Sub(3)

Foyle, Carlingford & Irish Lights Commission

Comisiun an Fheabhail, Chairlinn agus Shoilse na hEireann

Foyle, Carlinford, an Airish Lichts Commission

215-1

Waste Licencing Unit
Environmental Protection Agency
EPA Headquarters
PO Box 3000
Johnstown Castle Estate
Co. Wexford

Environmental Protection Agency
26 SEP 2005
P. Hermanson

13th September 2005

Dear Sir,

With regard to the licence application for a landfill at Meenaboll in Co. Donegal the Loughs Agency have serious reservations regarding the choice of site and would wish to voice our objection to the issuing of any licence by the EPA.

The proposed landfill is in the headwaters of the River Finn catchment on a tributary of the Cummirk River and as such has been afforded *Special Area of Conservation* status for Atlantic salmon under the EU Habitats Directive. As shown by a recent extensive genetic study (please find enclosed) the salmon in the River Finn are unique, with each tributary such as the Cummirk, having a separate identifiable population. The Agency, while recognising the precautions and proposed monitoring programmes to be put in place to minimise the escape of leachate by the council, nevertheless feel that this landfill poses a significant threat to the salmon population of the Cummirk and the River Finn. This river holds not only substantial stocks of 1 sea-winter salmon but also significanly is an internationally important river with regard to multi-sea-winter spring salmon. As widely documented these particular stocks are in global decline and the Finn is one of the few rivers internationally in which this trend does not appear to be occurring at present. There are therefore national and international obligations to ensure that these stocks are afforded the best possible protection to ensure their continued survival.

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In addition, the recent genetic work highlights the importance of the 1 sea-winter Finn stocks to the downstream commercial fisheries, the Foyle System is one of the most productive and stable fisheries internationally. The River Finn also provides a valuable rod fishery which attracts anglers from all over the world and thus provides income to a disadvantaged rural area.

I would be grateful if you would give this due consideration and if you require additional information or have any queries please do not hesitate to contact me.

Yours sincerely

Dr. Patrick Boylan
Biologist

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Genetic analysis of the Atlantic salmon populations and fisheries of the Foyle system

The Loughs Agency has recently been carrying out a comprehensive genetic analysis of the wild salmon populations and fisheries in the Foyle area…..

'Whygenetic information?

Knowledge of genetic population structure is essential for proper management of wild populations (sustainable production depends on maintenance of genetic diversity).

Genetic knowledge helps us to assess the implications of a number of management activities including: enhancement stocking; movement and transfers of fish within and between catchments, and impact of mixed stock fisheries.

This knowledge becomes more important when populations are under pressure from habitat loss, pollution and reduced marine survival.

What were the objectives of this study?

•To provide a comprehensive analysis of the genetic population structure and diversity of wild salmon in the Foyle system.

•To carry out analysis of the genetic composition of the mixed stock fishery.

How do we study genetic variation?

In Atlantic salmon, many generations of accurate homing to natal streams promotes genetic divergence and leads to separate populations becoming established:

- **Analysis of DNA will reveal genetic variation within and among populations.**

What is DNA analysis?

Long sections of DNA, in the form of "genes", code for the multitude of traits that a salmon (or any other organism) possesses., e.g. the age at which the fish matures and the time of year it enters the river.

As the "blue print of life", DNA provides a direct record of genetic status and can be examined using modern laboratory analytical methods.

