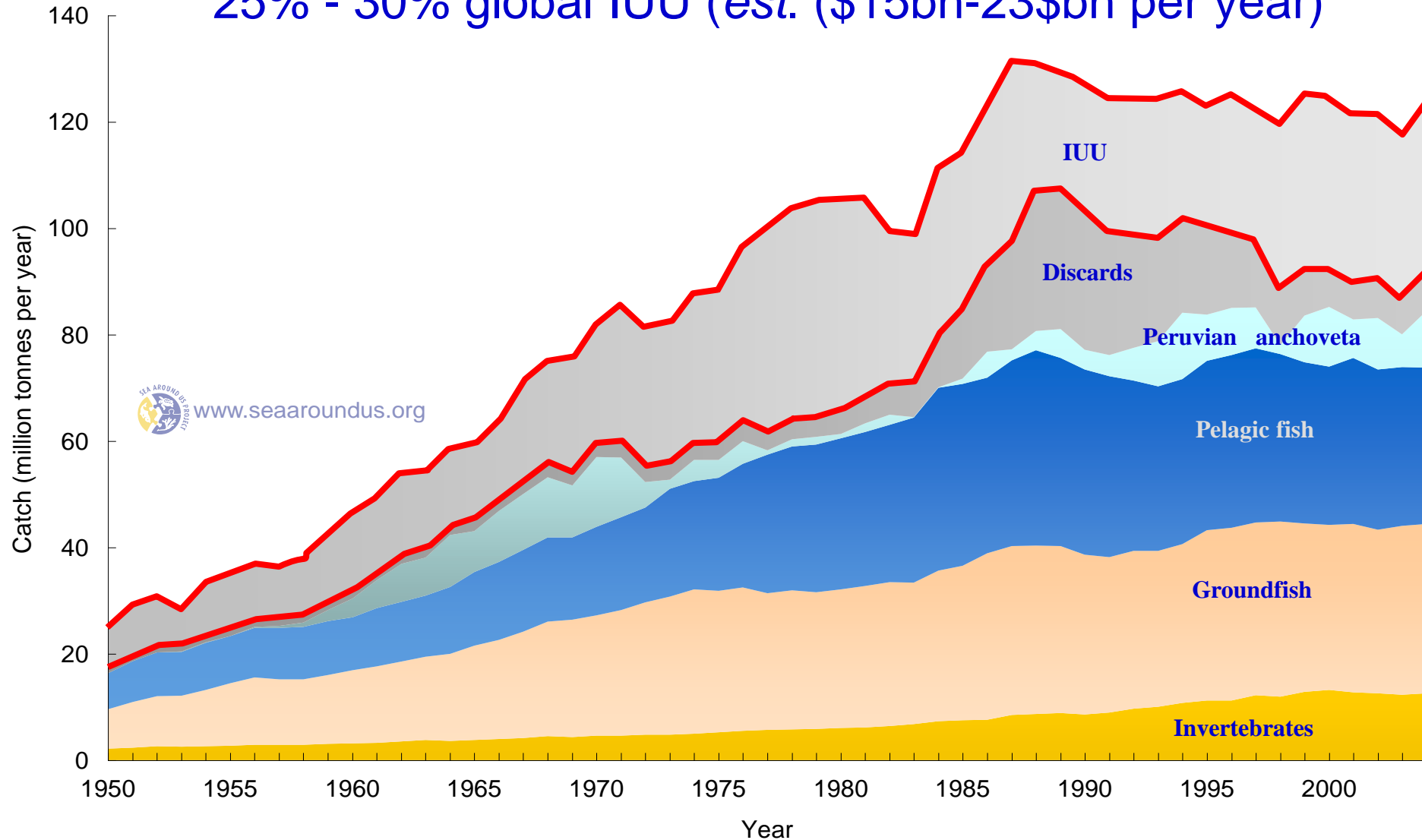


The impact of Illegal, Unregulated and Unreported Fishing (IUU)

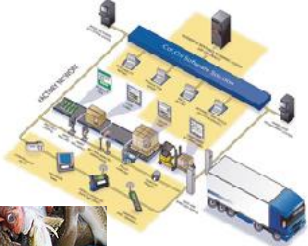
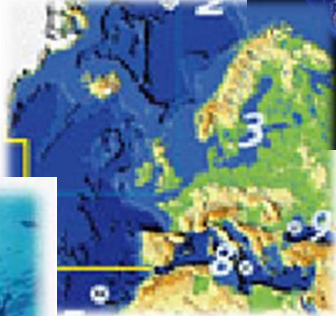


Global Impact of IUU

we don't know the catches of global fisheries... estimates of 25% - 30% global IUU (est. \$15bn-23\$bn per year)



We need a robust and enforceable traceability system from ocean to fork



Where from? What??



