Cromarty Firth Fisheries

Fishery Management Plan 2008

INTRODUCTION

The Cromarty Firth Fishery Management Plan is intended to guide the combined fishery management activities of the Cromarty Firth Fishery Board and the Cromarty Firth Fishery Trust over a 6 year cycle between 2008 and 2013. This document is a simplified version of the full Management Plan which was carried out as part of a contract for Scottish Government Fishery Research Services. The full plan contains much more detail and is available on request from the Cromarty Firth Fishery Board.

The plan is set out in a series of chapters which describe and analyse the historical and present status of fisheries in the region and also issues which impact on these fisheries. The plan then formulates a series of management priorities to guide annual work programmes over the plan period. The planning process is cyclical; a monitoring programme will review the success of actions in achieving the plans aims and guide the development of the next phase of the plan.

Consultation

A draft copy of the Cromarty Firth Fishery Management Plan was circulated in October 2008 to; Scottish Government Fisheries Research Services, Scottish and Southern Energy, Scottish Natural Heritage, Scottish Environment Protection Agency, Highland Council Fisheries Development, Forestry Commission Scotland, Highland Local Biodiversity Plan group, Rivers and Fisheries Trusts Scotland and angling groups. There was useful feed back from several of these organisations which has been incorporated in this document. Detailed responses are included in appendix 1. A new section on working with other plans, organisations and designations has been added to Section 1.

Aims and Objectives

The aim of this plan is to maintain and enhance the native fish stocks of the Cromarty Firth region and the habitats which support them.

For salmon and sea trout there is an objective to maximise recruitment, whilst maintaining diversity and fitness.

For all fish species exploited by fisheries there is an objective to ensure that both exploited fish stocks and fisheries are sustainable.

For native fish species which are not exploited by fisheries there is an objective to maintain a favourable conservation status.

Structure of Plan

The Cromarty Firth Fishery Management Plan is set out as a series of sections which lead sequentially from description, to analysis, to formulation management actions and then the monitoring of the effects of these actions. The Plan Sections are summarised below.

Section 1
This section describes the structure of Fishery Management within the Cromarty Firth Region. The location of catchment-based management units within the region and resources available for management.

Section 2
This section describes the history of fisheries and fishery management within the Cromarty Firth Region

Section 3
This section describes the topography, geology, landuse, hydrology and climate of each management unit.

Section 4
This section describes the present status of fish and fisheries within the Cromarty Firth region.

Section 5
This section describes present fishery management activities within the Cromarty Firth region.

Section 6
This section identifies factors impacting fish stocks and fisheries.

Section 7
This section explores and analyses potential management actions arising from the issues identified in section 6

Section 8
This section describes a programme of works arising from the analysis carried out in section 7. This sets out a series of priorities for species, habitats and research which then form the basis of annual work programmes over the plan cycle.

Section 9
This section sets out the monitoring and research requirements needed to support the implementation of the Plan and to assess the effectiveness of management actions in achieving the Plan's aims.

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Section 1. Management structure, area and resources

1.1 Structure of Fishery Management in the Cromarty Firth Region

The management of freshwater fisheries in the Cromarty Firth Region is delivered by the combined activities of the Cromarty Firth District Salmon Fishery Board and the Cromarty Firth Fishery Trust.
These two organisations are managed by a Joint Director who is supported by a Management Committee drawn from the two organisations.

The Cromarty Firth DSFB has a statutory remit under the Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003 as described in Part 3 of the act. The Fishery Board has the power to appoint Water Bailiffs with similar powers to Police Officers and has an important role in fishery protection and law enforcement. The Fishery Board is funded by raising an assessment on anyone owning salmon fishing rights in the region. The remit of the Fishery Board is limited to the management of salmon and sea trout stocks.

The Cromarty Firth Fisheries Trust does not have a statutory remit but is a registered charity governed by charities law and the OSCR regulations. The Cromarty Firth Fisheries Trust is recognised by the Inland Revenue as a Charity under Scottish Charity Number: SCO29221.
The Cromarty Firth Fisheries Trust is funded by charitable donation and has a remit for all native freshwater fish species and aims to support research and education programmes to further their conservation.

1.2 Contact Details

Cromarty Firth Fisheries Board and Trust
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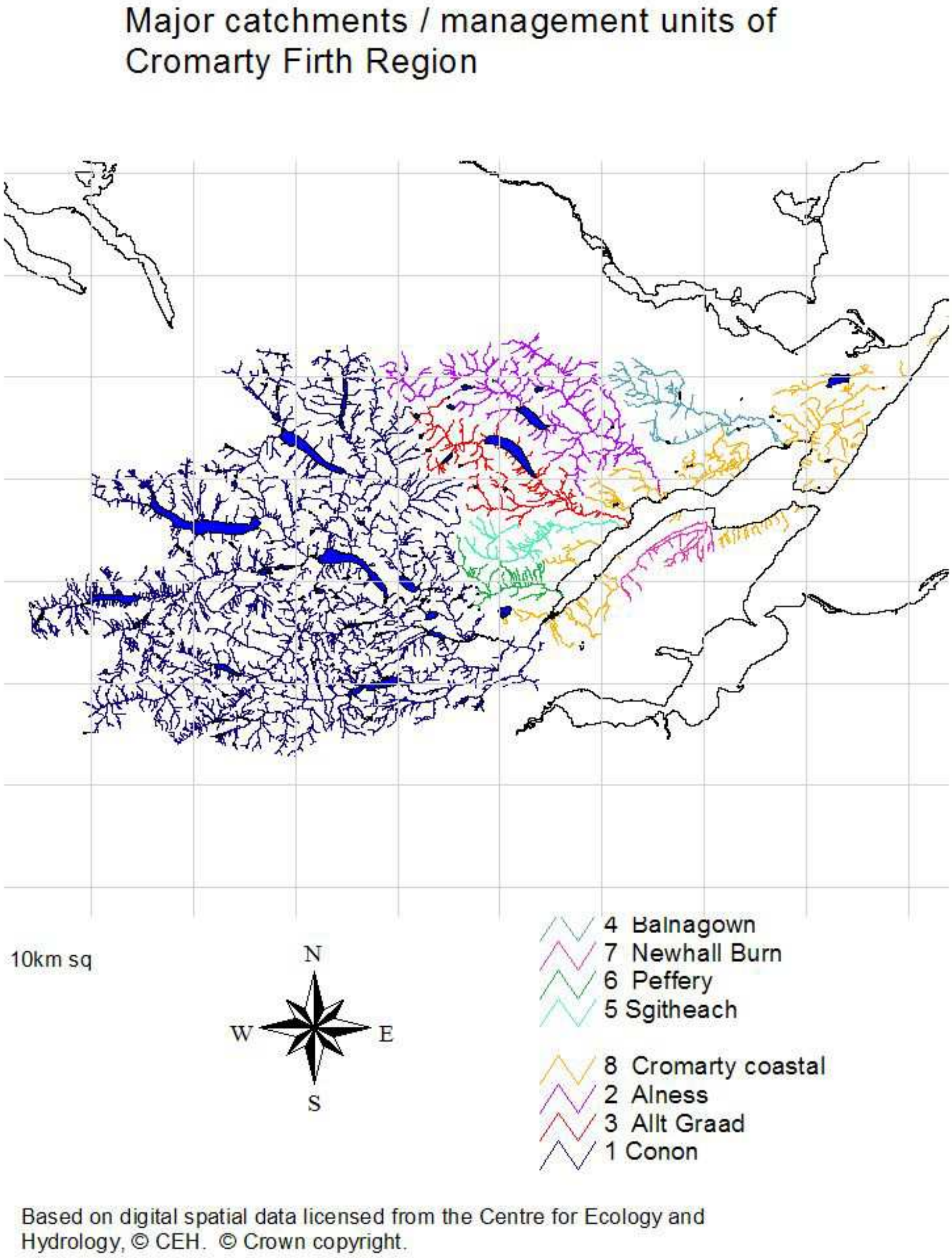
Cromarty Firth Fisheries Trust
Brodies LLP
15 Atholl Crescent
Edinburgh
EH3 8HA

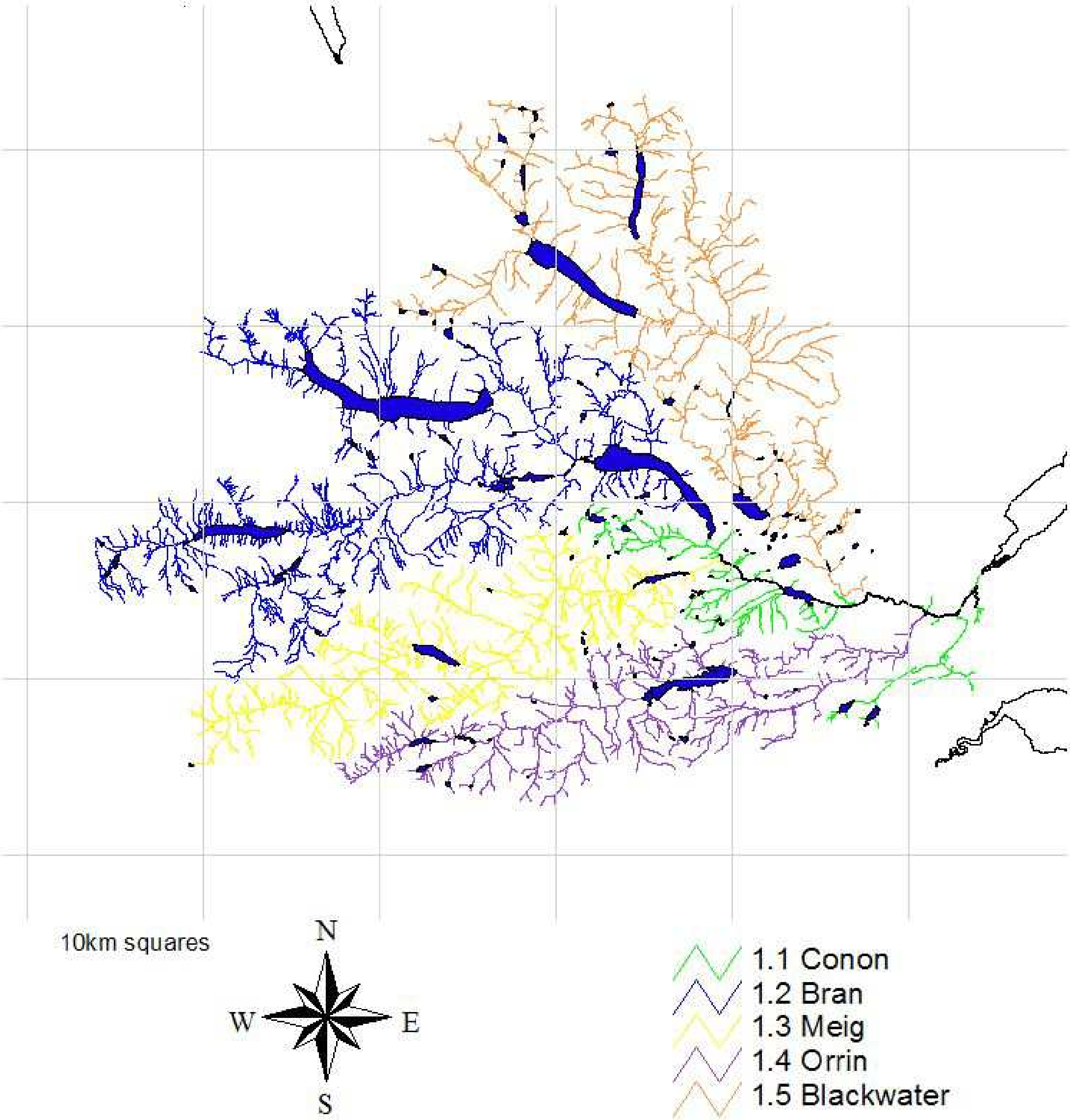
Cromarty Firth District Salmon Fisheries Board
Clerk Malcolm Younger
CKD Galbraith
Reay House
Inverness
IV2 3HF

1.3 Management units

The area managed by the Cromarty Firth DSFB / CFFT extends from Tarbat Ness in the North to the South Sutor and covers an area of sea 5km to the East of this coastline and rivers draining into it. The region includes the Cromarty Firth and the catchments of all rivers draining into the Cromarty Firth.



Conon Sub-catchments / management units



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1.4 Description of assets and resources

Human resources

Trust Chairman: Lord Nickson
Board Chairman: Andrew Matheson
Board Clerk: Malcolm Younger

Joint Board / Trust Director: Simon Mckelvey BSc Hons, MIFM, CEnv.

Conon Bailiffs;
Two full time Bailiffs are supported by an apprentice bailiff and two seasonal bailiffs.

Alness Bailiffs;
One full time Bailiff is supported by a seasonal bailiff.

Seasonal Research Assistants: Employed for specific research projects and contracts as required.

Buildings, offices, hatcheries, fixed traps, counters

Offices

CKD Galbraith,
17 Old Edinburgh Road
Inverness
IV2 3HF

Aultgowrie Farmhouse
Aultgowrie
Muir of Ord
IV6 7XA.

Buildings owned by Board

Bailiff's house
Loch na Croic
Achilty
Contin
Grid Ref 242900 859200

Salmon Bothy
Pitglassie
Dingwall
Grid Ref 254900 856900

Buildings rented by Board

Bailiff's house
Novar Estate
Alness

Strathconon Hatchery
Old Sawmill
Strathconon Estate
Strathconon Contains 7 no 2m tanks and 2 no 4m tanks.
Grid Ref 230200 855450

Novar Hatchery
Novar Estate
Alness
Grid Ref 261400 868500
Contains incubation facilities for 250,000 ova, 1 4m tank for broodstock

Buildings owned by Scottish Hydro Electric but managed by Board

Broodstock Holding unit
Loch na Croic
Achilty
Contin — Contains 10 no 3 m tanks with pumped water supply.
Grid Ref 242900 859200

Contin Hatchery
Tor Achilty Forest
Contin
Grid Ref 245400 856750

Incubation facilities for 4 million salmon ova, 8 no 2m tanks for first feeding fry.

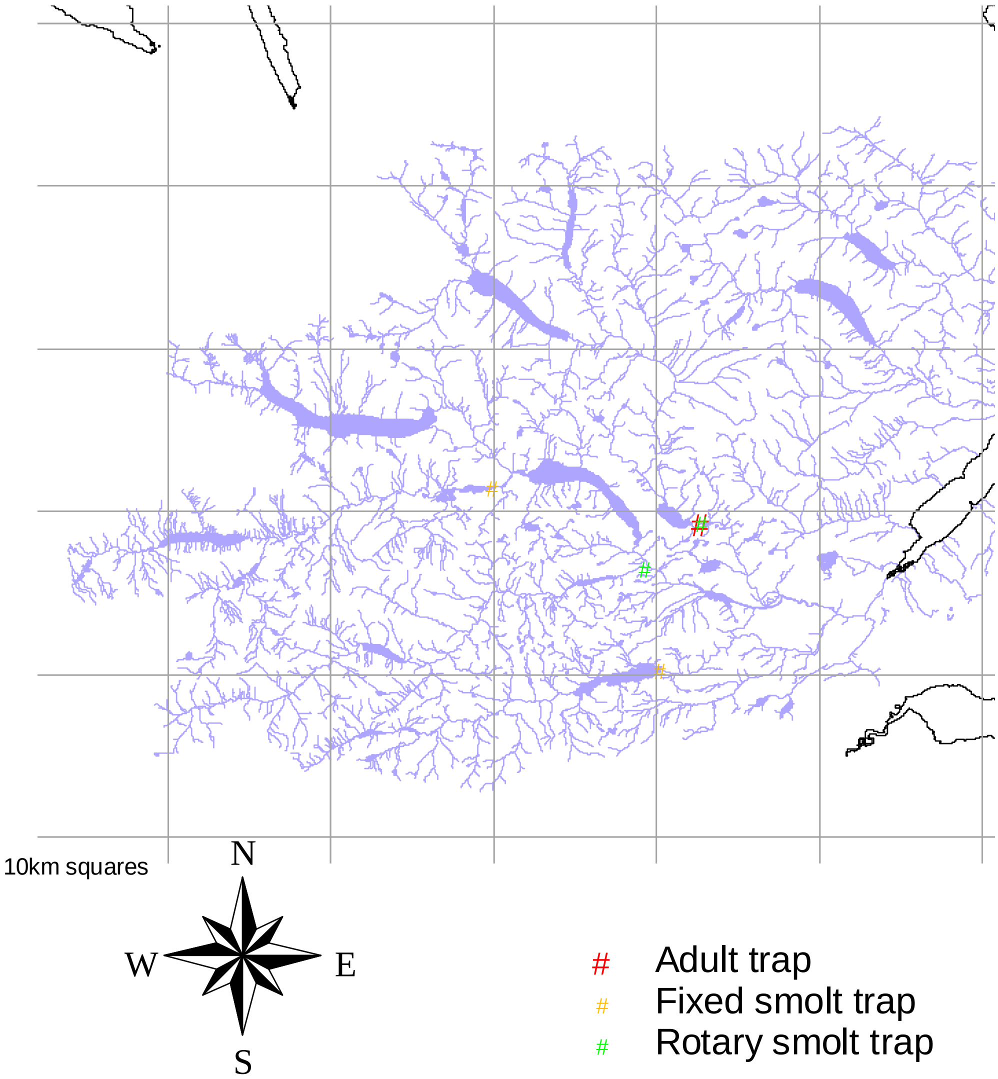
Fixed traps; owned and maintained by Scottish Hydro operated by Board

Loch na Croic heck and adult trap
Catches Blackwater adult salmon for broodstock.
Grid Ref 242900 859200

Achanalt Smolt Trap
Catches smolt run of River Bran which are then transported by road and released below hydro scheme.
Grid Ref 230050 861500

Orrin Dam adult trap
Catches adult salmon below Orrin dam so that fish can be released above dam.
Grid Ref 240400 850275

Fish Traps in the Cromarty Firth Region



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Fish counters; Owned and operated by Scottish Hydro

