Project 438

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Interim Report
438/1/W

R&D Project
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Genetic Aspects of Spring Run Salmon

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INTRODUCTION

This interim report lists those persons visited or contacted in Europe (E.R.) or N. America (F.O'F.) since the project started in January '93 (Table 1) and also details those who will be contacted during April (Table 2). It then outlines probable section headings for the final report and lists some of the topics which will be covered in each section.

Table 1. List of contributors visited or contacted

Ireland	
Noël Wilkins	University College Galway
Ken Whelan/Philip McGinnity	Salmom Research Agency
Paddy Gargan	Central Fisheries Board
John Browne/Niall O'Maoileidigh	Fisheries Research Centre
Scotland	
Alan Youngson/ Eric Vespoor/Anne McLay	SOAFD
John Webb	Atlantic Salmon Trust
Derek Mills	University of Edinburgh
John Thorpe	SOAFD
Lindsay Laird	University of Aberdeen
Peter Hutchinson	NASCO
David Dunkley	SOAFD
Wales	
Peter Gough	NRA (Welsh Region)
Canada	
John Anderson	Atlantic Salmon Federation
John Bailey	Atlantic Salmon Federation
Michael Chadwick	Dept. of Fisheries &Oceans N.B.
Gerry Friars	Atlantic Salmon Federation
Paul Ihssen	Ministry of Natural Resources, Ontario
L. McKay	University of Guelph
Brian Riddell	Dept. of Fisheries & Oceans B.C.
John Ritter	Dept. of Fisheries & Oceans N.S.
Richard Saunders	Dept. of Fisheries & Oceans N.B.
Ruth Withler	Dept. of Fisheries & Oceans B.C.
U.S.A.	
Vernon Antony	National Marine Fish. Service, U.S.A.
Ed. Baum	Maine Atlantic Salmon Comm.
Graham Gall	Univ. California (Davis)

Table 2. List of contacts with whom subject will be discussed during the coming weeks[1]

Ireland	
Andy Ferguson	Queens University, Belfast
Walter Crozier/Gersham Kennedy	Dept. Agriculture, N. Ireland
Wales	
John Beardmore/Michael O'Connell	University of Swansea
Peter Gough/Alan Winstone	NRA (Welsh Region)
Fisheries managers	
Norway	
Lars-Peter Hansen	NINA, Trondheim
Trygve Gjedrem	Agricultural Univ. Norway, Ås
Sweden	
Per-Olaf Larsson	Lysekil
Haken Jansson	Salmon Res. Inst. Alvkarleby
Canada	
Alex Bielak	Dept. of Fisheries & Oceans NB
David Reddin	Dept. of Fisheries & Oceans NFLD
C. Wood	Dept. of Fisheries & Oceans BC
U.S.A.	
William Hershberger	Univ. of Washington, Seattle
D. Jacobson	Dept. of Fisheries & Wildlife, U.S.A.
Anne Kapuscinski	Dept. of Fisheries & Wildlife, U.S.A.
J. Maransik	
Larry Stolte	US Fish & Wildlife Service

[1]Potential contacts have been identified in Iceland. However, no visit is, at present, intended because it appears more beneficial to make other visits.

Possible Sections for Final Report

1. BACKGROUND AND OBJECTIVES

NRA WELSH REGION - Why are rivers changing from good spring MSW salmon rivers to grilse rivers?
Proposed changes in legislation
Terms of Reference

2. POSSIBLE CAUSES FOR THE DECLINE IN MSW STOCKS

1.1 Habitat degradation and changes in productivity in fresh water
1.2 Changes in ocean productivity
1.3 Over-fishing - Greenland and Faroes
- Angling pressure
1.4 Selection pressure. (If continuously removing MSW salmon from breeding population then you are selecting for grilse).

3. SALMON IN WELSH RIVERS

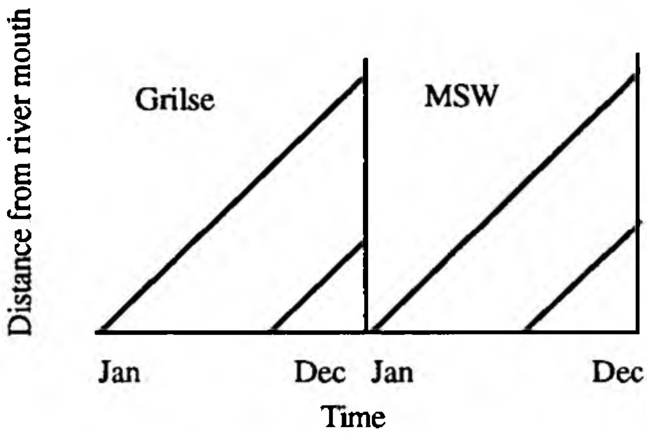
What is known about Welsh salmon: Where do they spawn, what is the parr density, what are the growth rates, smolt numbers etc. Before attempting rehabilitation measures, surveys will be needed to determine the size of the endemic stock, its precise distribution and its general life-history characteristics.

4. SPAWNING AREAS WITHIN RIVERS

Richard Saunders found behavioural differences between early-run salmon and late run salmon in eastern Canada. He noticed that early run salmon used the headwaters of the river to spawn and that the late run salmon used the lower reaches for reproduction.

This has also been found in Scotland, in the River Tay (John Webb, pers. comm) and in the River Dee (Alan Youngson, pers. comm.). In these rivers, early running fish of all year classes migrate to the upper reaches of the tributaries, whereas later running fish spawn lower in the system.

Figure 1. Schematic diagram of run timing in River Dee (modified from A. Youngson)



However, this is probably not the case for all rivers, e.g., in the River Tweed, it appears that the MSW fish predominate in the spawners of one tributary and grilse in another (R.N. Campbell, pers. comm.). Also, in the River Drowse in Ireland, the spring salmon spawn lower down the catchment than the grilse (P. Gargan, CFB, pers. comm.).