ONLY €2.50 each

**Pangasius
Filletts
190g**

(Caught at Sea; N.E. Atlantic)

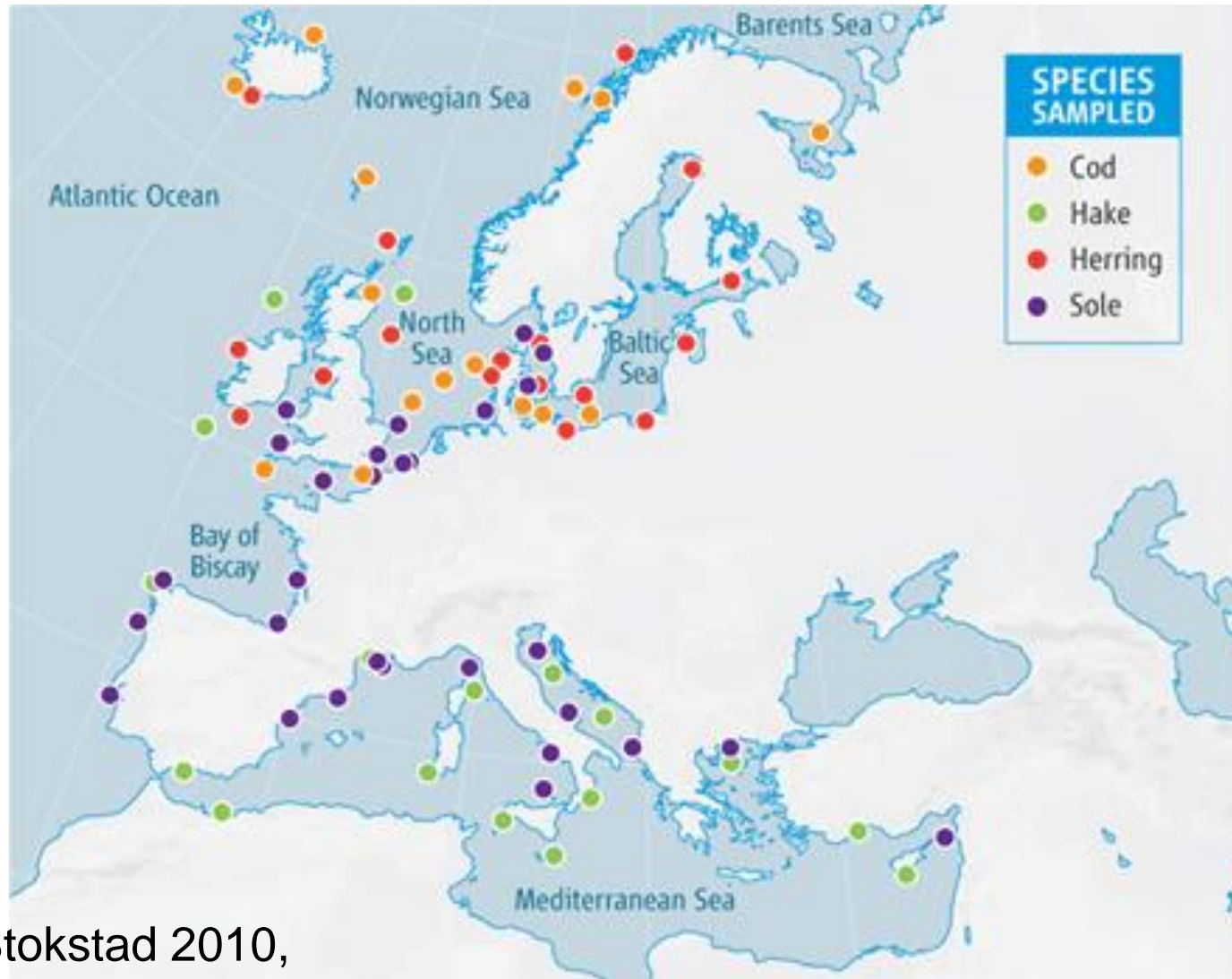
SF Issued 16/02/11

A case study – FishPopTrace



First to develop forensically-validated genetic tools for wide-scale marine fish populations