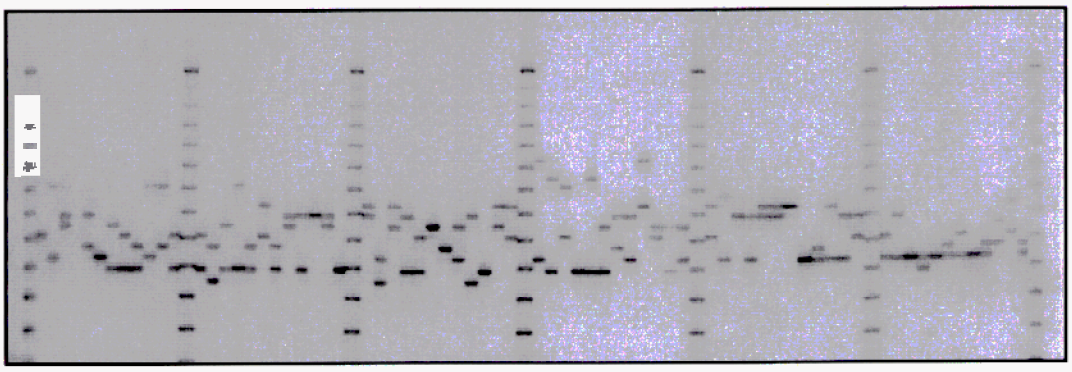
Although a salmon may have around 80,000 genes, we only need to sample a small number (say 5-10) genes to obtain information on the genetic makeup of each fish that can be used in population analysis.

DNA analysis only requires minute amounts of tissue, hence sampling can be carried out harmlessly, even on small fish.

A juvenile salmon from the R. Finn about to be sampled for DNA.

A small clip of tissue will be taken from the fleshy adipose fin in front of the tail and the fish released back unharmed to the river.

What does this genetic variation look like?



This photograph shows the results of examining DNA in a sample of around 60 fish, with each "lane" from top to bottom revealing the genetic status or "genotype" of an individual fish. Each fish has two "bands" of DNA, one inherited from each parent. Some fish share the same genotype, while others differ, depending on the genotypes of their respective parents. The frequency of occurrence of these genotypes across the sample of fish gives a characteristic "genetic profile" for the population. Note that the "ladders" in the photograph are there to provide standard points of reference when comparing DNA bands from fish right across the sample.

The results:

Genetic diversity:

Samples show genetic diversity in Foyle salmon comparable to other wild salmon populations examined in Ireland, Europe and N. America:

There has been no significant loss of genetic variation in the past and population sizes appear to be large enough to prevent loss of genetic variability through inbreeding.

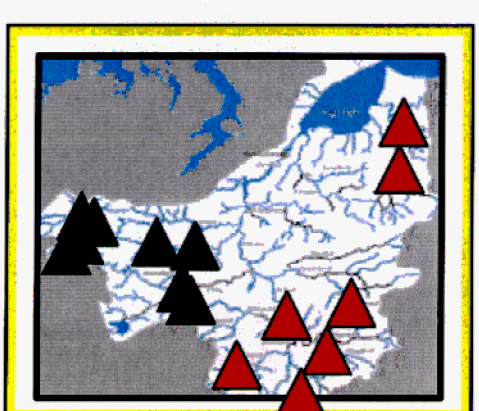
We conclude that the Foyle salmon have a healthy gene pool.

Population structure:

Statistically significant differences were found in allele frequencies (measures of genetic variation) among samples between river systems and within some river systems. Thus, genetically differentiated populations exist within the Foyle system.

Further analysis indicated **more than a dozen** defined genetic groups (**populations**), **which correspond** quite well **to** the main rivers and tributaries **within** the **Foyle catchment.**

Repeated sampling of some chosen locations over a period of time indicated that this population structure appears to be stable.