Therefore, it is very important that the use of the river by the different components of the fish stock be determined before putting a restocking or management plan into operation.

5. AGE AT MATURITY

5.1 What is a MSW spring run salmon?

In River Wye context, these appear to be 3SW or 4SW salmon returning to the river before June.

Two factors contribute to MSW spring run salmon 1) sea age at maturation
2) timing of upstream migration.

While these two factors are inextricably linked they are not synonymous.

5.2 What makes a MSW spring run salmon?

5.2.1 Genetics?

What is known about differences in stocks, between continents, countries, rivers, tributaries (Cross, Wilkins, etc.)

This will be followed by a section on definitions e.g., genetic drift, inbreeding, qualitative traits, quantitative traits, family selection, heritability.

The age at which Atlantic salmon (*Salmo salar*) reaches sexual maturity is an important life history characteristic for river management and for commercial salmon farming. Age at maturity has been shown to be partly under genetic control. In fish farming, early adult maturation (grilsing) is associated with a substantial decrease in growth rate, a marked reduction in meat quality and often a mortality increase. Grilsing and how to prevent it has been the subject of much research with regard to salmonid cultivation. It is intended to look at evidence from the aquaculture industry where selection is for fast growth and late maturity.

5.2.2 Environment ?

There is evidence that environmental components, particularly water temperature have been a major influence in the determination of age at maturity. This will be explored.

5.2.3 Other factors ?

Age at maturity has been linked with other life history characteristics such as smolt age, precocious maturation history, growth rate and growth pattern (J. Ritter, pers. comm.). However, the general picture is confusing.

6. GENETIC INFORMATION ON WELSH RIVERS

A review of information that exists for the Rivers Wye, Usk and Dee - allozyme/mt DNA studies.

7. MAINTENANCE OF EXISTING POPULATIONS AND ENHANCEMENT STRATEGIES

7.1 Habitat improvement

No interference except restriction of angling, particularly at the end of the season. It may also be possible to identify areas of the rivers/tributaries important for salmon and make these reserve areas, where no salmon angling is allowed (J. Webb, pers. comm.).

7.2 Restocking

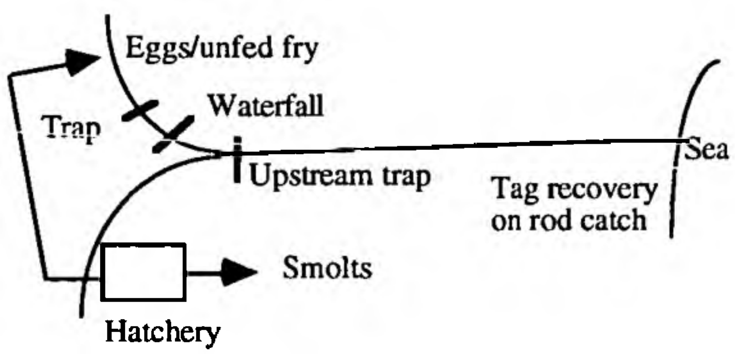
Restocking using MSW Spring run broodstock (assumes sufficient fish are available, and that prior knowledge is available on where fish spawn. Alternatively, one has to capture fish entering the river and hold for the entire year).

Topics covered here should include:
Broodstock capture
Broodstock holding
Mating techniques
Rearing procedures/role of hatcheries
Kelt reconditioning

7.3 Possible restocking scenario

Find out where early runners spawn. Take parents (3SW) - at least 50 females and 50 males, into a hatchery built near the spawning area. Strip and fertilise. Take a proportion of the fertilised ova and plant out as eggs or unfed fry in fishless area above a waterfall (if such exists, perhaps R. Monnow, on the Wye). On-grow the remainder until smolt stage, mark with micro-tags and release from hatchery (see Figure 2).

Figure 2. A possible restocking scheme



Put in smolt trap above falls and count and micro-tag all emigrants. Wait three years and repeat procedure using only marked 3SW returns. Initiate a tag recovery scheme on rod catch.

A programme of restocking on the River Shannon in Ireland is being undertaken at present (N. Wilkins, pers. comm.). This programme is composed of two sections - a grilse restocking programme and a MSW restocking programme. For the MSW programme, MSW x MSW crosses are being made. Half the eggs are being released as unfed fry and the remainder are kept until they smolt and are then marked and ranched. Only the marked fish returning to the hatchery are used as broodstock for the next series of crosses. For this programme, families are being kept separately and marked individually, to allow for future family selection, if required.

8. SUGGESTED MOLECULAR GENETIC WORK

If it is not known where fish spawn then it may be possible to use the so-called Genetic Stock Identification (GSI) programme to find out. This method is based on a mathematical model known as the EM algorithm and establishes the most probable composition of a mixture if one knows the genetic composition of the donor population. In practice, at least 100 parr from each tributary must be typed using a population genetic technique. We suggest minisatellite nuclear DNA, using single locus probes. Allozyme or mtDNA techniques could also be used but minisatellite DNA (the technique used in genetic fingerprinting) is more discriminatory and shows up more variation. After the parr from the tributaries are typed, this information forms the database for GSI which once established can be used for many years. The analysis will also indicate the level of population heterogeneity in the system. Having established a database and assuming heterogeneity, large samples (300+) each of grilse/2SW and 3SW/4SW are taken from the rod catches, with tiny slivers of adipose fin being preserved in absolute alcohol. These samples are assayed and the results analysed using the GSI programme. The proportional contribution (to the overall stock components) of the various tributaries can then be determined and depending on the results, it may be possible to identify tributaries where mostly 3SW/4SW spawn and use these tributaries as described above.