Tor Achilty Dam
Hydro Mk XI resistivity counter.
Grid Ref 244600 854500

Meig Dam
Hydro Mk XI resistivity counter
Grid Ref 237550 856000

Luichart Dam
Hydro Mk XI resistivity counter
Grid Ref 238800 857950

PIT Tag Decoders; Scottish Hydro operated by Board

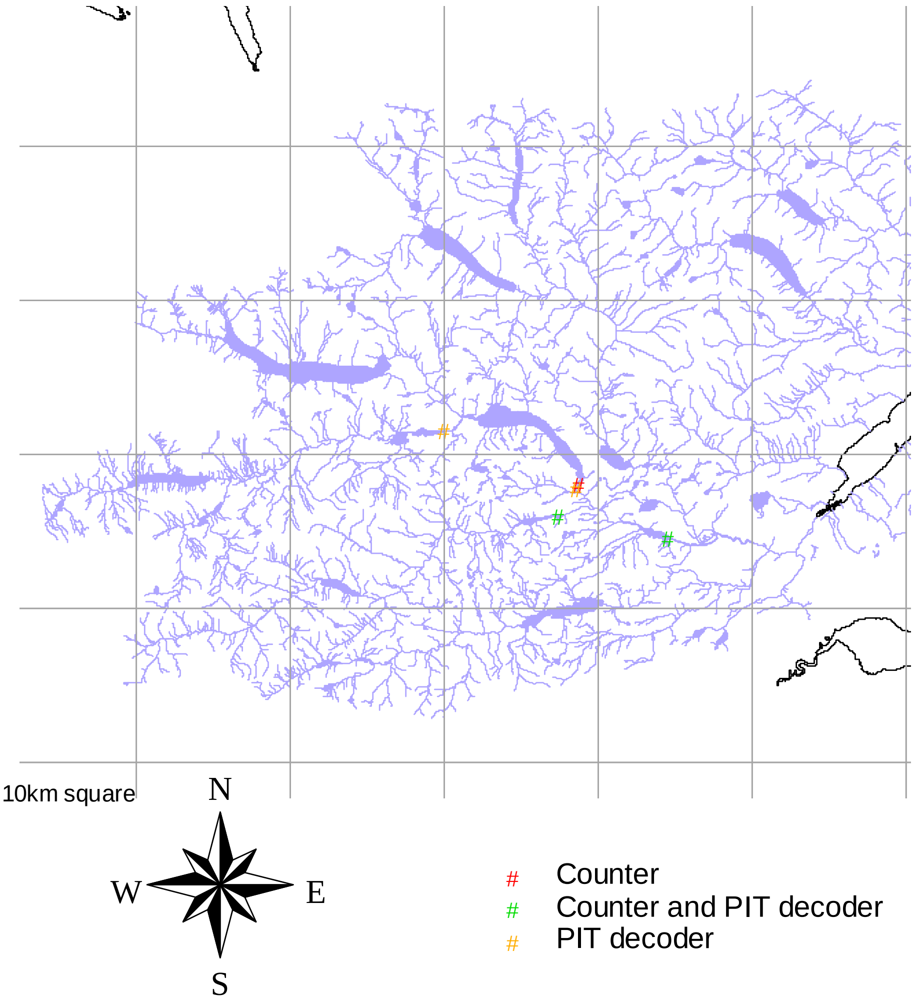
Tor Achilty Dam
Fixed to fish counter
Grid Ref 244600 854500

Meig Dam
Fixed to fish counter
Grid Ref 237550 856000

Luichart Fish Ladder
Removable installed in top orifice of fish ladder
Grid Ref 238600 857750

Achanalt Smolt Trap
Removable installed in fish trap entrance.
Grid Ref 230050 861500

Fish Counters in the Cromarty Firth Region



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Vehicles

Short wheelbase Landrover 90

High Capacity Landrover 110

4 no Vauxhall Corsa vans

Ifor Williams twin axle trailer

Lightweight box trailer

Boats

Avon Searider 4.7m RIB
60 Hp Suzuki 4 stroke main engine
6Hp Suzuki 4 stroke Aux engine.

3 man Avon inflatable dinghy
2Hp Suzuki 2 stroke engine

Old Town Discovery 159
Canadian canoe

Perception Carolina
Kayak

Cobra handheld VHF marine radio

Hummingbird marine GPS/chart plotter

Electric fishing equipment

Electracatch
WCF 9 Backpack

Electracatch
WCF 7 Bank based gear
Honda 4 kw generator

2 stop nets, hand nets, measuring boards, buckets, scales.

Portable traps

2no 6 ft diam Canadian Rotary Screw Traps

I.T. hardware and software

Hardware

Dell 420 PC with Windows XP

Hewlett Packard Compaq nx9010 laptop with Widows XP

Optoma Projector

Software

Microsoft Office 2003
Arcview GIS 3.2
SFCC Electro fishing database v.3.1f
SFCC Habitat database v. 2.1b
SFCC Catch database
AOL broadband silver

Geographic survey equipment

Garmin GPS 72

Survey nets

Fyke nets 2no.
Salmon sweep net

Other (e.g. fish tagging and tracking equipment, computers and software)

Fish transport tank one cubic metre with O2 diffuser.
Honda petrol water pump.
2no anaesthetic / short distance transport tanks.
Fry transport tank contains 10 separate baskets and O2 diffuser.
3 hand held PIT tag decoders.
Floy tag gun
Microscope for scale reading

1.5 Data holdings

Electric fishing sites

Monitoring

There are a number of sites that have been used as core monitoring sites within the region. However the selection of these sites has evolved over a number of years, many were selected to check the effectiveness of stocking and do not represent a sufficient spread of habitat types. We recognize the need to review the selection of core monitoring sites.

Table 1. Core Electro fishing Sites

Catchment/ River*	Total no. of Core sites	No of core sites fished					Total non-core sites		Total no of e/f si
		More than once a year**	Once a year	Every 2 years	Less frequently than once every two years	Non core quant	Non core p /a	Non core Timed	
1 Conon	2		2			6	1	16	25
2 Orrin	4			3	1	16	9	16	45
3 Meig	5			5		30	8	40	83
4 Blackwater	3			3		24	11	20	58
5 Bran	4			4		16	6	33	59
6 Conon catchment (1-5)	18					92	35	125	265
7 Peffery	2			2		7	0	0	9
8 Alness	2			2		2	34	35	73
9 Allt Graad	0			0		0	4	0	4
10 Sgitheach	0			0		0	16	0	16
11 Newhall burn & other small coastal streams	0								

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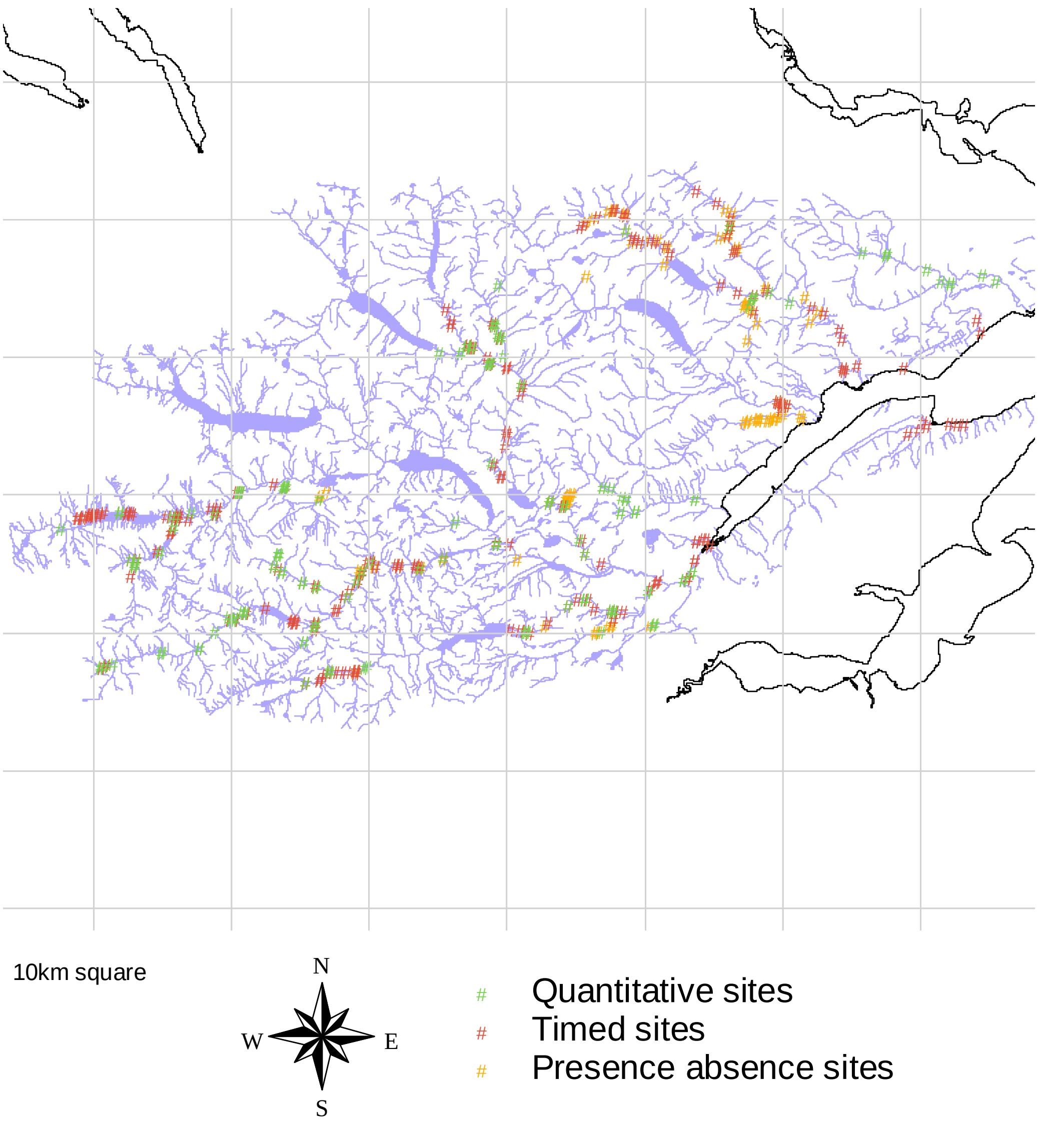
Most of the core monitoring sites on the Conon first fished in 1996 and 1997 were selected to test effectiveness of the large scale hatchery operation on the Conon. Sites were selected on each major tributary. The sites were selected using the 1995 habitat survey of the Conon system and sites of A or B grade habitat suitability chosen.

Cromarty Firth Electro-fishing sites



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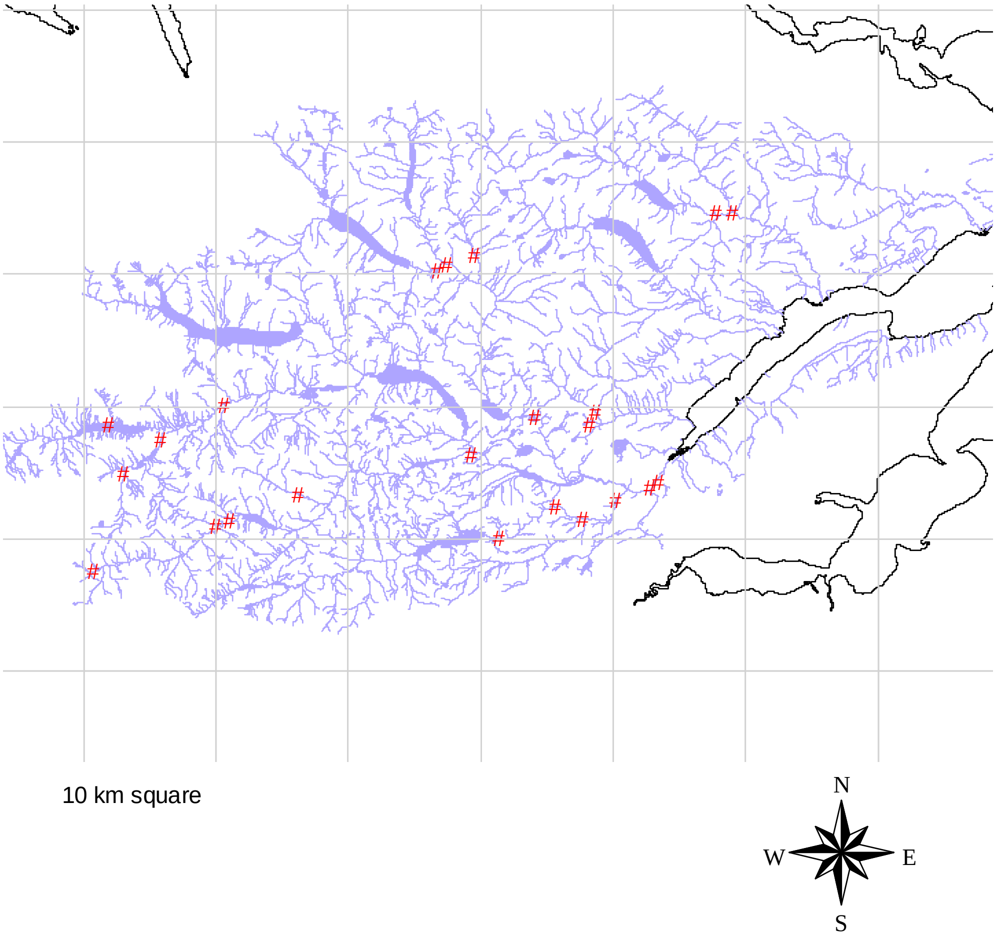
Electro-fishing monitoring sites



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In addition to the core monitoring sites described above sites have been electro fished for a variety of different purposes as shown in Table 2.

Table 2. Purpose of Electro fishing

Reason for electro fishing site:	**Number of sites**	**Number of visits**
Core monitoring	22	78
Monitoring stocking with eggs	7	17
Nutrient addition experiment	16	16
Quantitative and timed fishings. Mapping distribution/ passage of obstacles / relative abundance	260	Approx 300
Presence absence. Distribution /passage of obstacles	89	89

Details of electro-fishing surveys including reasons for survey are set out in a series of internal Board reports although some electro-fishing was undertaken in years between reports and entered into SFCC database;

Conon reports

1996 electro-fishing survey
12 quant sites mainly to check stocked areas

1997 electro-fishing survey
29 quant sites stocked areas but also some natural spawning

1997 Meig natural spawning survey
8 p/a sites to check limits of natural spawning

1998 electro-fishing survey
41 quant sites
22 p/a sites

1999 electro-fishing survey
32 quant sites
19 timed sites some on wider main stem reaches

2002 electro-fishing survey
5 quant sites
107 timed sites to give assessment of relative stock abundance around the catchment.

Alness reports

1998 electro-fishing survey of Alness
34 p/a sites to give some indication of stock distribution and limits to migration

2002 electro-fishing survey of Alness
35 timed sites to give more information on limits of migration and relative stock abundance.

2004 stocking strategy

Balnagown

1999 salmonid fry & parr survey by Bob Morgan and WGFT

Sgitheach

1998 Brief electro-fishing survey of R Sgitheach.
P/a sites to determine limit of migration at series of falls on the Sgitheach

Allt Graad

2000.
Timed fishings to determine limit of migration, relative stock abundance and check effects of recent poisoning incident.

Newhall Burn and smaller burns running into Cromarty Firth

Timed fishings to investigate distribution of salmonids

Electro-fishing Methods

Over time several different methods of electro-fishing have been used, with different methods being appropriate to different purposes.

Table 3. Electro fishing Methods

Reason for electro fishing site	**Percent of sites fished by method**					
	Fully quantitative depletion	**Semi-quantitative (single-run)**	**Timed fishing**	Presence / absence	Other method 2	Other method 3
Core-monitoring	100	0	0	0		
Distribution / limits to migration	40	0	40	20		
Nutrient addition experiment	100	0	0	0		
Other experimental	100	0	0	0		

Fully quantitative fishings are as per SFCC protocol

Timed fishings used backpack gear banner net and two operators. Samples were in riffle / shallow glide habitat and were for 5 minutes. Salmonids were recorded as 0+ and 1++ with scale samples taken as required.

Presence / absence fishings as per SFCC protocol

Electro-fishing data is stored in the SFCC database with a copy held locally and at SFCC, FRS, Faskally.

Counter data

Location of counters

River	Easting (6 figure)	Northing (6 figure)	Type of counter	Reliable Data?	Notes
Blackwater Trap	242850	859250	Adult trap	Yes	40 yr time series 1965-present
Conon / Tor Achilty	244600	854500	Hydro mk11	?	Long time series some problems in recent years make recent counts unreliable 1955-present
Conon / Tor Achilty PIT Decoder	244600	854500		Yes	Gives returning adult data from Bran trapped smolts, Another decoder is to be fitted to Meig dam next year
Meig /Meig Dam	237500	856000	Hydro mk 11	?	Long time series 1957-present
Bran / Luichart Dam	238800	858000	Hydro mk 11	?	Long time series. 1968 – Present. Gap from 1983 -95 when no stocking & smolt transfer took place.

Prior to introduction of resistivity counters in the 1980's at the hydro dams manual counts took place.

Trap data

River	Easting (6 figure)	Northing (6 figure)	Type of trap	Target: (Salmon/Sea trout/Both)?	Month(s) used	Years used (e.g. “1997 and 1999” not “2”)
Blackwater	242850	859250	V inscale trap	Salmon (adult)	Nov-Dec	1965-present
Bran	230050	861500	Wolf trap	Salmon (smolt)	April - June	1994 –present
Orrin	240350	850275	Wolf trap	Salmon (smolt)	April –June	1998 – 2002
Meig	239400	856500	Rotary Screw Trap	Salmon (smolt) but caught both	April /May	2005
Blackwater	242850	859250	Rotary Screw Trap	Salmon (smolt)	April / May	2005

Physical and biological habitat data

Detailed habitat survey data has been collected for all significant catchments in the region. The Conon and Peffery catchments were surveyed using a method which is similar to but predates the SFCC habitat survey method. All other catchments were surveyed to SFCC habitat survey protocols by SFCC accredited surveyors. The data collected is stored on the SFCC Habitat Database with copies held locally and at SFCC, FRS, Faskally.