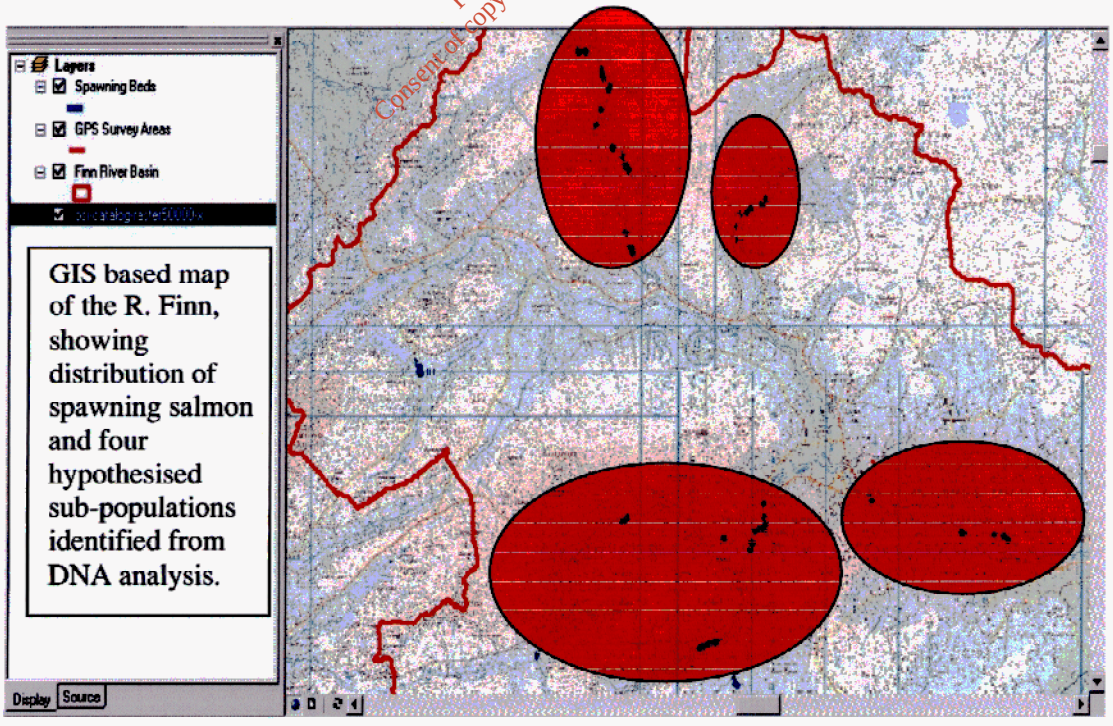


Results of genetic analysis of wild salmon from Foyle rivers and tributaries. Separate triangles represent genetically differentiated populations, which appear to group together into two higher-level related groups (or metapopulations), represented here by red and green colours.

Further work was done at a much finer scale in the R. Finn, where juvenile salmon samples from throughout the river were genetically profiled and results interpreted in the context of information on habitat type and distribution. In addition, spawning salmon were genetically sampled to complete the picture.

The results were fascinating, indicating that:

- **There are families of spawners, which distribute themselves throughout the river, in relation to availability of suitable spawning habitat.**
- **Groups of families form local sub-populations, at a level determined by the patchy distribution of suitable habitat.**
- **The basic level of genetic population structure (and perhaps the basic unit of production) appears to lie at around 5-20km;**
- **In the R. Finn example, there appear to be at least 4 sub-populations (see map below).**



GIS based map of the R. Finn, showing distribution of spawning salmon and four hypothesised sub-populations identified from DNA analysis.

What are the management implications of these results:

Conservation of the genetic diversity and genetic population structure of Foyle salmon should be a priority for managers.
•Maintaining higher-level (metapopulation) structure is an important part of this, as this level of structure is of evolutionary importance.
•However, sub-populations (for example within larger rivers) should also be a focus of conservation, especially where they produce fish with important characteristics (such as Reelan spring salmon).
•Managing the habitat in the Foyle is a central part of this conservation strategy, as population structure is closely linked to and dependent upon habitat quality and diversity.

What does this mean for stocking?

Because of the need to maintain the genetic population structure as outline above, stocking (supportive breeding) should only be carried out in areas that are in danger of extinction and where other management actions have been shown to be insufficient to protect the population; in effect, stocking should be a measure of last choice*.

Because of the potential for stocking to cause genetic change, some precautionary guidelines can be given as follows:
-Never stock using salmon from outside the Foyle.
-Fish from a Foyle river should only be used for stocking in that same river system.
-Within larger rivers, transfer between tributaries should be avoided if possible.
-As a working guideline, do not stock between the dozen or so "populations" tentatively identified in this study.

*Indeed, there was no evidence from this study that past stockings have been successful, for example, R. Roe salmon showed greater genetic similarity to Foyle fish, despite major stocking with R. Bush fish some years ago.

Genetic analysis of the composition of the commercial fishery.

The identification of the origin and composition of the catch is an important element of managing fisheries and especially so where the fishery potentially takes fish from more than one river stock (mixed stock fishery).