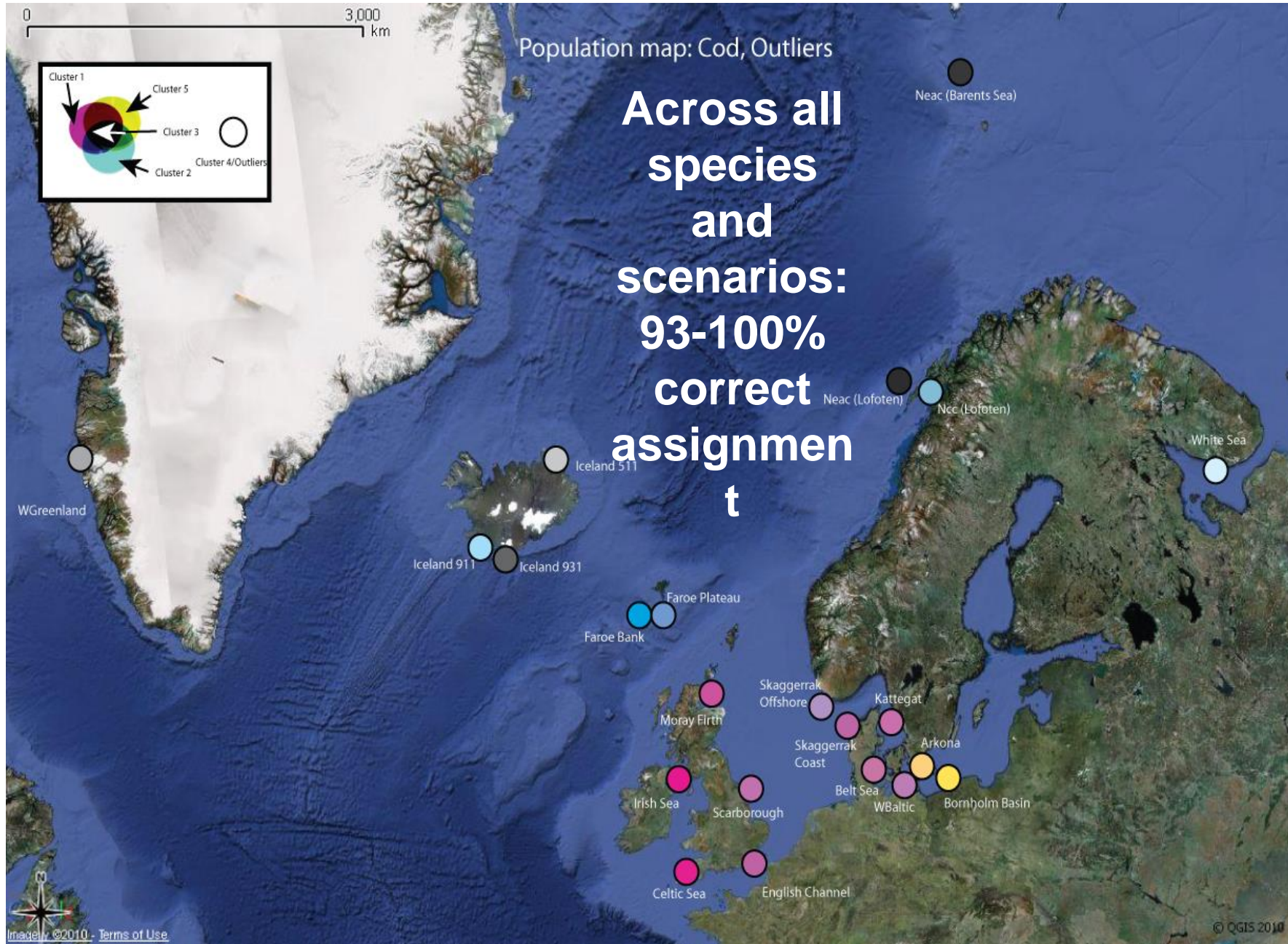
Population assignment of individuals to spawning populations



