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Joint Research Centre

The European Commission's in-house science service

European Commission
Joint Research Centre (JRC)
Maritime Affairs
January 2014

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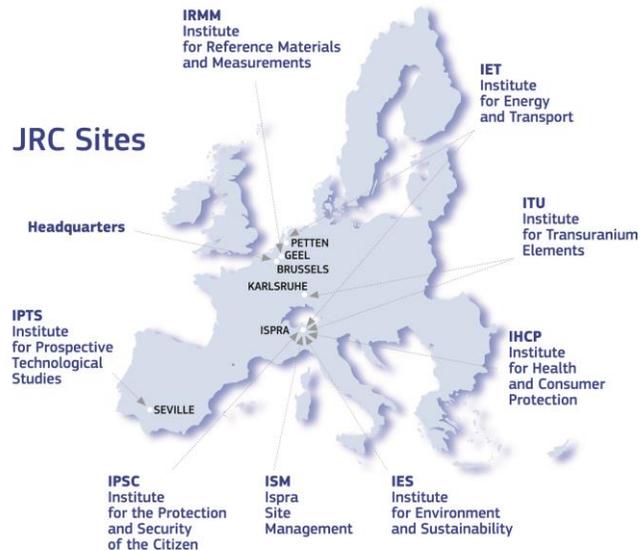
A JRC Reference report on the use of genetic approaches to fight Illegal, Unregulated and Unreported (IUU) fishing is freely downloadable from the EU Bookshop.

<http://bookshop.europa.eu/en/detering-illegal-activities-in-the-fisheries-sector-pbLBN24394>

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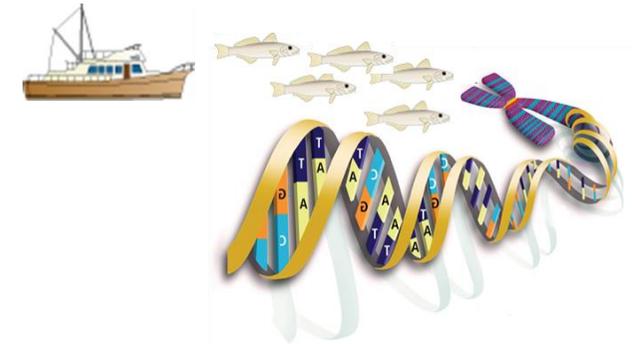
JRC Sites



As the Commission's in-house science service, the Joint Research Centre's mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle.

Working in close cooperation with policy Directorates-General, the JRC addresses key societal challenges while stimulating innovation through developing new methods, tools and standards, and sharing its know-how with the Member States, the scientific community and international partners.

Enhancing Fisheries and Aquaculture (F&A) Management and Governance through Genetics and Genomics



Activities of the European Commission's
Joint Research Centre

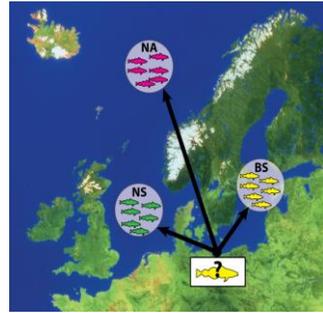
Fisheries and Aquaculture : food and income since millennia

Fisheries and aquaculture (F&A) are deeply embedded in human culture and ensure the provision of food and livelihood since millennia.

F&A create employment, secure food supply and contribute to economic growth. Today F&A products belong to the most traded food commodities worldwide and for many countries and coastal regions marine F&A activity is economically vital.

On the other hand F&A pose environmental and societal challenges, such as overexploitation of wild fish stocks, further exacerbated by illegal (IUU) fishing, and negative impacts on ecosystems by aquaculture activity. Thus the important potential of F&A remains constrained by an array of impediments.

This is also true for the European Union (EU), where Member States manage their F&A jointly under the Common Fisheries Policy (CFP). Additionally, international responsibilities result from the EU fishing fleet fishing in international waters and from the EU being a major importer of fish products.



Origin assignment of fish: Using genetic analysis, individual fish of unknown origin can be assigned to the stock or population they belong to. In this scenario there are three baseline populations from the North Atlantic (NA), North Sea (NS) and Baltic Sea (BS). The fish in question will be assigned to BS (after Martinsohn et al. 2011).

Genetics: not yet routinely integrated into F&A management

Despite examples, proving the great added value that genetics and genomics can provide to sustainable and profitable fisheries and aquaculture, its systematic, coherent, global and EU-wide (under the CFP remit) integration into fisheries management schemes is still lacking.



Stock structure analysis: Genetic Stock Identification (GSI) enables the identification of biologically relevant management units, their extent and geographical location and to reveal matches as well as mismatches with existing management units. In the above idealized scenarios two genetically distinct stocks are located in different management units (left), overlapping across the border of two management units (mixed stock – middle), or one stock is occurring in two management units. Such findings can help to guide fisheries management strategies and decisions.