Given that the Foyle rivers and tributaries hold populations of salmon that have now been genetically profiled, it raises the question can we use genetic techniques to find out how these populations contribute to the important commercial fisheries that depend on the existence of these salmon?

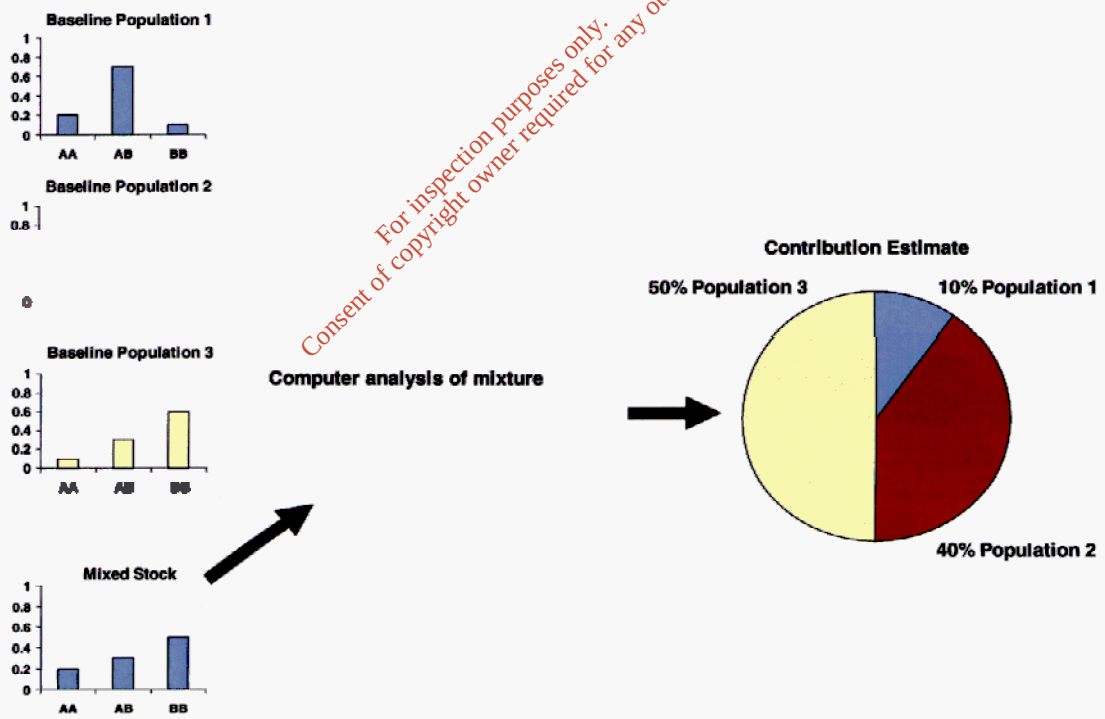
An adult Foyle salmon about to be sampled for DNA. Which river does it come from?

Fortunately, the answer is yes, as a technique called Genetic Stock Identification (GSI for short) uses the very sort of genetic data that we have been collecting during this study.

How does Genetic Stock Identification work?

GSI works on a very simple principle (see diagram Mow). If stocks potentially exploited by the fishery have differing stable genetic characteristics, we can identify the proportions of each stock that is present in the fishery if we sample and decode the genetic mixture that is present in the fishery.