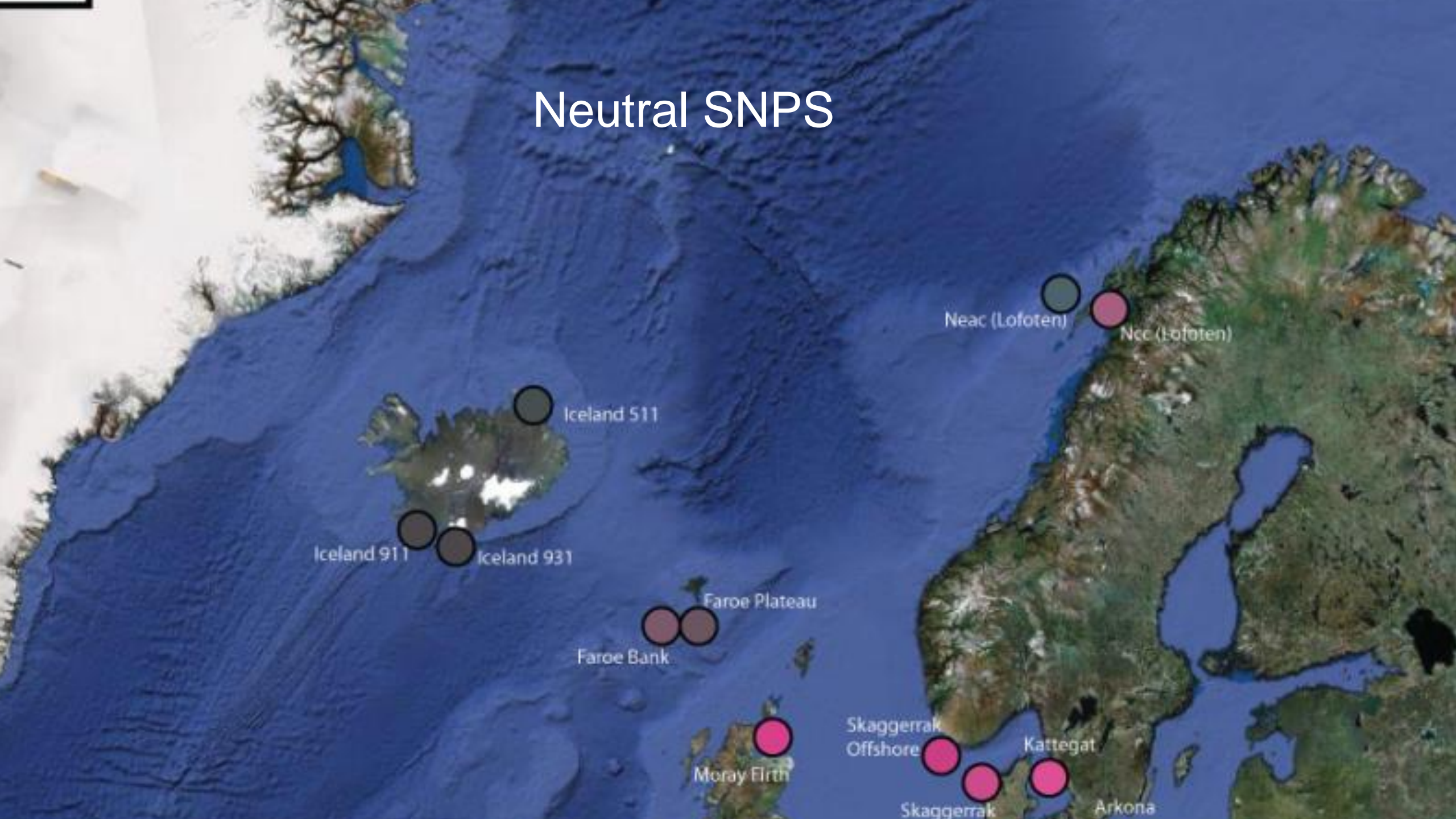
After Stokstad 2010,
Science, 330: 1468-
1469