The findings of the habitat surveys for each catchment are summarised in the following Conon DSFB reports;

Habitat Survey of the River Conon and tributaries.	1995
Habitat Survey of the River Peffery	1995
Habitat Survey of the River Grudie system and Allt Caisechain	1997
Habitat Survey of the River Alness and its tributaries	2000
Habitat Survey of the Balnagown River and its tributaries	2000
Habitat Survey of the River Sgitheach	2001
Habitat Survey of the Allt Graad and its tributaries	2001
Habitat Survey of the Newhall Burn and its tributaries	2001

The minor burns running into the Cromarty Firth have also been surveyed and the data entered into the SFCC database.

Redd counts

No redd count data has been collected partly because of the peaty nature of many of the watercourses and partly because of the workload of staff during the broodstock collection and stripping process.

Temperature data

Between 1995 and 1997 ova baskets designed to contain ova and gravel were planted in the head-waters of the Conon tributaries. The mesh size used prevented alevins from escaping, so that the baskets could be lifted and the survival to swim up fry stage recorded. Baskets were planted in the head-waters of the Bran, Meig and Orrin and two separate experiments were carried out at each site. In one set of baskets, freshly stripped green ova were used, which give an indication of the likely survival of naturally spawned ova which are subject to floods and frosts throughout the winter. In the other set of baskets eyed ova were planted in late March. This second experiment gives an indication of likely survival rate for artificially planted ova. Such planting would be done with eyed ova as they are more robust than green ova and can be transported more easily.

The results of these experiments were very encouraging. The survival of the eyed ova in all three tributaries was over 99% to the well developed alevin stage. The survival of the green ova was between 73% and 86% to the well developed alevin stage. The hatching time and development of the alevins was delayed in the river compared with that of the hatchery stock, especially in the Meig and Orrin.

Temperature data loggers were planted in river bed in the same locations as the ova baskets. These data loggers recorded the temperature every four hours and stored the information which was then downloaded to computer every month. The temperature records provided by the data loggers were then compared to the daily temperature records from the hatchery. The results showed a much more variable and harsh temperature regime in the river bed than in the hatchery and a lower average temperature over most of the incubation period.

A programme of temperature data monitoring was started by FFL in 2002 and is ongoing. Data from this monitoring is held by FFL Faskally.

Water quality

A programme of pH sampling was undertaken in 1995 by Conon DSFB with records stored on a database. High winter rainfall and periods of snowmelt allowed us to take pH readings during winter floods when acid conditions are most likely to occur. There are now 256 records on the database. A pH of <5 was recorded on 15 occasions (5.9% of database) most of these records occurred on burns badly affected by forestry and elsewhere acid episodes were short-lived.

Water samples taken from 9 sites around the Conon catchment in 1995 had detailed water analysis undertaken by FFL.

Water quality data is held by SEPA for monitoring sites throughout the region.

Catch data

Rod catch

Rod catch data exists for the major rivers running into the Cromarty Firth and is held by FRS at Montrose. Data from 1952 to the present has been collected and has been amalgamated for the Conon DSFB region. Separate rod data for each river is also held by FRS and has been requested. More detailed (although not complete) data of rod catch by beat is held locally by the DSFB.

Netting data

Annual net catch data is held by FRS Montrose for each netting station in the region from 1952 to the present. This data has been amalgamated for the Conon DSFB region but could also be supplied as separate data sets for the bag nets operating outside of the Cromarty Firth and the sweep nets operating within the Firth.

Tagging data

PIT tagging

PIT tagging programme on the Bran system began in 1997 and has been developed since then to include work on the Meig and the Blackwater. All of the Conon PIT tagging data has been entered into an Access database with copies held by FRS Faskally and the Conon DSFB.

Micro-tagging

Some limited micro-tagging of smolts from the Bran and parr stocked into the main stem of the Conon has taken place. Data from this tagging has been entered into the ICES database by FRS Faskally.

Radio tagging
Radio tracking work carried out by Andy Gowans on the River Bran is described in his Ph D thesis.
Radio tracking work carried by Keith Williams on the Conon and Bran is described in his Ph D thesis.

Acoustic tagging
Data gathered during acoustic tagging carried out by FRS Faskally on adult salmon migration in the Cromarty Firth is held by FRS.

Balloon tagging
Balloon tagging data from an experiment to assess the survival of smolts through the turbines at Tor Achilty Dam is held by Scottish and Southern Energy. The work is described in a 2004 report by Normandeau Associates Inc and Fishtrack Ltd.

Scale or other tissue collections

As part of juvenile electro-fishing surveys scales are routinely collected to establish breakpoints between year classes of salmon and trout.

Scale sampling took place during a number of radio-tracking studies on the Conon the scale collections were retained by the researchers involved and are not held by the DSFB although details are contained in the relevant reports.

Radio tracking study on the River Bran 1997 Andy Gowans PhD
Scale samples were taken from salmon and grilse captured at Loch Luichart prior to radio tagging.

Spring salmon radio tracking Conon 2003 Keith Williams PhD
Twenty spring salmon were scale sampled before being radio tagged.

Autumn salmon and post spawning tracking on the River Bran 2003 / 2004 Keith Williams PhD
Scale samples were taken from 18 autumn salmon in 2003 and twenty in 2004

As part of a study of predator damage to rod caught salmon in 1998 Frances Mackay collected a sample of 671 scales were taken from Conon salmon and Grilse. This collection is held by the Conon DSFB.

Information on population structuring and intra-specific biodiversity e.g. genetic data

No genetic analysis has been carried out on any of the fish populations of the region. This should be considered as a priority for future research.

Predator data

Predation on the River Bran was studied by D.Mills in the 1950s and 60s and is discussed in detail in Mills 1964.

The Conon DSFB has undertaken counts of sawbilled ducks and other piscivorous birds on the Conon and its tributaries since 1997. These counts were initially done on foot using DSFB staff and volunteers from local angling associations. Since 2004 have been carried out by DSFB staff using canoes.

During 1998 Frances Mackay examined 636 rod caught salmon and grilse from the main stem of the Conon. The proportion of fish damaged by predators was recorded and the types of damage recorded were categorised. Between June and September 1998 regular timed observations were made in the lower reaches of the Conon to record seal activity.

Between 1999 and 2001 Stuart Middlemas carried out research into interactions between harbour seals and Atlantic salmon in the Cromarty Firth as part of an Aberdeen University PhD project. Isla

Paul Thompson and staff at the Aberdeen University Cromarty field station have data holdings for the seal and bottlenose dolphins of the Cromarty and wider Moray Firths. These holdings include annual counts and population estimates.

2001 Keith Williams M Sc Aberdeen University. Examined 2069 salmon smolts captured in the River Bran for evidence of predator damage. Types of damage were divided into 7 categories. Some damaged smolts were also PIT tagged to compare their survival with undamaged smolts.

Parasite data

No parasite data is held for the fish stocks of the Cromarty Firth Rivers.

Other relevant biological data

A study of invertebrate populations at electro-fishing sites on the Bran and the Blackwater took place in 1999 for an Aberdeen University MSc project. A copy of Jenifer Hamlins 1999 report is held by Conon DSFB

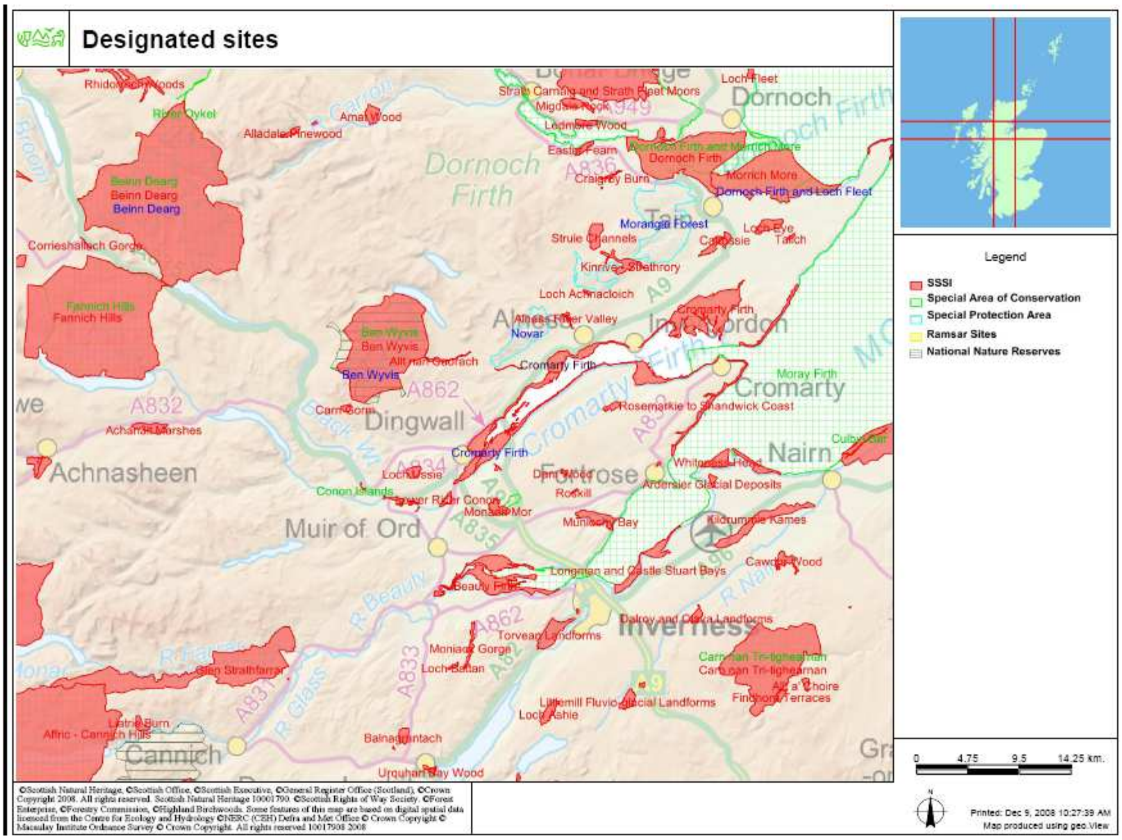
Derek Mills carried out a very detailed study of the River Bran during the 1950s. This work was summarised in The Ecology of the Young Stages of the Atlantic salmon in the River Bran, Ross-shire. Published by DAFSS in 1964

Invertebrate population data is held by SEPA for monitoring sites throughout the region and also for investigative sites.

1.6 Working with other plans and Agencies

Designated sites within the Cromarty Firth Region.

SNH kindly supplied a map of designated sites within the Cromarty Firth Region. A larger scale version of this map is included as a pdf in Appendix I. Details of the habitats and species designated are included in Appendix I and further information is available from SNH either via the Dingwall office or online.



Water Framework Directive.

The Cromarty Firth Fishery Board has played an active role in the Water Framework Directive process as a member of the North Highland Area Advisory Group. The Board contributed to the draft North Highland Area Management Plan and will continue to support the aims of the Water Framework Directive through membership of the NHAAG.

As part of the development of both the Cromarty Firth Fishery Management Plan and the North Highland Area Management Plan several meetings took place with SEPA WFD staff to look at common issues and actions arising from both planning processes. It is intended to develop this synergy between Fishery and WFD plans in future planning cycles.

Ross & Cromarty (East) Biodiversity Action Plan

The Cromarty Firth Board was represented at the Ross and Cromarty (East) Biodiversity Group which produced the Local Biodiversity Plan for the region. The Board contributed to the River, Loch and Wetland section of the LBAP which identifies Atlantic salmon as a 'flagship' species for Ross and Cromarty. The LBAP identifies eight objectives for freshwater habitats and lists future actions to achieve them. Many of these actions have been transferred to this plan and considered in more detail. The LBAP lists priority habitats and species of both national and regional significance.

Forest Design Plans

The Cromarty Firth Board has acted as a consultee during the production of a number of Forest Design Plans by the Forestry Commission Scotland in recent years.

Scottish Government Strategic Framework for Freshwater Fisheries.

The Board and Trust have been involved in the development of the Scottish Governments Strategic Framework for Freshwater Fisheries. In 2009 there is to be an input to the working group which will produce a Code of Good Practice for fishery management activities.

National Fishery Management Organisations

The Cromarty Firth Board is represented at the Council of the Association of Salmon Fishery Boards and at ASFB Directors Meetings. The ASFB has a role in setting national policy and guidelines for the management of salmon and sea trout.

The Cromarty Firth Fishery Trust is a member of the Rivers and Fishery Trusts Scotland and plays an active role in working groups on a number of fishery management issues.

The Board and Trust are represented at the Management Committee of the Scottish Branch of the Institute of Fishery Management. The IFM has worked closely with ASFB to develop and deliver training for Scottish Water Bailiffs. This relationship between ASFB and IFM is currently being further developed to meet the training needs of the wider fishery management industry.

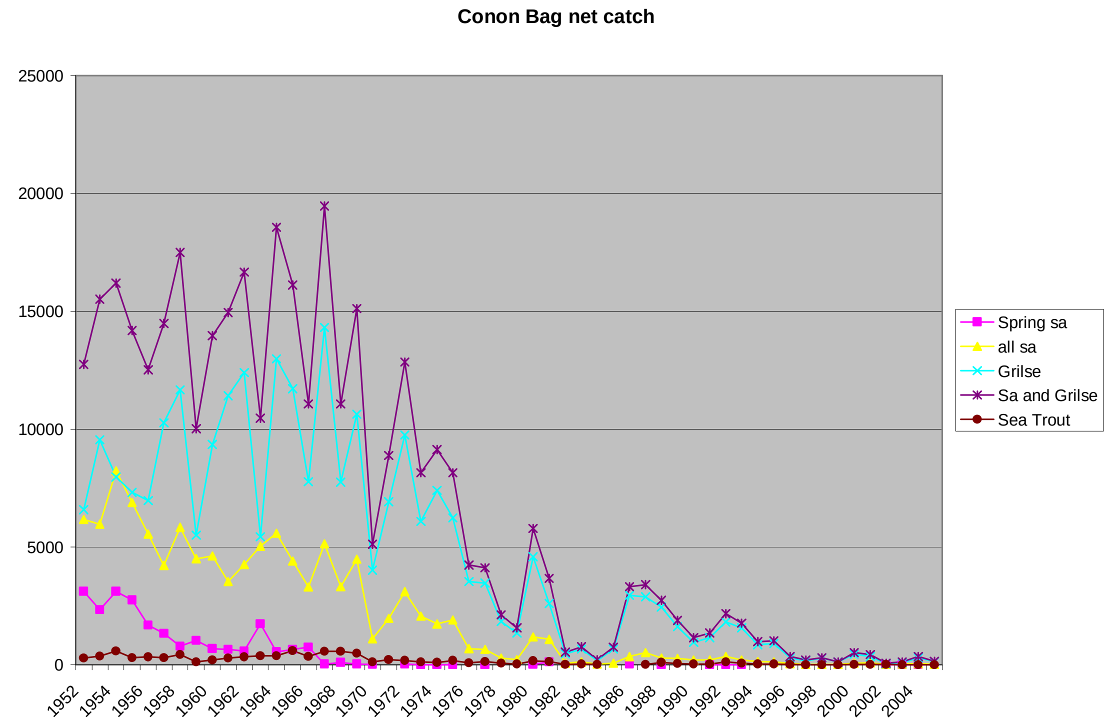
The Board and Trust are represented at the Management Committee of the Scottish Fishery Coordination Centre. The SFCC has developed national protocols and training for electro-fishing and habitat surveying. The SFCC is currently developing new web based databases to store fishery data.

Section 2. Historical context

2.1 Net Fishery

Shearer 2003 describes the history of netting in the Moray Firth from the 12th century onwards. Starting with the history of Crown ownership and the transfer of private heritable rights, he goes on to describe the administration of the net fishery and the methods employed. This includes the development of in river cruives, sweep nets, stake nets and bag nets. There is a description of the replacement of the in river net fisheries by more profitable rod & line fisheries from 1800 onwards, the restriction of fixed engines, first to the estuaries and then to the coast. Shearer also describes the short-lived drift net fishery in the Moray Firth, which was banned in 1962 and also the pelagic long-line fishery which was banned because of its by-catch of immature fish and kelts.

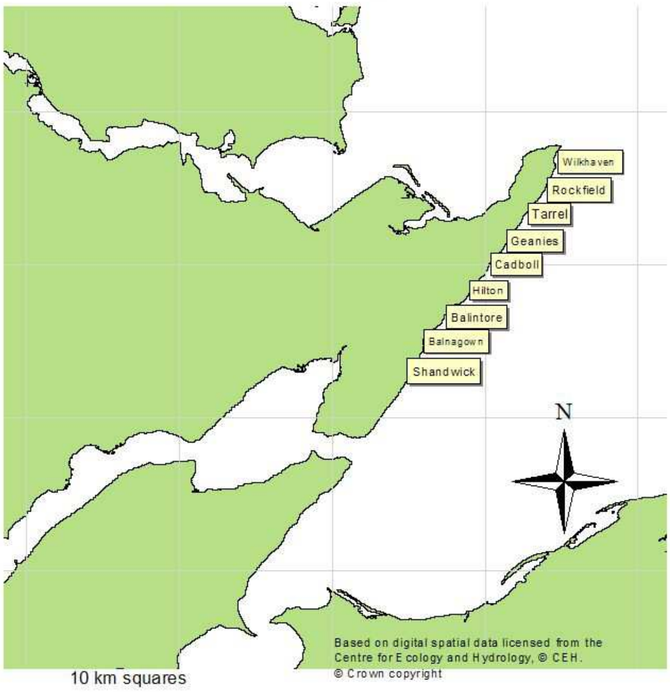
He describes the long term decline of the Moray Firth salmon net fishery from 1851 to 1987. In recent years from 1952 – 2002 the reported Moray Firth net & coble catch declined from 48,301 to 874 whilst the fixed engine catch declined from 62,714 to 72. Despite a 90% decline in fishing effort over the same time period a decline in pre-fishery abundance is considered to be a significant factor. The decline of the Conon bag net catch is shown on the chart below.