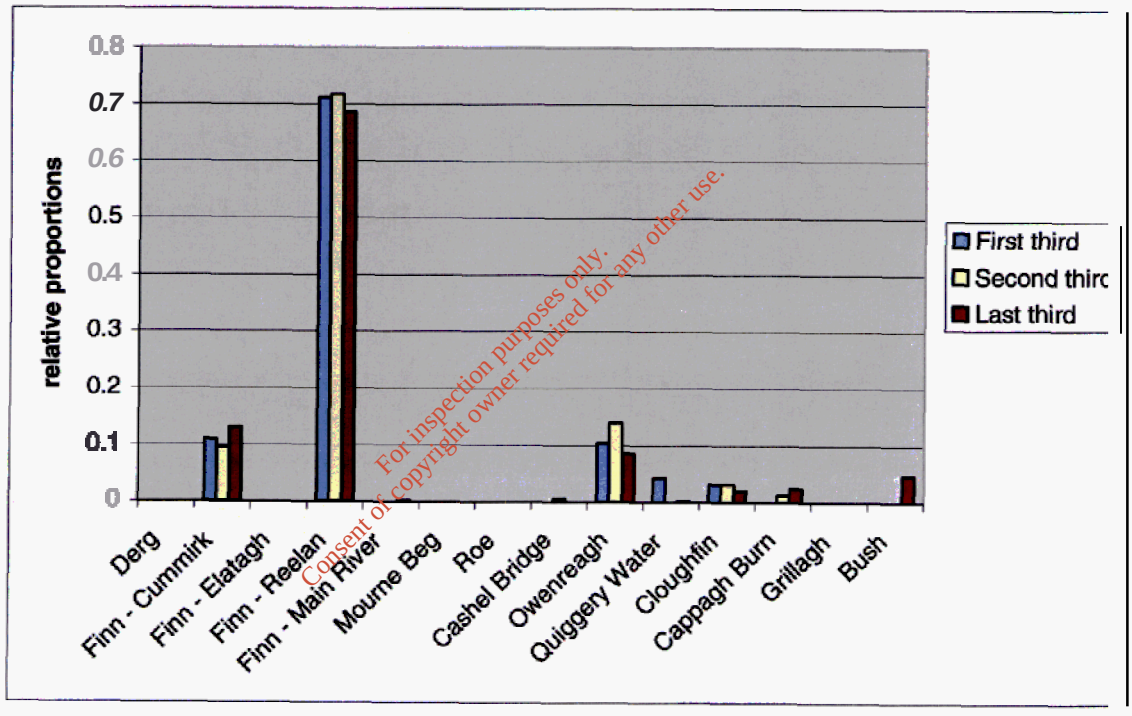
DNA techniques are ideal for this, as we already know the genetic characteristics of the Foyle salmon populations from the work detailed above, so all that remains is to sample the commercial fishery and run the analysis!