Large SNP data
base across
species range



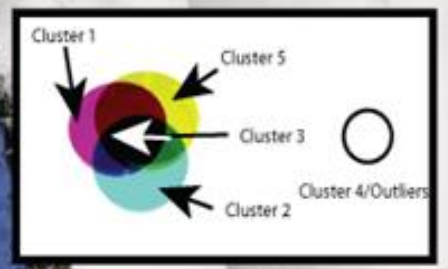


Neutral SNPS

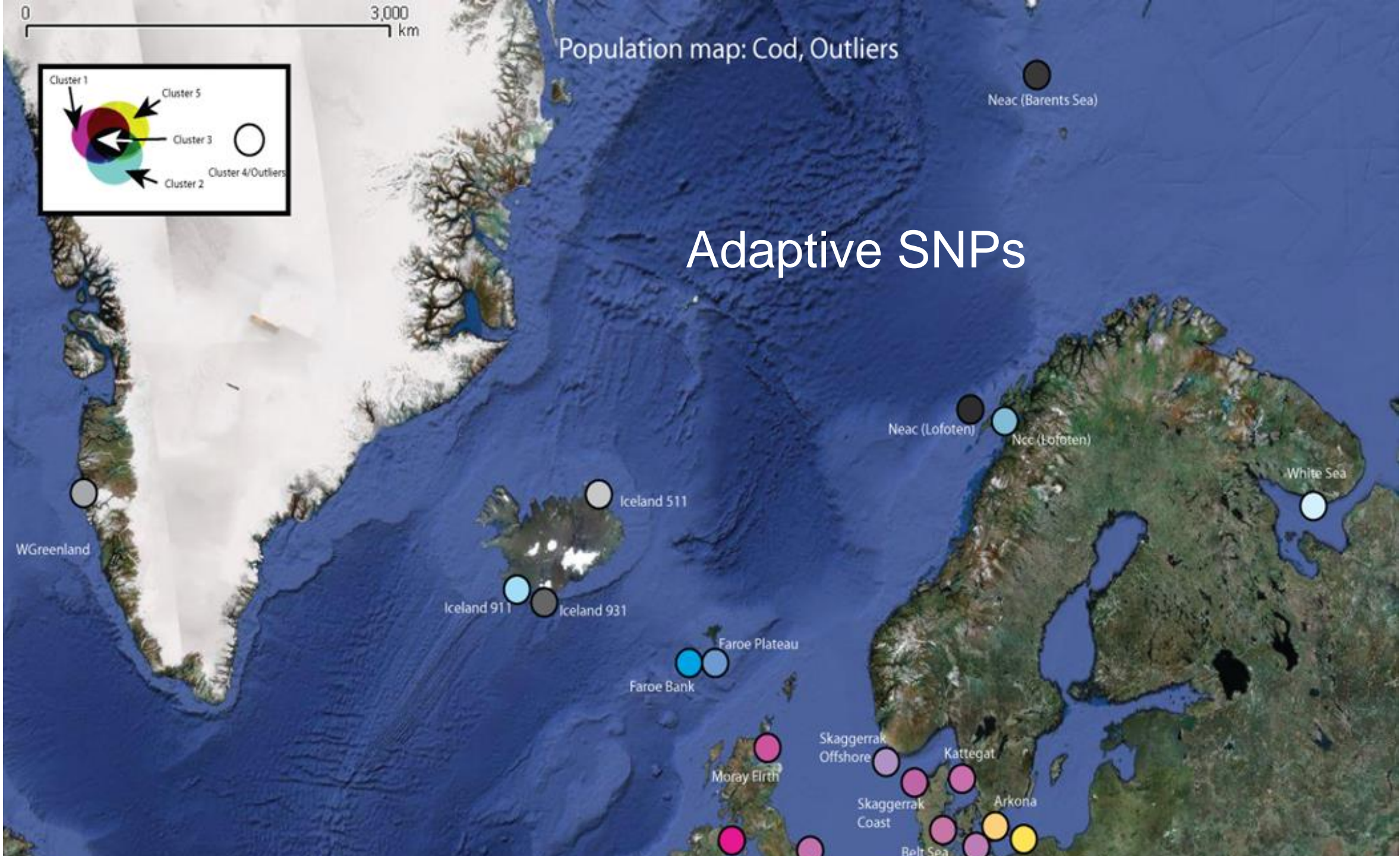


0 3,000 km

Population map: Cod, Outliers



Adaptive SNPs