F&A genetics at the JRC: from academic research to management applications

The JRC aims to foster improved sustainable and profitable F&A management through the integration of genetic and genomic approaches. The JRC attempts to enable and foster technology transfer through :

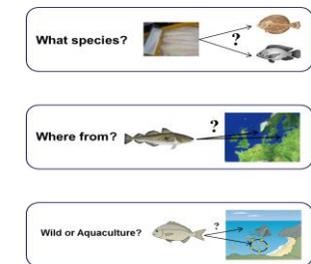
- communication of research to policy makers, authorities and other stakeholders;
- international and interdisciplinary collaborations¹;
- development of web-based GIS tools to facilitate scientific analysis and to better communicate research findings;
- engagement with priorities of the EU CFP;
- evaluation of costs and benefits and risk assessment;
- inclusion of end-users and stakeholder needs.

¹ <https://fishpoptrace.jrc.ec.europa.eu> and <https://aquatrace.eu>

Genetics: an added value to F&A management

The application of genetics and genomics can provide valuable information pertinent to F&A management:

- *Species identification/verification* even on processed products (fillets, canned etc.);
- *Genetic Stock Identification* of biologically relevant management units, their extent and geographical location;
- *Mixed stock analysis* to assess the proportions of different stocks contributing to the same exploited aggregation;
- *Abundance estimation* and other population parameters through genetic tagging and the determination of genetic diversity;
- *Ecosystem monitoring* through the assessment of biodiversity and evolutionary change;
- *Stock enhancement* by using genetics to optimize restocking strategies;
- *Aquaculture* by using genetics to support breeding strategies;
- *Aquaculture risk containment* through identification and origin determination of farm escapees;
- *Traceability* through the determination of species and provenance ('genetic origin assignment') of fish and fish products, an invaluable asset for fisheries control as well as traceability along the supply chain.



Genetic analysis can help to answer three pertinent questions relevant to F&A management:

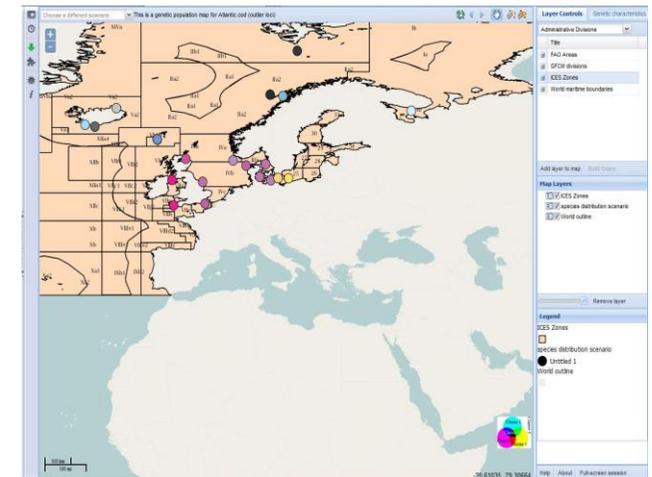
- *What species is it (even on processed and mixed products)?*
- *Where does the fish (product) come from?*
- *Is it wild or farmed?*

Enhancing F&A Management and Governance through Genetics and Genomics – JRC activities at a glimpse

The JRC provides scientific advice to help overcoming the challenges impeding sustainable and profitable fisheries. Among a broad scope of activities, such as fisheries modeling, socio-economic analysis, stock assessment, habitat mapping, the improvement of fisheries data collection, the JRC also focuses on the integration of genetic and genomic approaches into modern fisheries management frameworks.

Due to a boost in research and technology development, in recent years DNA analysis has become much more powerful and cost effective. The analysis of DNA can be highly beneficial for the support of F&A relevant aspects.

Pertinent examples are species identification through DNA analysis, which is routinely possible - even on processed products - and powerfully supports traceability and fisheries control, as well as Genetic Stock Identification (GSI). GSI can help to see whether and to what extent there is a match between established management units designed to exploit a (or several) fish species in a given region and (genetic) population units. GSI can also help determining the geographical origin of fish.



Snapshot of JRC web-based fishery genetics geobrowser. This GIS tool allows scientists, stakeholders and the general public to explore the genetic “make up” and relation between fish populations across EU waters and to relate this genetic structure to management units as well as environmental parameters. The example displayed uses a colour code to display the degree of genetic relatedness of sampled cod across the North Sea and North Atlantic (coloured dots) in the context of ICES fisheries management units.

https://fishpoptrace.jrc.ec.europa.eu/map/genetics_geobrowser/