For centuries salmon were caught in large fixed traps in the Cromarty and Dornoch Firths. However, during the nineteenth century when the efficiency of these traps improved, they were declared illegal. It was still possible to use 'sweep nets', which were not fixed, but large-scale commercial netting of salmon moved to coastal fishing stations outside the firths. By 1870 there were salmon netting stations at Cadboll, Hilton, Balintore and Shandwick. The fish were kept fresh on ice – for a journey which began by cart to the railway station at Fearn.

By 1904 George Paterson & Sons had established themselves as salmon fishers on the Seaboard coast. One of the family, John Paterson, painted oil portraits of men, women and youngsters – one of the earliest visual records of the fisher communities. The Paterson family bought or leased most of the netting rights between Wilkhaven and Castlecraig. These netting stations were fished by bag net. Bothies were constructed at each netting station and a week's supply of food was supplied by boat. The netsmen lived in the bothies during the week and returned home at weekends. The Locations of the bag netting stations are shown on the map below.

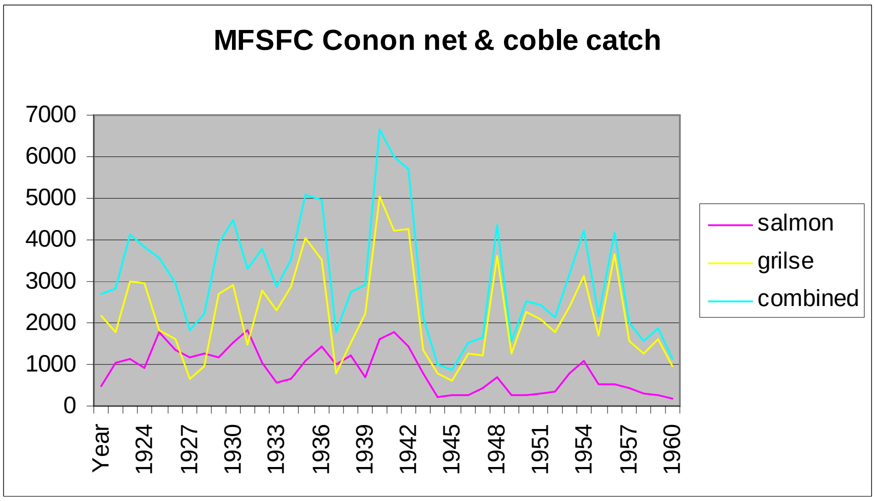
Location of Bag netting stations in the Cromarty region



The Moray Firth Salmon Fishing Company.

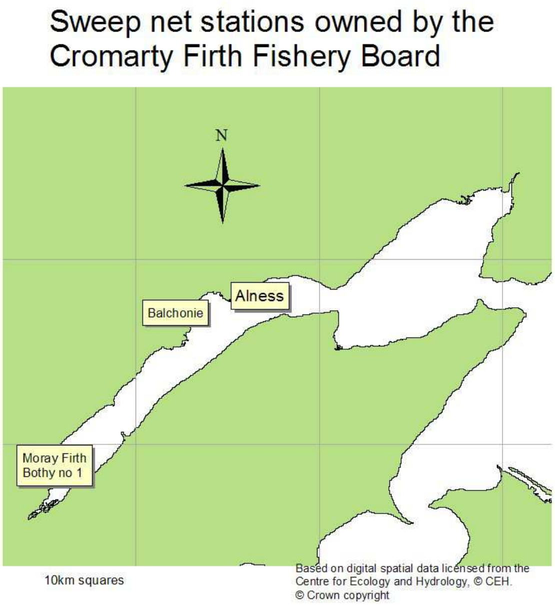
The Moray Firth Salmon Fishing Company was set up after the First World War by General Sir Walter Ross of Cromarty, when he and other landowners pooled their fishings. The Company was chaired by General Ross and managed for many years by Mr George Henderson of Hilton.

MFSFC netting station at the mouth of the Conon in the 1950's

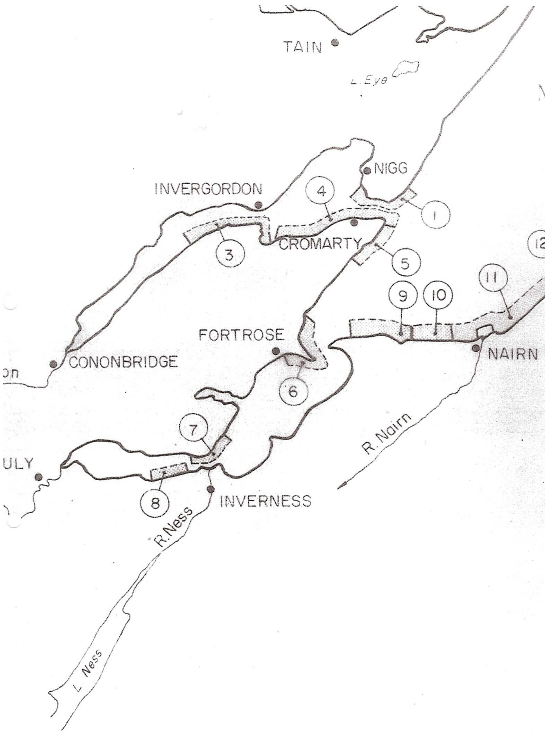


The net and coble catch of the Moray Firth Salmon Fishing Company up to 1960 is shown on the chart above. During this period the fishery remained a commercially viable enterprise.

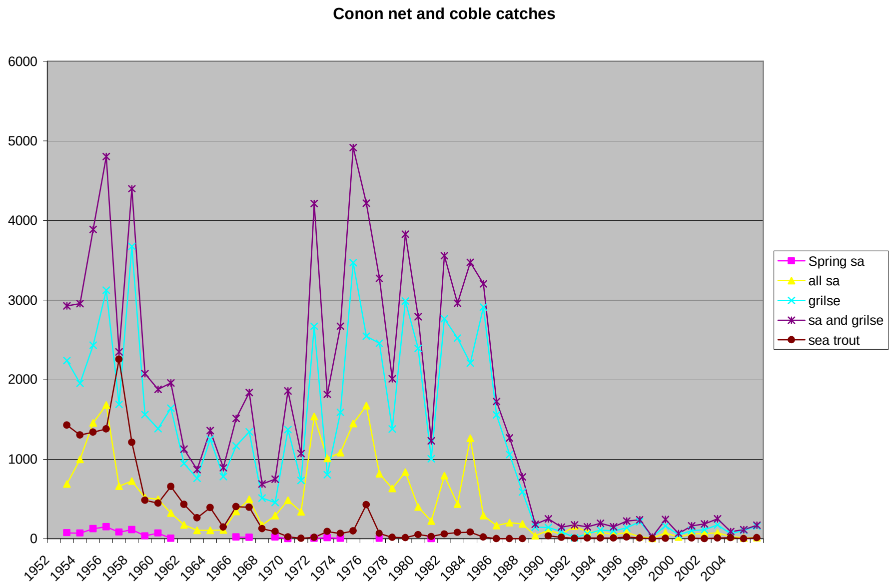
In 1985 the Conon Board carried out a review of netting ownership in the region and proposed a financial offer to the Moray Firth Salmon Fishing Company to refrain from fishing at the mouth of the Conon. Then in 1986 negotiations began with the Atlantic Salmon Conservation Trust to buy out netting stations in the Moray Firth. An assessment of the threat to stocks was undertaken and a valuation of between £18 and £26 per fish was made. In 1987 Colin Whittle from the Atlantic Salmon Conservation Trust made a presentation to the Board on the proposed purchase of the Moray Firth Salmon Fishing Company netting stations. In 1988 the Board proceeded to purchase the Pitglassie bothy and netting station at the mouth of the Conon and also the netting stations at Alness and Balchonie near the mouth of the Sgitheach (see map below).



The map below shows the netting stations previously owned by the MFSFC currently owned by the ASCT.

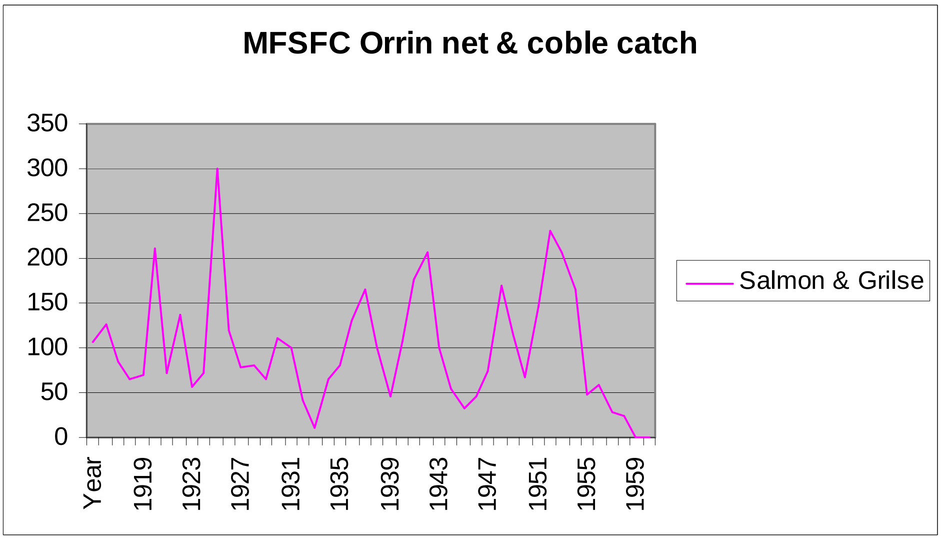


The result of these net buy outs has been a significant decrease in netting effort within the Cromarty Firth. This is reflected in the reduced exploitation shown on the chart below. The sweep net fishery is now operated more as a summer 'hobby fishery' rather than a commercial fishery.

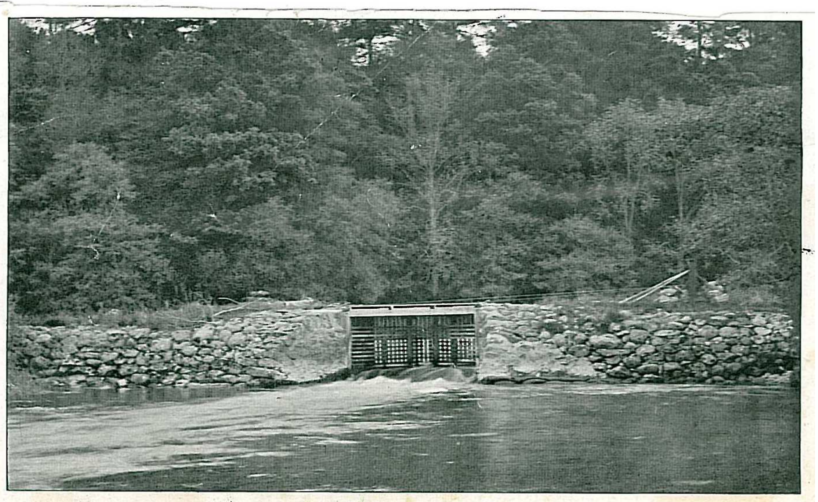


Orrin net fishery

Under the terms of a Royal Charter Fairburn Estate has the right to operate a sweep net in the Orrin Falls Pool. This right was operated until the 1960's. The records from the Orrin net fishery were held by the Moray Firth Salmon Fishery Company and are summarised in the chart below.



2.2 The River Conon Fishery



A Cruive in Fishing Order, R. Conon.

The Brahan cruives were constructed by Napoleonic prisoners of war and the Conon was subsequently managed mainly as a commercial fishery until the sporting value of rod and line fishing became more established in the late 19th century. The disputes between upstream rod and line interests and the commercial fishery from the cruives and netting downstream are recorded by Menzies and Calderwood.
An agreement was reached between 1889 and 1900 to curtail the operation of the cruives for the benefit of the rod fishery. However by 1904 this agreement had broken down and the cruives were catching large numbers of salmon. In 1911 an agreement was reached between the operators of the cruives and five upper proprietors to close the cruives.

From this time on the Conon became increasingly valued as a rod and line fishery.

Andrew Graham – Stewart 2005 describes the history of the Conon fishery in his 'Salmon Rivers of the North of Scotland and Outer Hebrides' which is reproduced by kind permission below.

'Lower Strathconon, now an open and serene landscape of rolling farm and parkland, used to have a very different appearance. Before it was drained in the 18th and 19th centuries, most of this terrain was bleak marsh and bog; the latter played a critical part in one of the most decisive battles of the clan era.
In 1491 the Mackenzie army of some 800 men were heavily outnumbered by over 2000 MacDonalds at the Battle of the Park (*Blar na Pairc*) near Contin. The MacKenzies, who were on home territory, cunningly lured the Macdonalds into a quagmire; as they wallowed and floundered in the peat, thousands of arrows rained down on them, before the MacKenzie line moved in to finish the slaughter. A few MacDonalds managed to flee towards the River Conon. As the river was in spate, they asked an old woman the location of the ford. Intentionally she misled them, and they attempted to cross at the wrong point; many were drowned, and those who desperately clung to the bank had their hands severed by the sickles of the old lady and her associates. No more than 200 MacDonalds survived to return to the Western Isles, and they never threatened the MacKenzies again.

The Conon system, by far the largest north of the Great Glen, drains 400 square miles of Ross-shire's high mountains and moorland. Bordered in broad-brush terms by the Beauly to the south, the Ewe to the west and the Carron to the north, it is supplied by a fan-like formation of four main tributaries, each between 20 and 30 miles long; they are in clock-wise order the Orrin, the Meig, the Bran and the Blackwater. The Conon itself has a course of some 12 miles from the Conon Falls, initially Highland in character before flowing through the rich pastures and arable fields to its mouth at the southern end of the Cromarty Firth by Dingwall.

The Conon was a very important source of wealth for the MacKenzies. An apocryphal story that another strain of MacKenzies (of Conan Estate) lost their netting rights in a gambling episode in the 1700s has no basis in fact. The estuary salmon netting was highly lucrative, and remained so over the centuries; the Cromarty Firth, completely protected from the open sea, is an ideal netting location. By the 19th century there was a profusion of nets up and down the firth, supplemented by in-river nets and cruives (fixed salmon traps). Between 1828 and 1837 a long legal battle was waged by Cromarty Estate against the use of stake nets by two other proprietors with land adjoining the firth. In 1838 the court found in favour of the Estate, with the estuary defined as extending as far the mouth of the firth at the Sutors, inside which the use of fixed engine nets was prohibited. This was reconfirmed by the Byelaw of 1865.

By the latter part of the 19th century, as salmon angling became more valuable, the cruives at Brahan on the lower Conon became extremely contentious. Those fish not trapped in the boxes were netted below and escapement above was thought to be minimal. In 1890 a consortium of river proprietors, wishing to maximise escapement, leased the Brahan cruives and net fishing. For the next few years there was no exploitation at this location, allowing stocks the opportunity to recover. However on the face of it the main beneficiaries were the net and coble operators in the firth. The district's netting catch increased steadily from 8,000 in 1892 to 27,200 in 1895. In the latter year the total for the rods including the neighbouring Alness amounted to only 800.

Evidently the intensity and productivity of the nets dismayed the river proprietors, and by 1901 the cruives were functioning again. According to Calderwood (1909), as well as the cruives, "27 shots (ie nets) are fished here in three and a quarter miles of water" and "it will be readily understood that a very complete control over all ascending fish can be exercised and, except during floods or the weekly close times, fish have a poor chance of reaching the upper waters". The efficiency of the nets was beginning to have a marked impact on stocks, as in 1907 their catch was reduced to little more than 4,000; this included "150 clean fish at the first sweep" on opening day (February 11).

Within a decade the decline in stocks was "serious", threatening the viability of rod-fishings, and the river proprietors decided to act. Sir John Stirling and Lord Roberts amongst others joined forces with the Sellar family (who had the Findhorn Bay nets) and the Lovats on the Beauly to form the Moray Firth Salmon Fishing Company in 1920. They bought up most of the area's coastal nets including those in the Conon estuary and firth, so that they could be properly regulated and operated to achieve a balance; once stocks built up after a period of little if any netting effort, the company would reactivate their operations to exploit the better numbers. This was the pattern for four decades or so before it adopted a more business-like approach. As salmon stocks started to dwindle in the 1980s, so once again the company reduced the intensity of its operations; between 1977 and 1986 its annual average catch within the firth was 502 salmon and 1478 grilse. The company's rights in the Cromarty Firth were acquired and mothballed by the Atlantic Salmon Conservation Trust in 1991.

In terms of angling the Conon was historically very much a spring fishery, with fresh fish in the lower reaches from opening day (February 11); incidentally there seems to be some confusion as to when and by whose authority the opening moved to January 26. The main runs of salmon were in March and April. Prior to 1939 the lower Brahan beat (above the tidal stretch) would typically catch 150 by the end of March, and 300 by the end of April; between 1898 and 1900, before the nets were brought under some control, Brahan Castle averaged only 96 up to the end of April. Up until the 1940s Fairburn Estate, with the right bank for some four miles upstream from the mouth of the Orrin, hardly fished after the end of June, and thus in most years no more than three grilse were recorded!

The Blackwater tributary, which joins the left bank of the Conon from the northwest some five miles up from the mouth, was also a superb spring fishery; the short Middle beat (below Rogie Falls) could easily produce 500 fish by the end of June.

The system was first tapped for electricity in the 1920s when a small power station was built to harness the potential of the Falls of Conon. Then between 1946 and 1961 the whole of the catchment was exploited in the most ambitious and comprehensive hydo-electric scheme in the north. In three separate stages- the Fannich Scheme, the Glascarnoch-Luichart-Torr Achilty Scheme and the Orrin Scheme- the Conon catchment was transformed with seven main dams, 20 miles of tunnels, 15 miles of aqueducts and seven power stations.