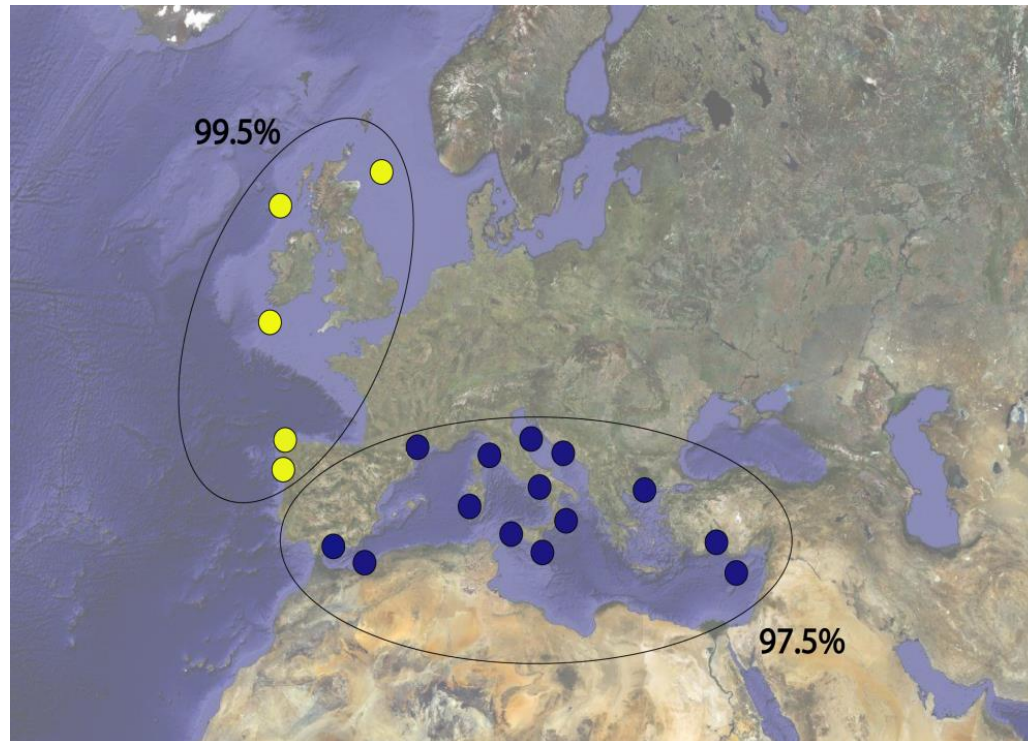
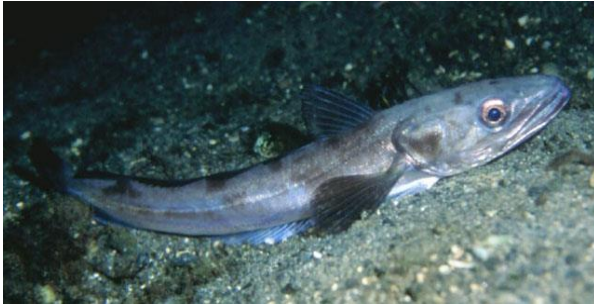


Real- life policy-led scenarios provided by the European Commission

(Nielsen et al., 2012)



Scenario 1: Origin of hake?