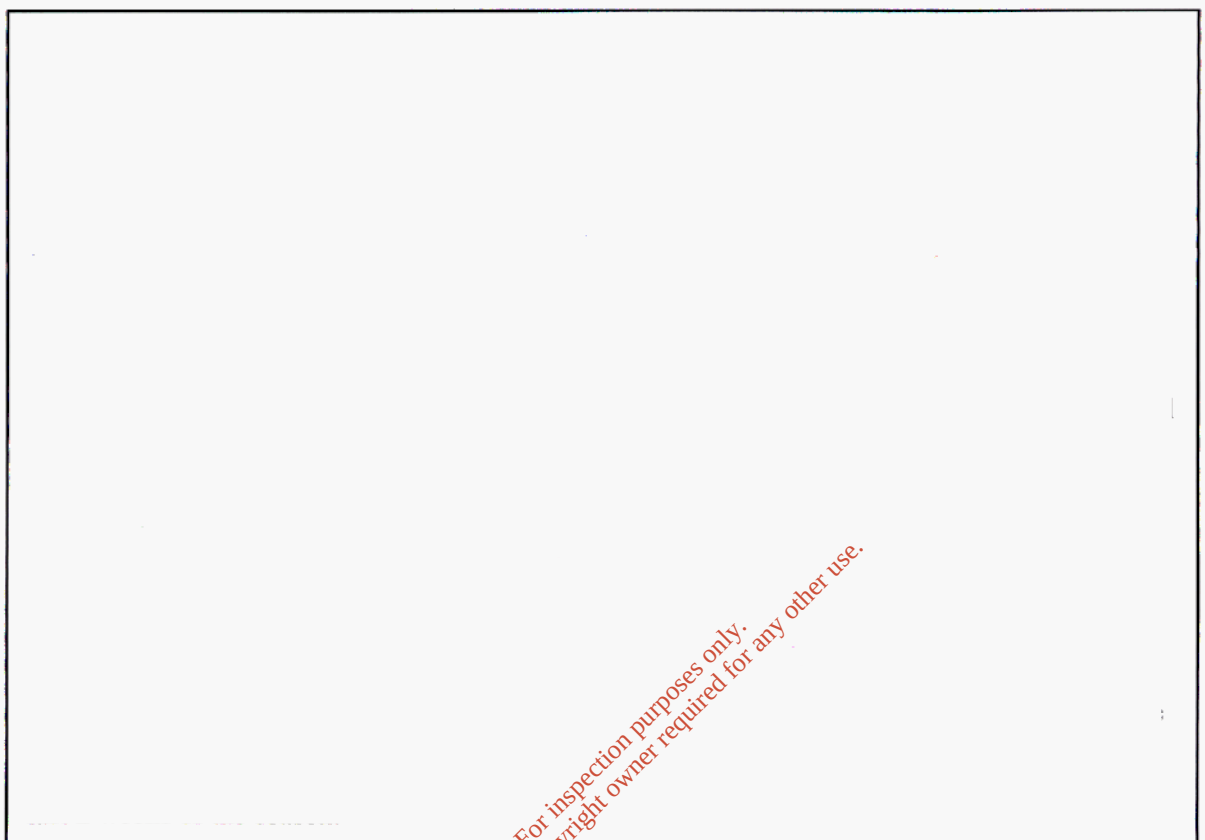


Diagram, showing analysis of a hypothetical mixed stock fishery taking fish from three populations, that have differing genetic characteristics, such as observed here for Foyle salmon. The genetic profiles of the three populations and the fishery sample are shown of the left, while the pie chart on the right shows the results of the GSI analysis. Population 3 is the greatest contributor, accounting for 50% of the catch.

What happens when GSI is carried out on the Foyle commercial fishery?

This technique has been tested in the Foyle commercial fishery over a number of recent seasons. *An* analysis of the 2003 fishery is shown below, as an example of the type *of* results achieved:





Having examined the composition of the fishery over a number of seasons, some general conclusions can be drawn:

- **The Foyle commercial fishery is supported by salmon from a wide range of Foyle rivers and tributaries, however, composition appears to differ between years and also within years as the season progresses, reflecting differences in contributions of various populations. This may be partly due to innate characteristic differences in run timing and also environmentally-induced variation in run pattern (e.g. flow affecting run timing).**

- **Some areas** appear to be **significant drivers** of the **fishery,** and this **is supported** by independent

observations of spawning and juvenile distribution in the freshwater system.

- Other areas appear to be under-contributing in relation to production that might be expected from the size of those rivers, however in the case of at least one river (R. Roe) this may reflect migration outside the period of the fishery rather than low production.

- Salmon from outside the Foyle area are found from the genetic analysis to he present in the landings at Greencastle and this has been verified independently by reference to recoveries of tagged R Bush salmon. In some instances, it is thought that salmon caught outside the Foyle area may be landed at Greencastle, so some fish may not have been caught in the Foyle fishery itself.

How is this fishery information useful to managers?

Genetic analysis of the mixed stock fishery can be used to direct conservation efforts at those stocks that are supporting the fishery, to make sure they retain their productive capacity.
Similarly, this knowledge can direct rebuilding or enhancement programmes at stocks that are apparently under-producing (relative to river size).
The variation in stock composition of the fishery within seasons suggests that the potential exists for managers to direct exploitation in-season away from weaker stocks and towards stronger stocks.
It is emplasised that a time series of these data needs established, before these techniques can be used to direct management decisions.

What benefits has this study provided?

- **A comprehensive genetic baseline from which to monitor future population changes.**
- **Assessment of population structure, indicating where conservation should be directed, in order to conserve natural diversity and achieve sustainability of fisheries.**
- **An analysis of those areas of the Foyle contributing to production and those areas that are under-contributing, thus targeting areas for management action, such as stock enhancement/rebuilding programmes.**
- **Practical advice on stocking policy, tailored specifically to the Foyle salmon populations.**
- **Demonstration of the critical link between habitat and genetic population structure, providing further support for the importance of habitat protection and improvement policies adopted by the Loughs Agency**
- **An essential genetic perspective, complementing the present management regime, keeping the Loughs Agency at the forefront of progressive management techniques.**

For further information, please contact:
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