Thereafter the character of the system was fundamentally altered. Both the Conon and the Blackwater used to be wilder and less predictable in the spring. There were major floods in 1892 and 1922. There were also four big damaging floods between 1962 and 1989- after the harnessing of the system- before lessons were learned. In the 1962 flood the Marybank to Moy Bridge road was beneath 16 feet of water. The main stem of the Conon now carries far more water on an annual basis than previously, as it receives great volumes from outwith its own catchment- the headwaters of the Carron, the Blackwater and the Orrin. Since 1989 there have been no further floods, as more water is released on a regular basis from Loch Luichart, and consequently there is enough spare capacity to hold back flood waters when required.

As the scheme developed, the Hydro-Board bought all the salmon fishing rights (including the valuable Brahan Castle fishings, held for generations by the Seaforth family) - with one notable exception: the late Sir John Stirling refused to sell the Fairburn beats, despite the threat of compulsory purchase, as he believed that in due course the fishings would actually improve downstream of the dams.

During the 1950s the Hydro-Board put into place an extensive programme of works designed to mitigate for the loss of spawning grounds and natural flows. This "compensation package" included numerous fish-lifts within dams, a large capacity hatchery and guaranteed compensation flows (the Conon no longer becomes unfishably low in summer). New fish-ladders were installed- most notably at the Conon Falls; prior to this the falls had never been surmountable, although their blasting had been considered on several occasions since the late 19th century. With these falls circumvented, salmon had access for the first time ever to the River Bran (the largest tributary) and a vast area of virgin spawning territory. There were considerable teething problems with the downstream migration of smolts, but these have now been resolved and the Bran is already making a considerable contribution to the system's smolt-producing capacity.

The Blackwater was also radically affected by the Hydro scheme. Its headwaters were dammed and piped across to the Conon. Most of the spawning burns and habitat were lost, and consequently the two dams were constructed without fish-passes. By way of further compensation a large fish trap was built on the Upper Blackwater; this was designed to capture the entire run of adult salmon returning to the Blackwater, and these fish are indeed trapped each year as broodstock for the hatchery.

Whilst the importance of the Blackwater as a fishery has greatly diminished, it is still a vital nursery area; in fact two thirds of the River Conon's annual rod catch is now landed below the junction with the Blackwater. It is probably fair to say that the tributaries have borne the brunt of the effects of the Hydro schemes. The Meig, which flows from the west parallel to the Bran and joins the Conon below the falls, and the Orrin are no longer so accessible to adult salmon.

The Orrin, the lowest tributary (two miles up from the mouth), was another excellent spring fishery; the Falls pool was, by virtue of a separate royal charter to Fairburn Estate, extensively netted and in some years it yielded 1000 salmon, with fish taken as early as opening day. The Orrin was impounded prior to the 1959 season; that year the nets took 87 and the rods three, and the following year they had one and one respectively. The reason for this dramatic decline was the amount of dirt and silt being washed downstream from the works above. The tributary was then restocked, but the outbreak of UDN in 1967 meant that it was the early 1970s before adult numbers recovered, with the net taking an average of 111 salmon and 239 grilse between 1973 and 1982. Fish began to use the four Borland passes in the dam; however the smolts could not get down, and modifications were carried out- now some smolts are descending. Netting ceased in 1988, and these days there is hardly a fish in the Orrin before July.

The Conon system's run patterns have changed substantially. The spring runs are a faint shadow of their former selves, but the grilse runs are generally excellent. Whilst the Hydro regime has contributed to the demise of the system's spring run, other factors have contributed, including UDN and marine mortality. There are indications that numbers of multi sea-winter salmon are beginning to recover, as a result of restocking programmes. Thus the Brahan beats' 2004 spring catch was over 70, compared to an average of 39 for the previous three years.

Salmon in the high teens of pounds used to be caught by rods in good numbers. Fish between 20 lb and 30 lb were landed on a regular basis. Heavier examples are not unknown. One spring in the early 1920s the Stirling family's German tutor, a salmon angling novice who had never caught a fish, was struggling to put out a line on the Muirton Falls Pool (now submerged at Torr Achilty dam). Somehow he managed a reasonably long cast, and hooked a fish. Realising that this was the salmon of a lifetime, old Forbes the gillie seized the rod without ceremony and 45 minutes later a cock springer of 48 lb was on the bank. In the early 1900s a baggot was caught by a rod on the Brahan water. Before it was released, it was laid out on the sand, so that its outline could be recorded. From the measurements its weight was later estimated at over 60 lb.

By any standards the magnitude of the current stocking policy is impressive. In the last ten years an average of 2,600,000 ova per annum (an astonishing figure) have been handled by the hatchery. The river board's approach is as follows: "By distributing the juvenile salmon in large numbers and at an early stage of development over the suitable nursery, they are exposed to natural selection for as long as possible in freshwater. The resulting smolts are of indigenous stock, have lived in the wild for two or three years and are well adapted to the habitat that produced them". In the last decade close to 100 miles of previously inaccessible juvenile habitat have been brought into use; this includes half a mile of a specially created "nursery channel" (completed in early 2004), with optimal habitat to support a high density of fish, adjacent to the lower river. Each year over 700 holes are dug by hand in the headwaters to create artificial redds. These continuing efforts have ensured that the Conon system remains a significant fishery, as these figures for the average annual rod catch for the main river and the Blackwater confirm:

	Salmon/grilse
1980-1984	1428
1985-1989	1960
1990-1994	1861
1995-1999	1726
2000-2003	1290

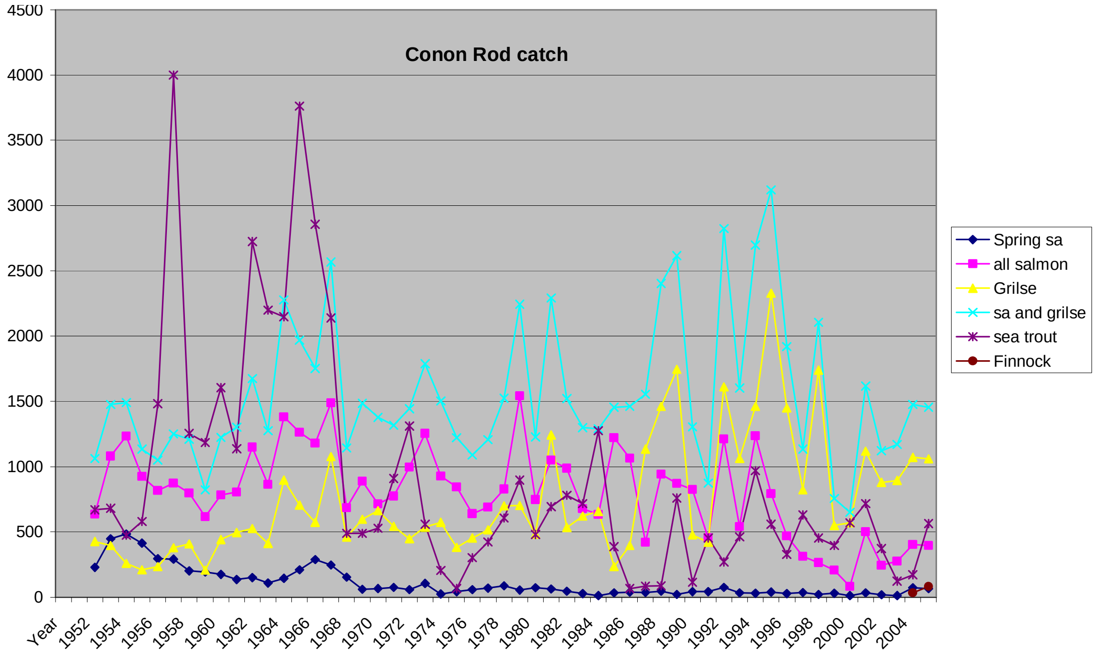
It is fair to stress that these numbers could not have been achieved without the immense assistance of Scottish Hydro Electric, which has been freely provided on every level for four decades. The harnessing of the Conon is a *fait accompli*; that said, the company does everything within its power to promote salmon regeneration.

In the 1980s Hydro Electric sold off their salmon fishing rights; the company was really not set up to be riparian owners. The prolific Brahan fishings, purchased by Peter Whitfield in 1985, were successfully syndicated; consistently they now enjoy over 50% of the system's rod catch, and their annual average (1991-2000) was 986, dropping to 690 for the period 2001 to 2004.

On the netting front the Conon Board spent over £250,000 on buy-outs in the 1980s. All that remain are three bag-net operators outside the Firth and five sweep-net operators inside the Firth.

Their take is approximately 500 fish a year; they have an incentive to restrict their netting to six weeks from mid-June, as the board then allows a 90% rebate on their rates.
The Conon is afflicted with a formidable and diverse array of predators. Seals have always been a problem, as Grimble noted; "their depredations are very serious". Today the population in the Cromarty Firth is close to 400, a considerable gauntlet for salmon to run, and they make frequent raids into the Conon, as far upstream as Torr Achilty dam, some seven miles inland. In 2001 a 25 lb fish was landed with no less than four large seal bites. Recently a lady angler, on the Green Bank Pool of the Lower Brahan beat, had played out a salmon and was bringing it towards the net, when it was seized and removed by a seal.
Considerable populations of pike exist in the lower Conon. There are frequent encounters with pike in the 12 lb to 14 lb class. It seems likely that the pike emanated from Loch Luichart, where in the early 1960s the Hydro Board netted a 32 lb specimen. The Bran tributary holds considerable numbers of perch. Mink are steadily establishing themselves, especially on the Blackwater. Perhaps the most unusual alien species discovered to date is a cobra; in 1999 one was found, newly expired, in bushes on Moy Island.
Recently there was an unusual case of attempted unsanctioned human predation. In 2001 a local poacher was apprehended in a wet-suit, carrying a spear gun, by the Russian pool on the Brahan water. At his subsequent appearance at Dingwall Sheriff Court, he pleaded "not guilty" and stated that he was "shooting eels in the burn to feed a sick otter". The magistrate then asked, against a background of considerable mirth, why a wetsuit was necessary in the burn. The defendant replied that the unfortunate otter was on the other side of the river, and so it was going to be necessary for him to swim across with the eels. Rarely has a court of law collapsed so uncontrollably.'

The rod catch for the Conon from 1952 to 2006 is shown on the chart below.



The Orrin Fishery

A description of the Orrin Fishery by the late Sir Roderick Stirling of Fairburn is given below.

'The Conon was formerly a 'Spring river'. Before the 1939-war, 150 fish used to be taken from the bottom beats before the end of March. Salmon could be caught in the Orrin falls pool on the opening day of the season the 26th of January

In the 1940's the peak of the fishing was in the last week in April and fishing virtually ceased at the end of June. Fairburn Estate made an agreement that they would not operate their net after the 29th of May!

In the year following the completion of the Dam, only 35 hen fish were trapped at the top of the Orrin Falls fish pass by the Fishery Board. The river was then restocked with Blackwater stock, with up to 2,000 fish or more being caught in the trap. These were then transferred to the Lade and held for stripping. However, UDN put a stop to that.

Some 850,000 parr were planted by helicopter in the Upper reaches of the Orrin. While it was found that salmon could be lifted upstream through the Borland Passes in the Orrin Dam, the kelts and smolts would not descend the Dam. Finally planting above the Dam was abandoned but continued below it.

With the coming of UDN, Superintendent Macintosh tried to treat the salmon stored in the Lade with Malachite Green, but found his efforts unsuccessful. He forbade any angling in the Orrin, other than by the Estate Owners or their Ghillie. He took the view (a) that diseased fish lying below the Falls or in the Falls pool should be removed whenever possible (b) that with very limited spawning areas left in the river, the majority of fish ascending the river , while of enormous benefit to the Lower Proprietors of the river and its estuary were simply going to waste. He therefore encouraged the Estate to operate their Netting Rights.

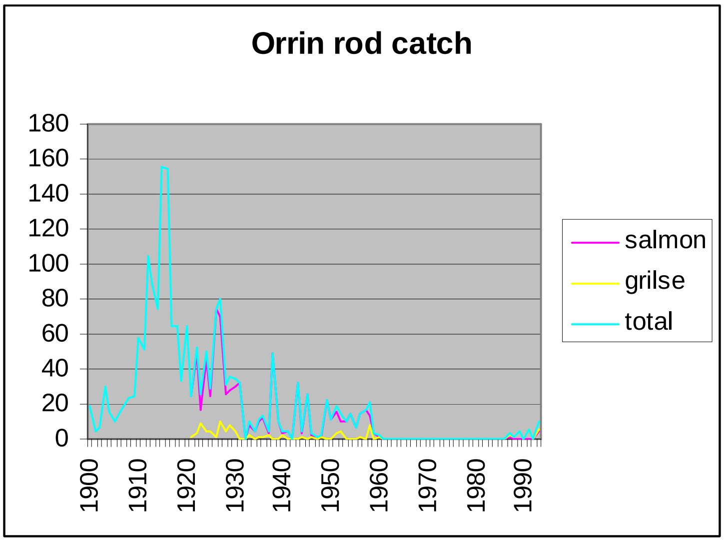
By this time the Orrin was no longer a 'Spring river'.

The record haul of net caught fish by the Estate was, I think 272 fish on the 17th of June 1943 at around 11pm in one haul of the Falls Pool. Mr Macintosh exceeded that when catching fish in November, I forget in which year, for stripping, with a haul of 375 fish in one attempt.

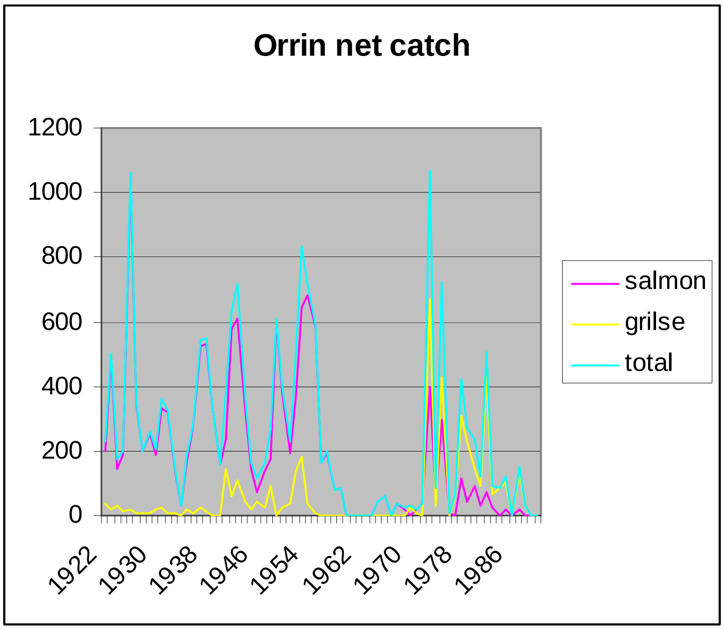
It is the wish of some members of the Fishery Board that Fairburn Estate should not continue to exercise their right to operate their net on the Orrin Falls pool. In deference to that wish and a shortage of fish the Estate has not done so for some years and has forgone the income derived therefrom. In return the Board have not levied an assessment on the fishery.

Pre North of Scotland Hydro Electric Board Scheme , angling was limited to the pools below the Falls, it being felt by the Estate that if salmon were able to ascend the Falls they should be allowed their freedom. Today we find that the fish run straight through to the Falls virtually without stopping and any angling which is undertaken takes place above the Falls. Nobody other than the Estate Owners or their employees , is allowed to fish in the area of the Falls.

The Orrin rod catch from 1900 onwards is shown in the chart below. The dominance of multi-sea winter fish in the catch up to the construction of Orrin Dam in 1959 can be seen. Following dam construction and the outbreak of UDN in 1968 there was no rod fishery until 1987, since when this has been limited to occasional fishing by Estate workers and the rod catch has been dominated by grilse.



The Orrin net catch from 1922 is shown in the chart below. As with the rod catch there is a dominance of MSW spring fish up to dam construction in 1959 and restocking with Blackwater fish from 1960 onwards. The post 1960's net fishery shows a complete reversal with dominance of grilse over spring fish.



2.3 The Alness Fishery

Andrew Graham – Stewart 2005 describes the history of the Alness fishery in his 'Salmon Rivers of the North of Scotland and Outer Hebrides' which is reproduced by kind permission below.

'The recent history of the Alness is testimony to one of the most remarkable transformations of a Highland salmon river in modern times. Until just a few decades ago this east coast spate river was of marginal interest from an angling point of view. In terms of salmon rivers the Cromarty Firth was, throughout the 19th and for most of the 20th centuries, viewed almost exclusively as the long estuary for the Conon, universally accepted as one the north's great systems. By comparison the Alness, with its mouth half way down the 20 mile long Firth was barely accorded a mention.
The river's status was hardly surprising given the level of rod catches; a hundred years ago they amounted to a maximum of 30 salmon/grilse per annum and up to 150 sea-trout. The real value attached to the river was the lucrative netting rights at the mouth- taking both Alness fish and passing Conon fish.
The source of the Alness is in the mountains of Kildermorie Forest in Easter Ross, close to the watershed of the upper Carron. The river, known in this upper section as the Abhainn na Glasa, flows for some ten miles, first through flat high moorland (excellent spawning territory) and then through a fast tumbling boulder-strewn section, to Loch Morie. The latter, surrounded by precipitous hills, is very deep and some two miles long. Incidentally both Grimble and Calderwood stated that salmon could not "reach Loch Morie"; this is clearly erroneous as below the loch there is no obstacle of any consequence.
From the loch the Alness (also known as the Averon) has a course of 12 miles- initially at a sedate pace through moorland and then much more swiftly through gorges and heavily wooded sections- to its mouth below the town of Alness. It has one of the steepest descents (over 600 ft) of any river of comparable length in Scotland, although there is no significant waterfall, and is one of the most stunningly attractive rivers in the north. Two miles below the loch the river receives its most important tributary, the Blackwater, which runs down Strath Rusdale from the northwest.
In the early 1800s Sir Hector Munro, a general who had made a fortune in the East India Company, put together a major estate in Easter Ross, which in due course became known as Novar; the holdings included most of the Alness. One section excluded was that attached to Ardross Castle, half way up the river; here some importance was attached to angling as a network of catwalks to facilitate casting was constructed in the mid 19th century.
The Salmon Fisheries Commission of 1863 concluded that the Alness ("owned by Munro of Teaninich, Matheson of Ardross and Munro of Novar") was "very badly managed" but that it "might be made a very valuable stream, were it not overlapped by two stake nets". Management did not improve and in fact it became more difficult as during the first half of the 20th century Novar divested some of its interests in the river; in essence ownership of the salmon rights became highly fragmented.
Right up until the 1960s very little priority was given to salmon angling. In fact back then the lease of the shooting rights at Novar included seven single bank miles of the river at no extra cost; in truth the fishing could hardly be marketed separately as the annual rod catch of salmon/grilse for the whole river often struggled to reach double figures. Then some 40 years ago the late Arthur Munro-Ferguson, descendant of Sir Hector Munro and laird of Novar, determined to realise the potential of the Alness and turn it into a viable rod fishery. The task was immense, but he had a great affinity with the river and, crucially, a vision of what was possible.
He set to work on a variety of fronts. Wherever possible he extended and rationalised Novar's ownership, so that in due course the estate had some 70% of the river (double bank) between

Morie and the sea. He hired a huge bulldozer and excavating machine, with which he created a network of tracks, allowing easy vehicular access to all the estate water- a massive undertaking; prior to this much of the river had been essentially cut off by dense woodland. The same machine was employed in the river. Whilst initial advice on pool improvement was obtained from fishery consultant the late Neil Graesser, the hands-on day to day management of a most ambitious programme involving 50 or so pools and extensive other works was under the control of the then river superintendent Bill Topham, whose attention to detail proved in the ensuing years to be invaluable.