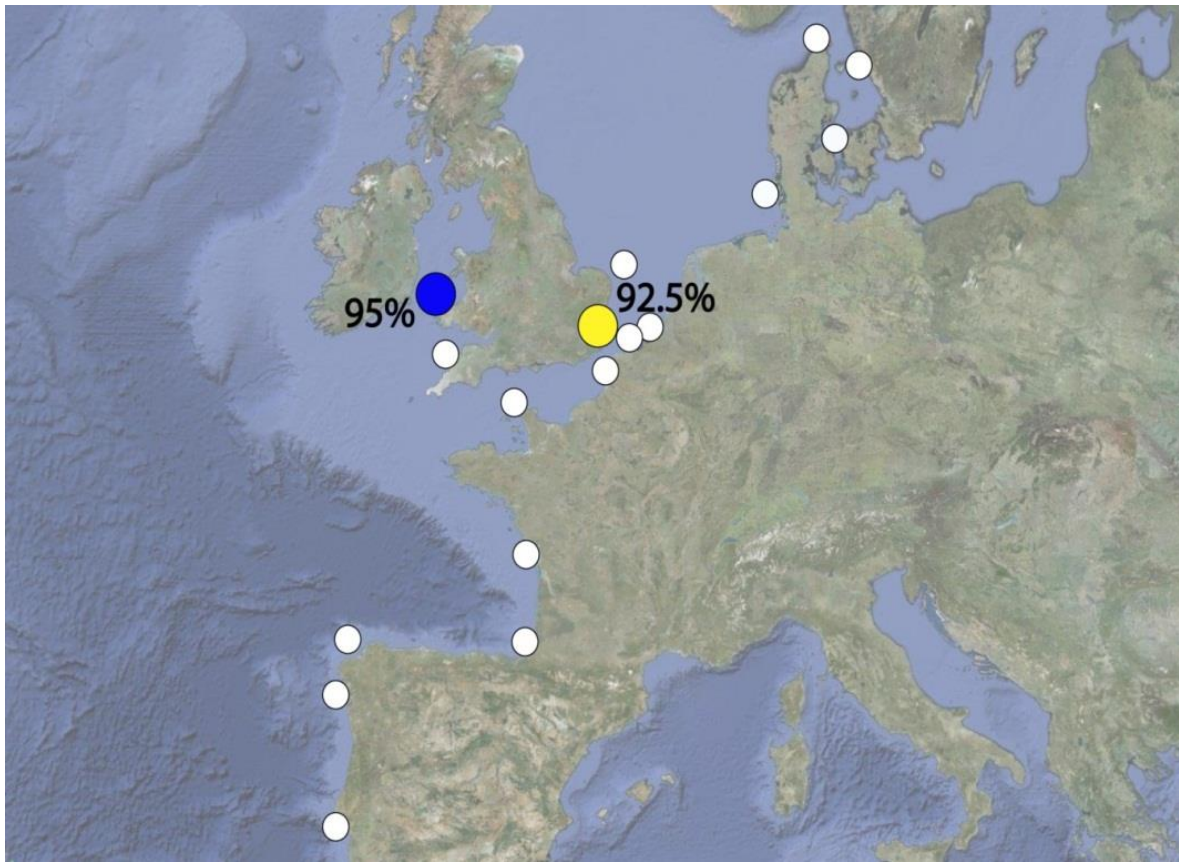
Fishing regulations
(legal size limits):

Atlantic = 20 cm

Mediterranean = 27 cm

SNP panel: 13 markers

Scenario 2: Origin of sole?



Northeast Atlantic: high mortalities → stock rebuilding

Belgian ports: Irish Sea (open) or *en route* (closed)?

SNP panel: 25 markers

Fisheries forensics - an interview with Dr Rob Ogden, TRACE wildlife forensics network



1. What is fisheries forensics?

Fisheries forensics is the use of scientific analysis to support investigations into illegal fishing and fish fraud. It usually involves the identification of fish species, or their place of origin.

2. Why do we need to have tools that comply with forensic standards?

Any scientific method that is used to provide evidence must have been tested to demonstrate that it produces accurate, reliable results, under a range of different conditions. Ultimately, people may go to prison based on the forensic evidence submitted, therefore just like human forensics, it is absolutely essentially that the results are correct.

3. Isn't forensic testing just too expensive to use on fish?

Forensic testing does cost money, but there are ways to limit costs and it can actually save money too. Using the tests to simply monitor a fishery, rather than to provide forensic evidence, generates the same type of data for a fraction of the cost, allowing investigators to identify a problem before investing in forensic analysis. In cases where forensic evidence is produced, defendants often plead guilty, massively reducing the legal costs of running a full trial.

4. Does anyone use fisheries forensics already?

There are a number of laboratories around the world where forensic techniques are being developed. In The USA and Australia, government authorities already use forensic species identification and routinely prosecute people suspected of illegal fishing. However, FishPopTrace is the first major project that has produced tests to identify the geographic origin of marine fish for fisheries enforcement.

5. How does fish forensics differ from human forensics?

Human forensics usually focuses on the identification of individual people, or linking people to trace evidence and crime scenes. In fisheries forensics, although the lab techniques are often similar, the issues are generally much broader and involve many different species. This presents challenges for forensic scientists who have limited resources to address the many different questions asked by enforcement agencies.

6. Is fisheries forensics the answer to IUU fishing?

Hopefully it will be one of the answers. Forensic sample analysis can provide extremely powerful evidence, but it is rarely used in isolation. Investigators need intelligence data to help identify potential issues, which is where trade monitoring can help, and there are many other technologies, such as vessel monitoring systems and digital forensics that support the detection and prosecution of illegal fishing. At the end of the day, enforcing compliance will always remain a last resort; deterring IUU fishing and encouraging compliance must be the way forward. The good thing about FishPopTrace is that many of the techniques can be also be used to demonstrate authenticity, promoting responsible fishing and supporting effective fisheries management.