Boulders were moved, creating long large pools wherever there was a flat section of water; in addition in the faster sections innumerable small runs and pots were enhanced and developed. The amount of holding water was increased immeasurably; the fish, that had previously tended to navigate the river through to the loch with hardly a pause, now began to move upstream more slowly. Inevitably some croys have been washed out- particularly in a tremendous flood in 1989- but most are still in place and have blended into the natural surroundings.

A hatchery was built in 1980; since then between 150,000 and 200,000 fry have been planted out annually in inaccessible areas; it is perhaps worth noting that ova from the Helmsdale were introduced to the system in the 1920s. In 1979 a small dam incorporating a fish pass was constructed at the outlet from Loch Morie; judicious use of the stored water allows a spate to be prolonged by a week or two.

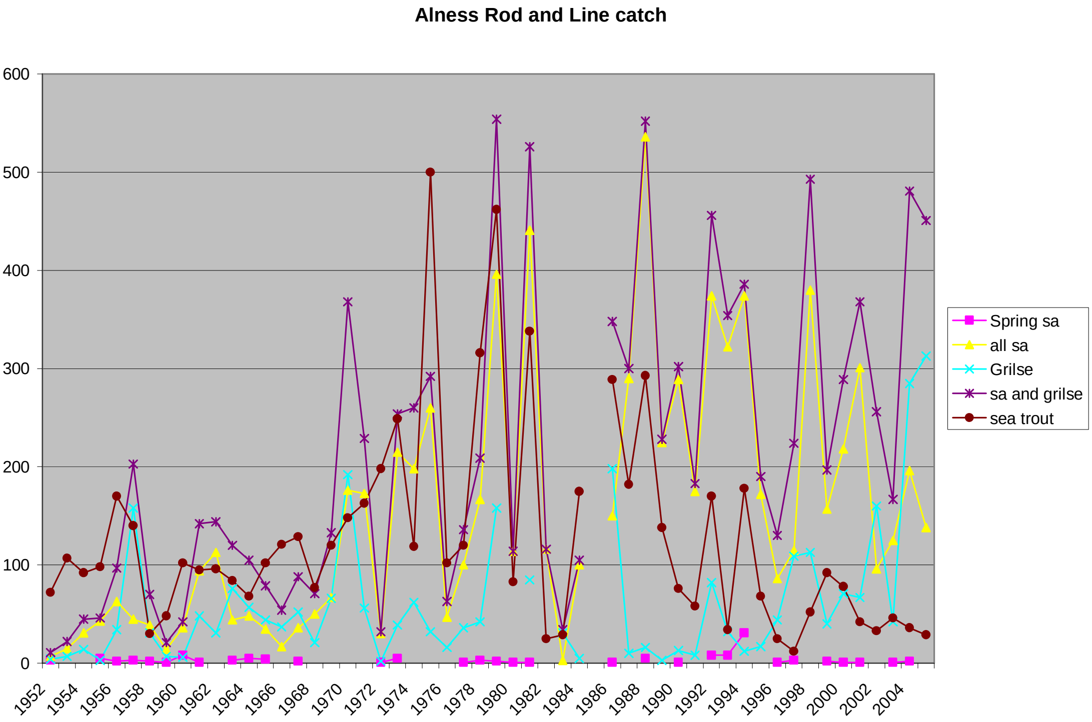
Mr Munro-Ferguson split the Novar water into six rotating beats (emulating to some extent the Helmsdale) and a Home beat; the latter was subsequently scrapped in a further reorganisation. Netting at the mouth finally ceased in 1987; in 1992 the rights were acquired by the district fishery board. All of these factors combined to create a viable rod fishery and the results have been impressive. In the 1980s the Novar beats averaged close to 250 salmon/grilse per season. Given that it is a spate river substantial variations are inevitable; in the wet season of 1985 Novar had some 600 (the total for the whole river was some 750). Since the mid 1990s the average for Novar, to some extent reflecting the global downturn in salmon stocks, has dropped to 150; it is also fair to say that angling pressure is less now than it was in the 1980s.

The Alness's main grilse and summer salmon runs are from mid June. It is a late river with a genuine back-end run; indeed sea-liced fish were caught this October. There is still a race of heavy late-running powerful salmon, in the 12 lb to 16 lb class with much bigger fish among them, the majority of which come in during late October and November- after the end of the rod season; they are usually known as greybacks or bluebacks. Locals in Alness, who regularly watched them surmounting the sluices at Dalmore, refer to them, for some unknown reason, as "Norwegians".

There is also the remnant of a spring run, with the odd fish taken in May. There was (and perhaps still is) an earlier run; certainly bailliffs' reports from the early 1900s refer to springers running in April. It appears that rudimentary attempts to develop the spring runs, presumably for the benefit of the nets, were made in the 1920s by purchasing limited quantities of ova from the Helmsdale. It is thought that early running fish were adversely affected by the absence over many decades of an effective fish-pass at the weir at Dalmore; the latter was a temperature barrier, below which springers were highly vulnerable. The situation was rectified 20 years ago with the construction of a new fish-pass.

The Alness is very much a "hunter's river". Whilst the larger pools may be fished conventionally, much of the water is difficult to read and needs a different approach. Small lies are everywhere- the Alness is one of the great dibbling rivers. The finest exponent of this art was Arthur Chamberlain; he fished the river for 40 years, finally hanging up his rod when he was 90. His knowledge of the lies was supreme and, such was his skill, he had an uncanny ability to take a fish from the river at will. His confidence was such that with many lies, if he could not induce an instant take, he would simply declare that "he's not there". Some sections of the Alness can really only be tackled with a dibbled fly. Both methods of dibbling are effective- the dibbled dropper and the dibbled tail fly; the latter is usually a version of a Collie Dog skated between the boulders.

Apart from the Novar water, there is also a thriving club, the Alness Angling Club, with two miles of the lower river (from the Douglas pool to the sea) as well as a mile below the junction with the Blackwater; between 2000 and 2002 the club averaged 94 salmon/grilse and 60 sea-trout.'



The Alness is very much a spate river, huge variations in rod catch can be seen from year to year which are driven more by angling conditions than the overall number of fish returning.

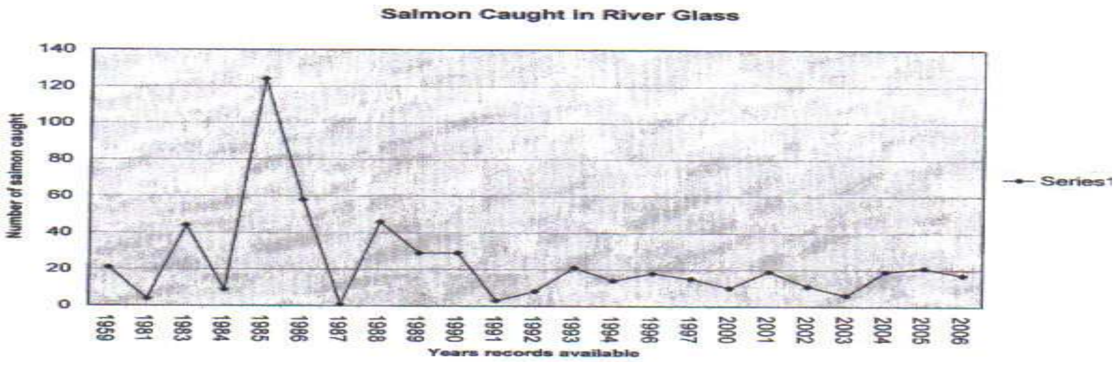
2.4 Allt Graad & Sgitheach

A history of the Evanton angling club by John Macdonald is reproduced below.

The Evanton angling club was formed on the 16th of august 1956, after some months of negotiation the sum of £5 was paid for the Novar fishing's on the river Glass, from the gorge to the railway bridge and the sum of £10:10/- to the admiralty for their fishing's from the railway bridge to the sea.
In 1957 a prize of £1 was offered for the biggest salmon caught and for it to be weighed in the presence of two committee members at the local shop, and was won with a fish of 10lbs. Also in 1957 offers were asked for bank clearance with the maximum spend to be no more than £15. The fees for club membership in 1958 were adults £1, boys 14-18 years 10/- and boys under 14 5/- per season, no mention of girls then. In 1959 a Mr Fraser received a free ticket and £2 for his work in clearing the river. In 1961 the rent increased to £20 for the Novar fishing's. The fishing season was from the 11th of February to the 31st of September in 1964. Also in 1964 31 salmon were netted in the vee pool (which no longer exists) on the 31st of October and were released above the gorge "alive" as the salmon are unable to negotiate the gorge to spawn because of a waterfall. Eleven live salmon were also released above Neils Pool on the sgitheach. In 1965 10,000 sea trout fry from the Ardgay region were released into ponds and the upper reaches of the river sgitheach. And 60,000 salmon fry from the river Alness were released above the gorge. In 1966 the river below the railway bridge to the sea was straightened in areas and reinforced with granite rocks to stop it flooding the surrounding fields in large spates. Also in 1966 the secretary was authorised to purchase one bottle of whisky and two half bottles of whisky for Mr Mackintosh and his men, for their help in netting salmon in the vee pool for stocking above the gorge, I may put a proposal in at the next AGM !. In July 1966 the dams at Neil's pool and Swordale on the Sgitheach were drilled and blasted with dynamite to allow the passage of fish to the upper reaches of the river sgitheach, and I have it on good authority that it was raining stones that evening !. In 1967 a ladder was purchased for £2 for the Lockage pool at the end of the Black Rock gorge, which is better known as the small ladders. There was until 1990 a big ladders 15 yards up stream, which came from Evanton railway station, which consisted of several ladders bolted together to a height of approximately 45 feet .In 1970 the angling club stopped due to no fishing being available.

After a gap of eleven years the club was offered the fishing in 1980 by Novar again and it was decided to reform the angling club. The season was to run from the 26th of January to the 31st of October, with the fee for the season to be £4. In 1982 the rent for the river glass was £100. In 1985 due to an exceptionally wet summer the best season on record happened with 124 salmon and 28 sea trout caught, but unfortunately a land slide below tigh na craig in November of that year caused by one of the biggest spates in many a year, filled the river in with approximately 3 million tons of gravel and sand, which left sand banks in the deepest pools and the tails of fish sticking out of them!!!. And effectively killing all life in the river.
In 1987 spinning reels were banned, and the meeting was advised that buying and selling salmon can only be done under license, this was duly noted by those present with some amusement !!!. In 1988 salmon escaped from a fish farm in loch glass in to the river, these fish are believed to be from the brood stock of spring fish from the river Helmsdale in Sutherland. In 1990 a large amount of work was done on the river glass with a digger from the gorge to the caravan park to create pools and remove some of the gravel from the landslide in 1985.
In 2006 after 8 days of near continuous rain the river glass and sgitheach reached an unimaginable force creating floods along the whole length of each river, and moving boulders up

to 5 tons or possibly more, and gouging out some pools from two to 5 feet deep. This spate has put much of the rivers back to a natural state, which looks good for the future. One notable story from the river glass is back in 1944 when salmon went into the lade tail race at Culcairn mill, and from which a large salmon was removed with a homemade net constructed from some chicken wire, and when it was weighed it reached the magical mark of fifty two pounds and was duly raffled at the red cross fair in Dingwall.
The graph below shows the catch records for the available years, the largest salmon caught on rod and line is 16.5 lbs in season, and one of 17.5lbs was caught for the stocking programme in 2005. Although many a story is told about the one that got AWAY !!!!!!!!



2.5 A Summary of the history of the Conon District Salmon Fishery Board 1948 – 2007.

The full Management Plan document contains an extensive summary of Board Meeting minutes and Superintendent's Reports over this time period. The original documents are held by the Cromarty Firth Fishery Board.

2.6 History of stocking works in the Cromarty Firth Region

There is a long history of hatchery stocking on the Conon. In 1913 Augustus Grimble reported 'There is a good hatchery near Conon Bridge, from which about 70,000 fry of seven weeks old are turned into the river each season, and exchanges of ova have been made between the Conon and the Thurso and the Tweed.' Even at this time there was some thought about the genetic issues associated with stocking. Grimble reported 'Some of the proprietors were against trying Tweed ova on the grounds that the two rivers were so unlike in the character of their courses and their waters.'

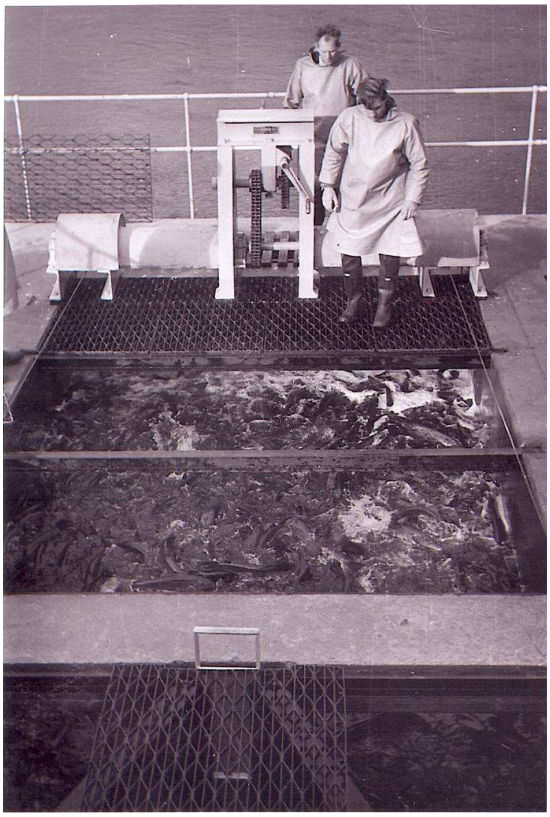
It wasn't until the late 1940's with the proposal to develop the Conon for hydro-electric generation that a hatchery operation on a larger scale was considered. In 1948 a proposal was made to include a hatchery operation as part of mitigation for hydro development. The proposal Was further developed to include the opening of the River Bran to salmon, in compensation for lost spawning areas on the Blackwater above the proposed Glascarnoch and Vaich impoundments. The idea of opening up the Bran had been suggested several times in the past. In 1837 Stoddart in his 'Angling Reminiscences' recommended the easing of the falls below Luichart. This suggestion was later repeated by both Calderwood and Menzies in their reports as Inspector of Salmon Fisheries for Scotland.

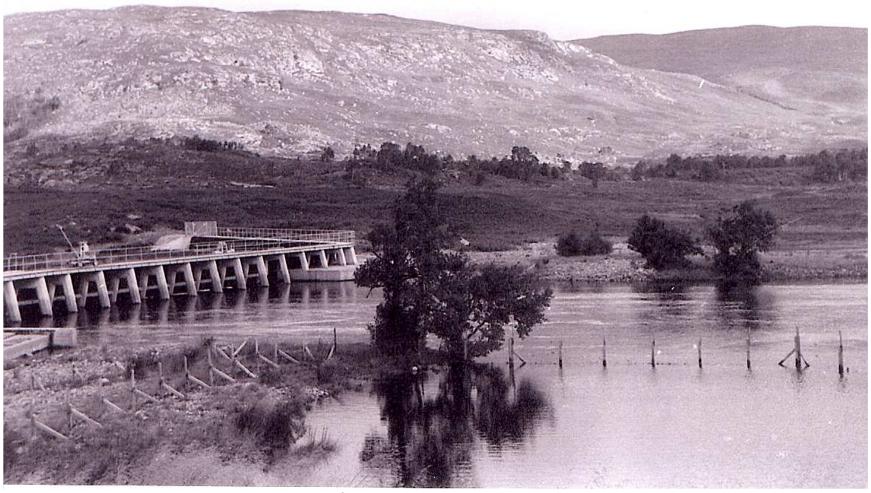
During the 1950's the Bran was eventually opened up to salmon during the construction of the Conon Basin Hydro Scheme by the North of Scotland Hydro-electric Board. This involved the construction of fish ladders at Conon Falls and Borland Lifts in Luichart Dam and Achanalt Barrage.


Contin Hatchery in 1950's photo courtesy of Dr D. Mills

To provide broodstock for this development a hatchery was constructed at Contin in 1953. The hatchery contained sufficient troughs for 2 million fry which was later expanded.

A fish trap and heck were constructed at Loch na Croic on the Blackwater in 1954. The heck contained a low water and a high water trap. After capture, fish were held in wire mesh pens in Loch na Croic. In 1954 the first stocking of the Bran took place and the Blackwater trap was operated for the first time. In 1955 the fish ladders on the Bran were completed.


Loch na Croic trap. Photo courtesy Dr. D Mills


Heck & holding pens. Photo courtesy of Dr. D. Mills

However in 1956 with a smolt trap set up at Conon Falls it was discovered that smolts were not finding their way out of Loch Luichart successfully. A variety of methods were tried to get smolts out of Loch Luichart without success. The history of the Bran stocking and research is described in detail by Mills 1964 & Mills & Pyefinch 1971.

In 1962 the recommendation was made to construct a smolt trap at Caisechain above Loch Achanalt and to trap and transport the smolt run of the Bran releasing them below the hydro scheme. This project is described in Mills & Pyefinch 1971. The wooden smolt trap had to be installed each year and was prone to flood damage. The cost of operating the trap became increasingly difficult to justify and was eventually abandoned in 1977. With the cessation of stocking and smolt transportation, the run of adult salmon dwindled and the fish ladders fell into disrepair.

After the construction of Orrin Dam in 1959 the stocks of the Orrin collapsed, despite attempts to stock above Orrin Dam with smolts. The Upper Orrin was abandoned and in the late 1960's the Orrin was stocked downstream of Orrin Dam with fry from the Blackwater and a fishery re-established. (See netting history above).

The stripping at Loch na Croic was originally done outdoors. In 1966 a wooden shed was built at Loch na Croic which also helped the Conon Bailiffs watching the holding pens during November and December.

Stripping shed

The Bran project was resurrected in the 1990's by cooperation between Scottish Hydroelectric and the Conon DSFB. In 1992 the Board stocked the Bran with unfed fry. In 1994 Hydro completed the construction of a permanent concrete and steel smolt trap attached to the Achanalt Barrage at Loch a Chulinn. In 1995 the Bran fish ladders and Luichart Borland Lift were refurbished. The first smolts were transported in 1994 and the first adult fish returned in 1995.

Since then Board staff have operated the trap, transported the smolts and released them below Tor Achilty Dam. This has resulted in a smolt run of up to 12,000 smolts per year and up to 400 returning adults.

In the late 1980's the wire mesh pens at Loch na Croic were replaced by Scottish and Southern Energy with concrete and steel pens and the Board constructed a house so that the site was permanently occupied.

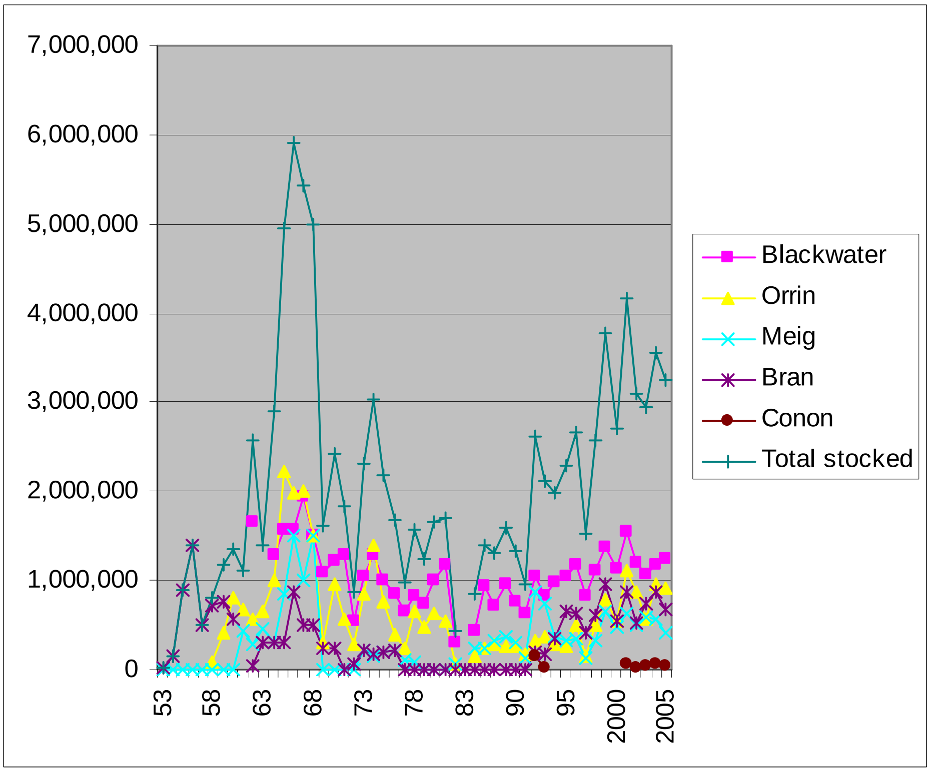
In 2004 SSE replaced the holding pens with a purpose built tank-based holding unit fed by water pumped from the Blackwater.

Inside the broodstock unit there are ten four metre tanks capable of holding 1,500 adult salmon. There is a separate stripping room with a holding bath and shelving to store bowls of salmon eggs after fertilisation. The trapping operation at Loch na Croic has been operated for more than fifty years and has maintained a rod and line fishery downstream as well as an average of 1,900 returning salmon per year to the trap.


Holding tanks


Stripping room

Details of the number of juvenile salmon stocked in the Conon system are shown on the chart below.



The stocking strategy on the Conon has evolved over time and has been based on stocking large numbers of early life stages into areas in which wild fish are not spawning. A detailed stocking strategy for the Cromarty Firth Region is described in Section 6.

2.7 Fisheries of Scotland Reports

A search of the Department of Agriculture and Fisheries for Scotland 'Fisheries of Scotland' reports for references to Conon and Alness regions are summarised in the full Fishery Management Plan. These reports date from 1882 to the present.

2.8 Other Sources & Reports

Other early descriptions of the rivers of the region and their fisheries are contained in Grimble 1913, Calderwood 1921 and Menzies 1928.

GH Nall's 1937 description of sea trout in the region remains a definitive work which without the then active netting industry would be difficult to replicate. Nall collected scales and biometrics from net caught sea trout in 1935 &1936 and described the stock structure of the Cromarty Firth sea trout. In 2008 it is proposed to start a 3 year Moray Firth Sea Trout project which will collect scales from rivers and firths as well as collating data on the distribution and habitat use of sea trout in the region.

The history of an experiment to compare the wild spawned salmon stocks of the River Meig with the hatchery stocks of the River Bran is described by Mills & Pyefinch 1963.

Mills 1969 and in other associated reports describes the juvenile stages of Atlantic salmon in the River Bran in great detail. He includes studies on predation, smolt migration, diet and invertebrate production.

Mills 1969 examines the effects of stocking salmon fry at different densities into tributaries of the Bran. He used traps to study emigration from the experimental burns as well as electro-fishing to establish fry and parr densities. Mills suggests that a fry stocking density of 2-5 fry / m2 was the most efficient use of stock. He also discusses the increase in production linked to fertilising a loch at the head of a stream.

Mills 1968 found that artificial freshets alone had little effect on salmon movements.

Mills & Shackley 1971 describe the success of the transfer of smolts from the Bran smolt trap and release below Tor Achilty in generating a run of adult salmon back to the Bran.

Mills 1994 describes the degree of straying of returning adults which were transported as smolts from the Bran to the neighbouring Meig and Blackwater.

Jamieson 1979 carried out a review of the rod and line fishery of the Conon and Blackwater which was then in the ownership of the North of Scotland Hydro Electric Board.

Mackay 1998 recorded the behaviour of seals in the lower reaches of the Conon and developed a classification of predator damage from the examination of rod caught fish.

Hamlin 1999 studied the invertebrate fauna at electro-fishing sites on the Meig and the Orrin. By comparing fish densities with invertebrate data Hamlin found a relationship between fish densities and invertebrate diversity but not invertebrate biomass.

Conon DSFB Habitat survey 1995-2002

Scottish Fishery Coordination Centre method used by accredited staff.

- 250 m lengths of watercourses surveyed with 100+ parameters recorded and entered into SFCC GIS compatible database.
- Identifies location and quantifies areas of suitable habitat.
- Identifies obstructions to migration.
- Identifies degraded habitat.
- Identifies point pollution sources.
- Identifies opportunities for improving habitat or access.

Rivers surveyed; Conon, Alness, Peffery, Allt Graad, Sgitheach, Grudie, Balnagown, Newhall Burn and Minor Cromarty Firth Burns.

Electro-fishing juvenile surveys.

Same rivers as above.

- Identifies limits to migration and distribution of salmonids and other species.
- Records densities for salmonids & extent of habitat usage.
- Monitors effectiveness of stocking works.
- Identifies problem areas if unexpectedly low densities or missing year classes.
- Distribution of lampreys around Cromarty Firth studied for SNH.
- Some contract work carried out for SEPA and SNH in recent years.

PIT tagging project

Electronic tags (Passive Integrated Transponders) used to uniquely identify individual parr and smolts and follow their lifecycle. Tags detected at traps and by automatic decoders at Hydro dams. Gives data previously unavailable, has been pioneered in the UK on the Conon in partnership with FRS and SSE.

- Records freshwater survival of parr (over wintering survival, migration survival from various parts of Bran system). This has led to modification of stocking strategy for Bran.
- Marine survival of smolts.
- Effect of release point on marine survival.

- Effect of fin clipping on marine survival.
- Smolt behaviour- time of migration, age / size at migration / shoaling behaviour / diurnal pattern of migration.
- Survival of hatchery reared smolts.
- Rod exploitation rates.
- Most work has been done on Bran but projects on Meig and Blackwater underway.

NERC smolt homing project
Joint project with Edinburgh University and FRS. Project to study the neural / olfactory mechanisms involved in the smolting process. Involves transferring smolts between tributaries, returning adults to be scanned to observe neural activity whilst exposed to home or transfer river water. Effects of environmental pollutants to be investigated on these brain activities.
As a by product of this research the Board will have access to two rotary screw traps at the end of the project, get PIT tag return rates for the Blackwater and Meig to compare with the existing Bran data and get a PIT tag decoder fitted to the Meig Dam fish pass.

Radio-tracking

Andy Gowans PhD 1998
Project on fish passes of the Bran. Used conventional radio tags and EMG tags which record muscle activity, so that the amount of effort required to swim up a fish pass could be recorded. Study found problem areas in several fish passes which have since been re engineered by Hydro. Also found that fish had difficulty passing through section of boulders below Luichart Dam. A new freshet regime was agreed with hydro which successfully allows fish past this area. The experience from this also led to a change in the freshet regime on the Lower Meig which gets fish past a difficult section below Meig Dam.

Keith Williams PhD
Spring salmon radio-tracking showed high survival of rod caught spring fish through to spawning time. Also showed that most fish stayed in main stem in deep water during summer before making an autumn migration.
Autumn grilse tracking to look at where fish went after spawning and how nutrients from dead kelts were distributed. Found 1/3 retained in headwaters, 1/3 in Bran lochs and remainder migrated downstream.

Predator damage surveys
Frances McKay MSc project. - Examined rod caught adult fish throughout season. Found high proportion of damage was caused by dolphins.

Keith Williams MSc project looked at predator damage to smolts at Bran Trap. Found damage attributable to saw billed ducks and to pike. Found higher levels of predation in dry spring when smolts were delayed in lochs.

Seal surveys

Stuart Middlemass PhD – Found peak in seal activity in lower reaches of Conon in July also found activity strongly tidal with most seals coming into river over high tide.
SMRU / Isla Graham NERC funded project. Building on Stuart's work also attempting to catch seals for satellite tagging and photo ID of individuals.

Parr micro-tagging

Experiment agreed with members of Brahan Syndicate to rear and release parr from fish caught by ghillies from Lower Conon. To monitor this 1,000+ of the released parr have been micro-tagged and fin-clipped each year since 2002 (none have been recaptured to date).

Nutrient studies

Keith Nislow US Forest Service / FRS
Kelt carcasses in Bran and Conon tributaries. Invertebrates were monitored at, above and below addition sites. Showed increase in invertebrate production and also marine isotopes of Nitrogen were found incorporated into the invertebrates.

Keith Williams PhD – Project just completed and ready for submission. Links addition of kelt carcasses to increase in juvenile salmonid production.

Egg basket experiments

Eyed eggs were stocked around Conon tributaries in egg baskets so that hatching and swim up success could be investigated. At most sites success rate over 90% but some Blackwater tributaries had low survival linked to forestry and PH problems.

Egg density experiment

Joint project with Norwegian research agency / FRS and US Forest Service.
Looking at effects of even or clumped distribution of eggs on subsequent fry dispersal and survival. Has important implications for stocking policy, at present we try to stock evenly with small numbers of eggs in each redd. The first year's results would support this as best practice. A second year's research will reverse the treatments between the pairs of experimental burns.

Acoustic tracking of adult fish in Firth.
FRS project

In 04 and 05 adult salmon were caught in sweep nets in Outer Cromarty Firth. They were tagged with acoustic transmitters, listening stations in the Firth and at the mouths of rivers tracked their progress. Fish were detected entering the Conon, Sgitheach, Alness, Allt Graad and Balnagown with the majority entering the Conon. River entry did not seem to be influenced by tide. Some fish went out of the Firth one being caught by a Ness sweep net. There was a low loss rate in the inner firth of less than 5%, which includes netting and seal losses.

Balloon tagging.

Balloon tags were used in a Hydro funded experiment to test survival of smolts through Tor Achilty Dam turbines. Unacceptable losses were found at compensation flow but very few losses at higher flows. In light of this Hydro have modified flow regime at Tor Achilty to give more than 2 megawatts during the smolt run.

Other relevant reports and references are detailed below

Augustus Grimble 1913
The Salmon Rivers of Scotland

W.L. Calderwood 1921
The Salmon Rivers and Lochs of Scotland

Menzies, W.J.M 1928
Salmon of the River Conon
Fishery Board for Scotland
Salmon Fisheries 1928 No. VIII

G.H. Nall 1937
Sea- Trout of the River Conon
Fishery Board for Scotland
Salmon Fisheries 1937 No. IV

Pyefinch & Mills 1963
Observations on the movements of Atlantic salmon in the River Conon and the River Meig, I.
DAFS Freshwater and Salmon Fisheries Research 31

Mills 1964
The Ecology of the Young Stages of the Atlantic salmon in the River Bran, Ross shire
DAFS No.32

Mills 1965
Smolt Production and Hydro Electric schemes
ICES Salmon and Trout Committee No 31

Mills 1965
Observations on the effects of Hydro Electric Developments on Salmon migration in a river system.
ICES S&T Committee No.32

Mills   1968
Observations on the movements of Atlantic salmon in the River Conon and the River Meig, Ross-shire
ICES Anadromous and Catadromous Fish Committee

Mills 1969
The survival of Hatchery-Reared Salmon Fry in some Scottish Streams
DAFS Freshwater and Salmon Fisheries Research No.39

Mills & Shackley 1971
Salmon smolt transportation experiments on the Conon river system Ross shire
DAFS Salmon and Fresher water fisheries research No 40

Mills 1975
The Conon Valley
Report which includes a description of the Conon system and trap data up to 1975

Mills 1994
Evidence of straying from wild Atlantic salmon, *Salmon salar* L., smolt transportation experiments in northern Scotland.
Aquaculture and Fisheries Management 1994, 25 Supplement 2, 3-8

A.D. Jamieson 1979
Analysis of a Salmon Fishery- The Conon-Blackwater
Fish. Mgmt (1979) 10, No.2

Payne, P.L. 1988
The Hydro. A study of the development of the major hydro-electric schemes undertaken by the North of Scotland Hydro-Electric Board
Aberdeen University Press

Frances Mackay 1997
The interactions between salmon and seals within the Conon river system
University of Aberdeen MSc thesis

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Predator damage to salmonids, tagging recaptures and seal movements within the Conon system.
Report to the Atlantic salmon Trust

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A study of the interaction of Juvenile Atlantic salmon with the river systems Meig and Orrin- tributaries of the River Conon (Ross-shire)
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John Armstrong, Frances Mackay, Simon Mckelvey & Paul Thompson 1998
Salmon and Seal Studies on the River Conon in 1998

John Armstrong & Simon Mckelvey 1998
The Development and Application of PIT Tags for Tracking Movements, Growth and Survival of Anadromous Atlantic salmon.

Gowans ARD, Armstrong JD, Priede IG, Mckelvey S 2003
Movements of Atlantic salmon migrating upstream through a fish-pass complex in Scotland
Ecology of Freshwater Fish 2003; 12

Aprahamian M.W, Martin Smith K., McGinnity P. Mckelvey S & Taylor J 2003
Restocking of Salmonids-opportunities and limitations
Fisheries Research 62 (2003)

Normandeau Associates Ltd 2004
Survival Estimation of Wild Juvenile Atlantic salmon passed through a Kaplan Turbine at Tor Achilty Power Station, River Conon, Scotland
Report to Scottish and Southern Energy

Williams K 2001
Classification of predator damage on Atlantic salmon (Salmo salar L.) smolts captured at Loch Achanalt, Ross shire
Aberdeen University M Sc thesis

Department of Agriculture and Fisheries for Scotland
'Fisheries of Scotland' reports held in FRS Library

Nislow KH, Armstrong JD & Mckelvey S
Phosphorus flux due to Atlantic salmon in an oligotrophic upland stream; effects of management and demography.

Butler J.R.A et al
Bottlenose dolphins (Tursiops truncatus Montagu) and illegal Atlantic salmon (Salmon salar L.) nets in the Moray Firth, Scotland: assessing by-catch risks for a protected cetacean population.