Fisheries Forensics P.17 FishPopTrace Stakeholder Pamphlet

Validation Study

Repeatability

- Identical plates run on different platforms x 3

Robustness/Stability

- Variation of thermocycling temperatures outside of specification
- Variation of cycle number
- Degraded samples (old/ cooked)

Reproducibility

- Inter-laboratory study

Sensitivity

- Limit of detection of template [DNA]

Specificity

- Test results using con-generics & other relevant fisheries species

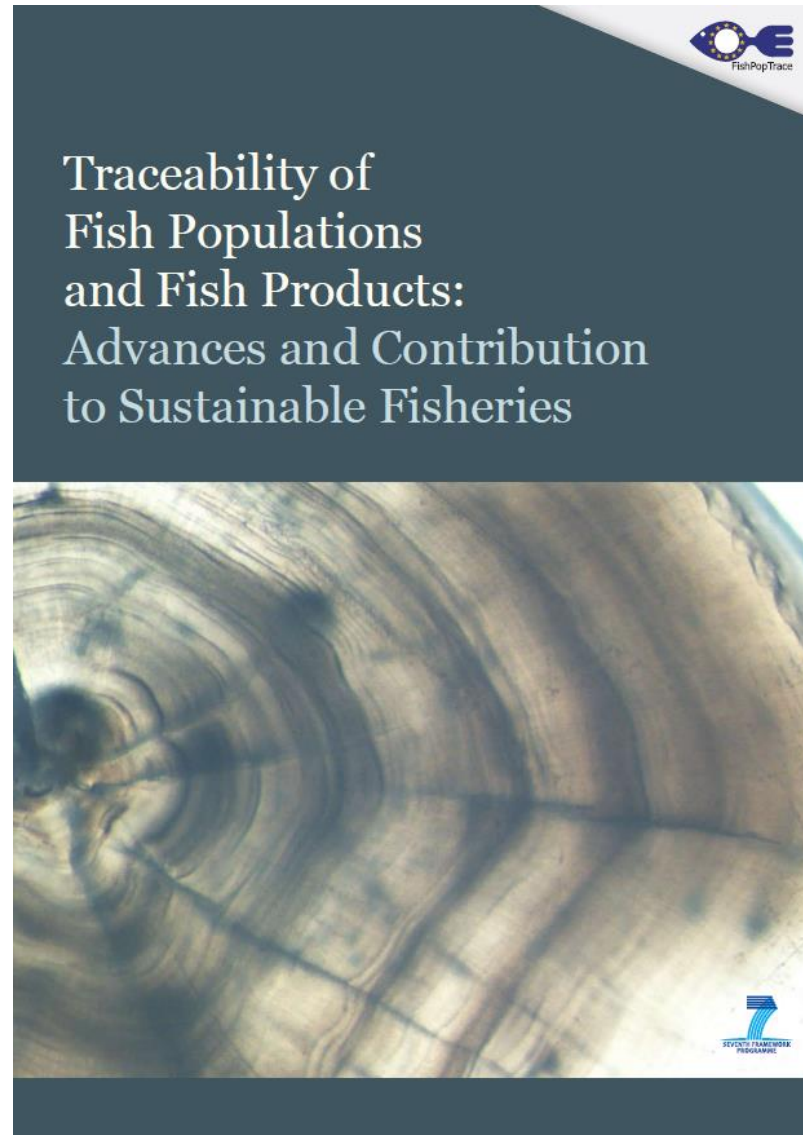
Selectivity

- Different tissue types yield same result (fin, skin and tissue)

Data

- ddRAD vs KASP genotypes

Stakeholder pamphlet available now...



FishPopTrace
website and pdf on
course resource
site:

(<https://fishpoptrace.jrc.ec.europa.eu/>)

Some recent Population Traceability Research (DNA tools)

- Transfer of FishPopTrace research to application
 - European cod, hering, hake, sole
 - Department for Food, Environment and Rural Affairs (DEFRA, UK)
- Skipjack and yellowfin tuna (Australia)
- AQUATRACE – aquaculture product traceability
- Marine Stewardship Council (MSC) DNA authentication programme + MANY OTHERS!!