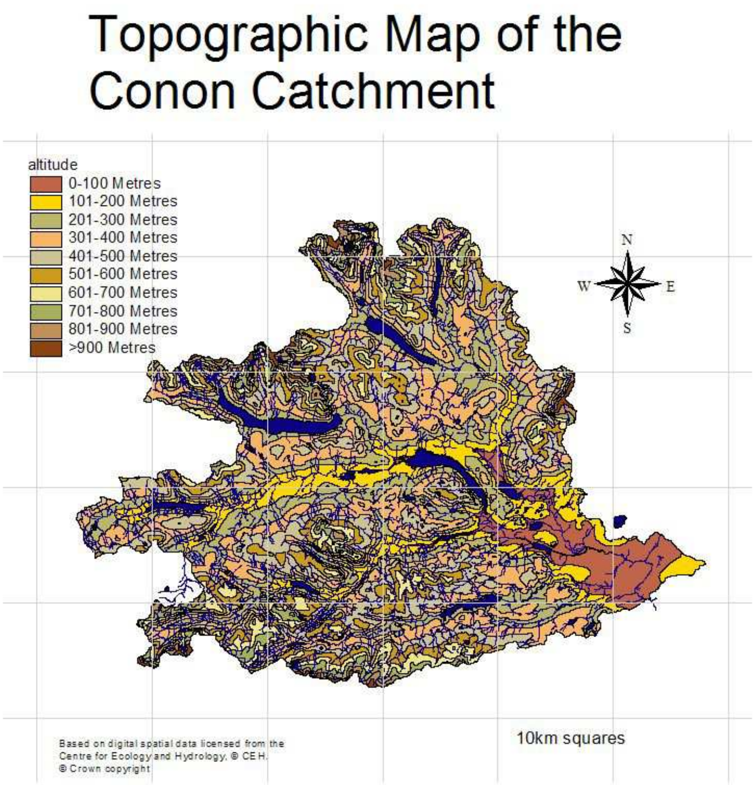
Section 3. Physical catchment characteristics

3.1 Topography by management unit

3.1.1 Conon topography and description

The Conon system slopes west to east from mountains of over 900m to sea level. The high granitic mountains of the west slope down to gentler sandstone foothills and coastal floodplain. The effects of glaciation with steep sided valleys and typical glacial features can be seen in the upper reaches of the tributaries. There are eight man made reservoirs in the upper catchment linked to hydro-electric development. The Orrin and Meig catchments are particularly steep sided, whilst the Bran and Blackwater are less rugged and have wider floodplains.

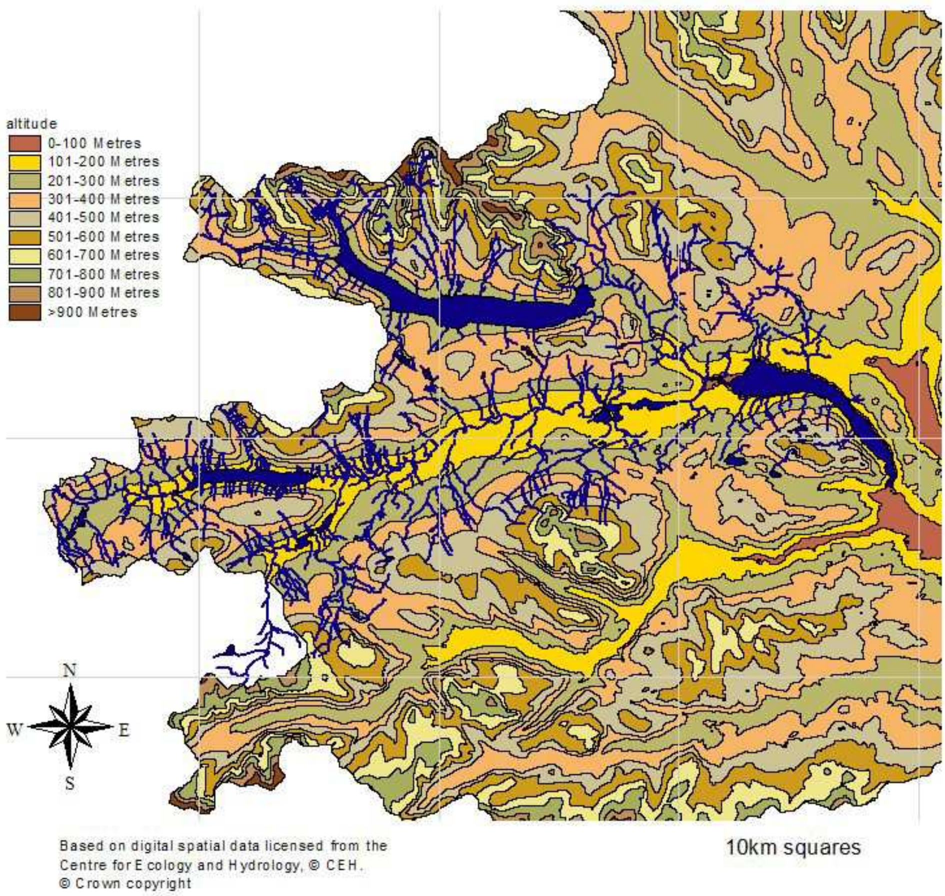
The Lower Conon Valley is formed by the joining of the Strathconon valley with the Blackwater and Orrin valleys. There is a marked reduction in gradient and this area is characterised by the effects of deposition and historical meandering of the channel. The channel form of the Lower Conon has been modified by human activity with the construction of flood banks and the regulation of flow by hydro-electric development.



3.1.1.2 Bran topography and description

The Bran valley is wider and of lower gradient than the more southerly tributaries of the Conon system. Although it drains some higher ground the majority of the Bran system is between 100m and 200m in altitude. The Bran contains more still water than the other Conon tributaries, with Loch Rosque and Loch Gowan in its upper catchment and Loch Achanalt, Loch a Chulinn and Loch Luichart in its lower reaches. The areas above Loch Rosque and Loch Gowan are steep and boulder strewn. Below these lochs the Bran and its tributary Abhainn a Chomair are more stable with a moderate gradient, mixture of substrate sizes and good spawning habitat. The lower reaches of the Bran below Caisechain are slow deep and meandering before passing into a complex of lochs and marshes at Achanalt and Loch a Chulinn. The lower reaches of many of the Bran tributaries are of moderate gradient and are accessible to salmon because of the relatively wide floodplain of the Bran. The main tributary of the Bran is the Grudie which is very steep and drought prone due to hydro development.

Topographic Map of the Bran

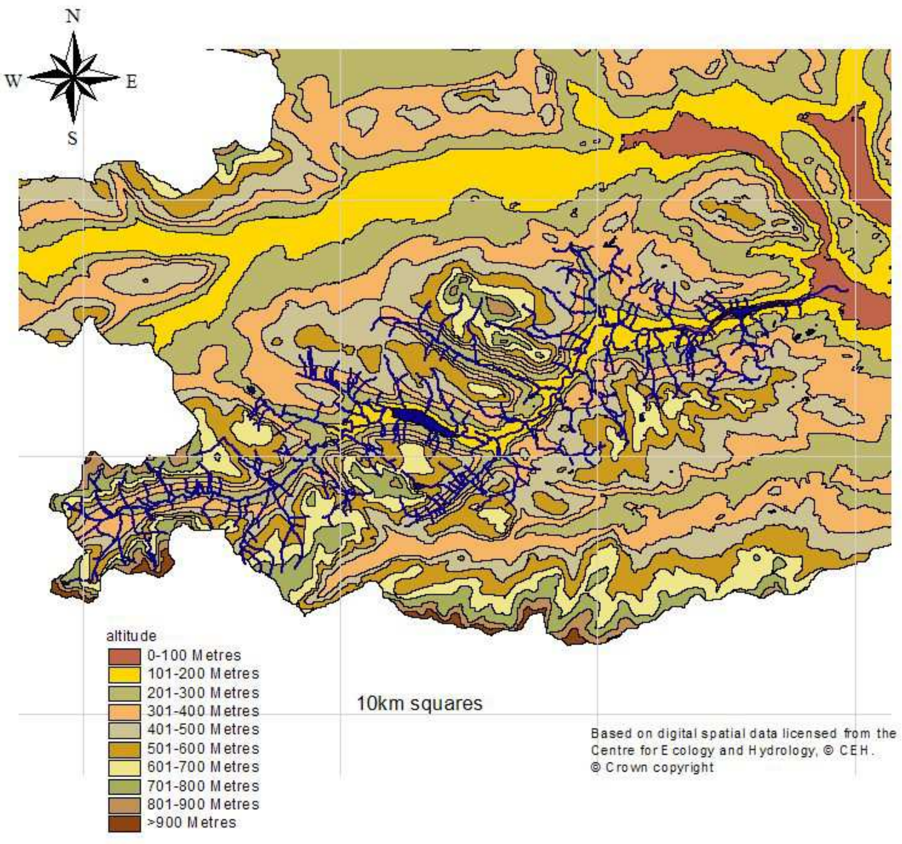


3.1.1.3 Meig topography and description

The River Meig is separated into three distinct sections by lochs at Scardroy and Meig Reservoir. The Meig arises at the top of Glen Fhiodhaig and runs swiftly down to Loch Beannacharain (Scardroy). This section runs through a steep sided glacial valley with only the lowest reaches of any tributaries accessible to fish before their gradient increases. There is a falls at Coriefeol which is passable to salmon under some flows via a semi-natural bypass channel. The Upper Meig contains some of the highest suitable salmonid habitat in the Conon catchment at an altitude of 200m to 300m.

The middle reaches of the Meig have a moderate gradient and a mixture of pool / glide / riffle habitat which provides good salmonid spawning and nursery habitat. The Middle Meig is between 100m and 200m in altitude and in places has a wider valley and several major tributaries which contain good salmonid habitat. The Lower Meig from Meig Dam down to the confluence with the Upper Conon flows through a steep sided gorge before opening out into a wider valley where the Meig and Conon catchments merge.

Topographic Map of the Meig



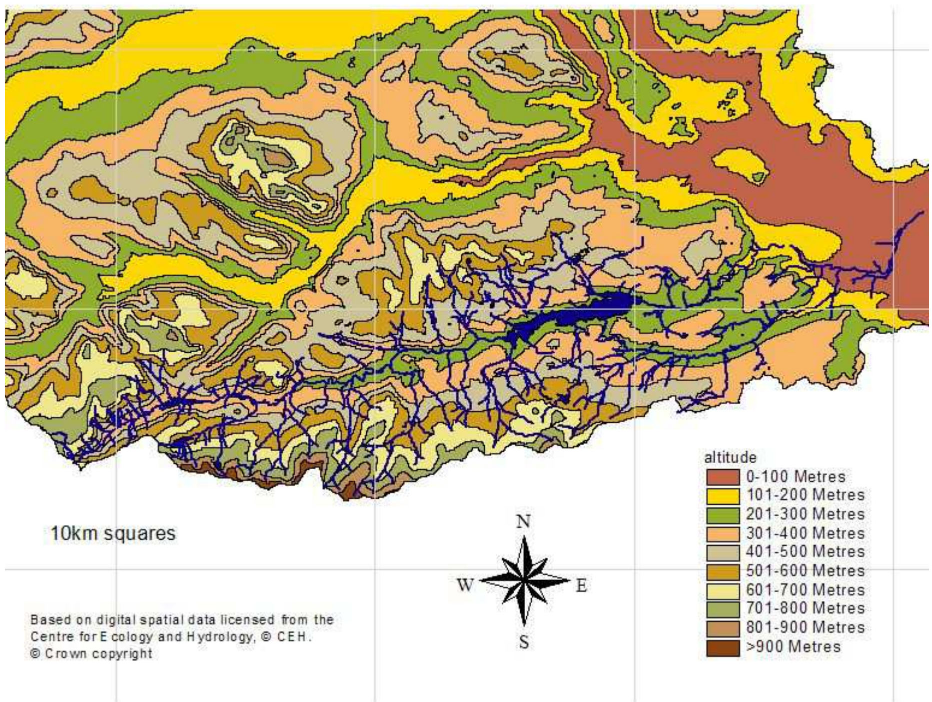
3.1.1.4 Orrin topography and description

The River Orrin is one of four main tributaries of the River Conon. The Orrin rises between Strathconon and East Monar Forests within five kilometres of Loch Monar. The Orrin meets the Conon near Urray. In 1959 the Orrin was divided into Upper and lower sections by the construction of Orrin Dam as part of the Conon Basin Hydro-electric Scheme.

The Orrin has been more influenced by hydro development than the other Conon tributaries. The Orrin Dam was found to be a major barrier to smolt migration and the area of excellent nursery habitat upstream of the dam was lost to migratory fish. In recent years Scottish Hydro Electric and the Cromarty Firth DSFB have been working to restore access to the Upper Orrin.

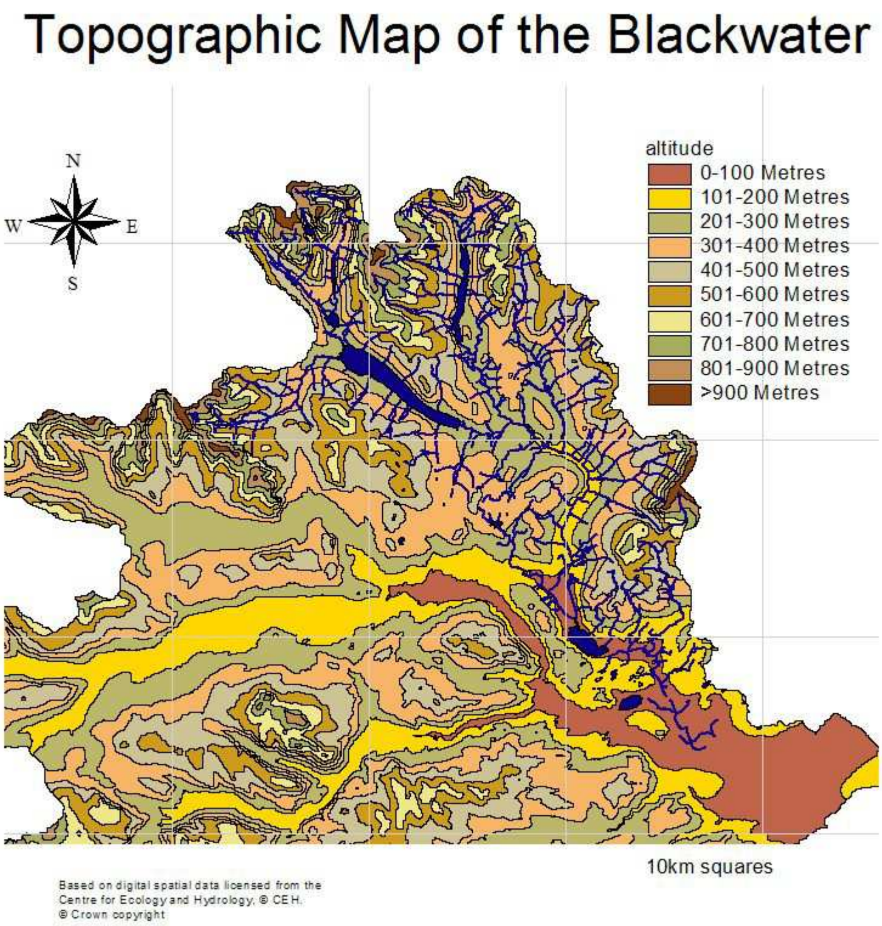
The contour map shows that the Lower Orrin from Orrin Dam down to Urray is further divided into two sections by Orrin Falls. The section below Orrin falls has a gentler gradient than the section above the falls which is relatively steep. This has led to a further effect on instream habitat. Orrin Dam prevents the downstream movement of gravel and finer sediments which would normally take place. The section from the Dam to Orrin Falls being steep has been scoured of gravels and finer materials since 1959 and these materials have not been replaced. This has led to an increase in substrate size which gives cover for parr but a loss of gravel for spawning and fry. A 1995 Conon DSFB habitat survey identified this imbalance between spawning and parr habitat as limiting the potential of the Lower Orrin.
The Upper Orrin contains the highest altitude salmonid habitat in the Conon system, with habitat over 300m in altitude.

Topographic Map of the Orrin



3.1.1.5 Blackwater topography and description

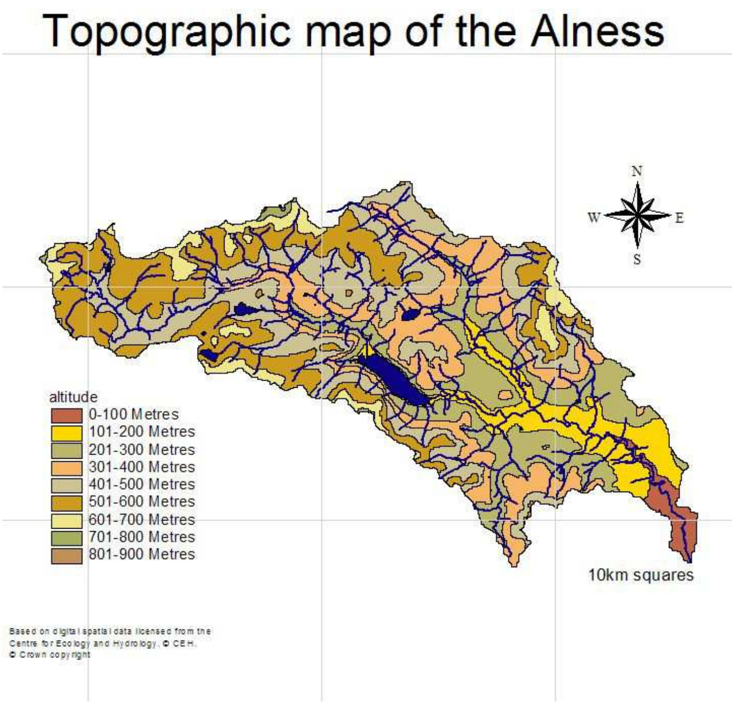
The Blackwater is the most northerly of the Conon tributaries. It is lower lying than the Meig and Orrin, with large areas of the valley below 100m in altitude. The upper reaches of the Blackwater are cut off by dams at Glascarnoch and Strath Vaich. The gradient below these dams is moderate and the valley floor wider than the more southerly Conon tributaries. A major tributary, Strath Rannoch, flows into the Blackwater from the North although much of the flow of Strath Rannoch is diverted by pipeline into Loch Vaich. There are a series of significant falls at Silver Bridge before the Blackwater flows at a more gentle gradient into Loch Garve and Loch na Croic. Downstream of Loch na Croic, the Blackwater flows through a steeper gorge and the large water falls at Rogie which are bypassed by a fish ladder. Downstream of Rogie falls the gradient decreases as the Blackwater flows into a wider valley below Contin before joining the Conon above Moy Bridge.



3.1.2 Alness topography and description

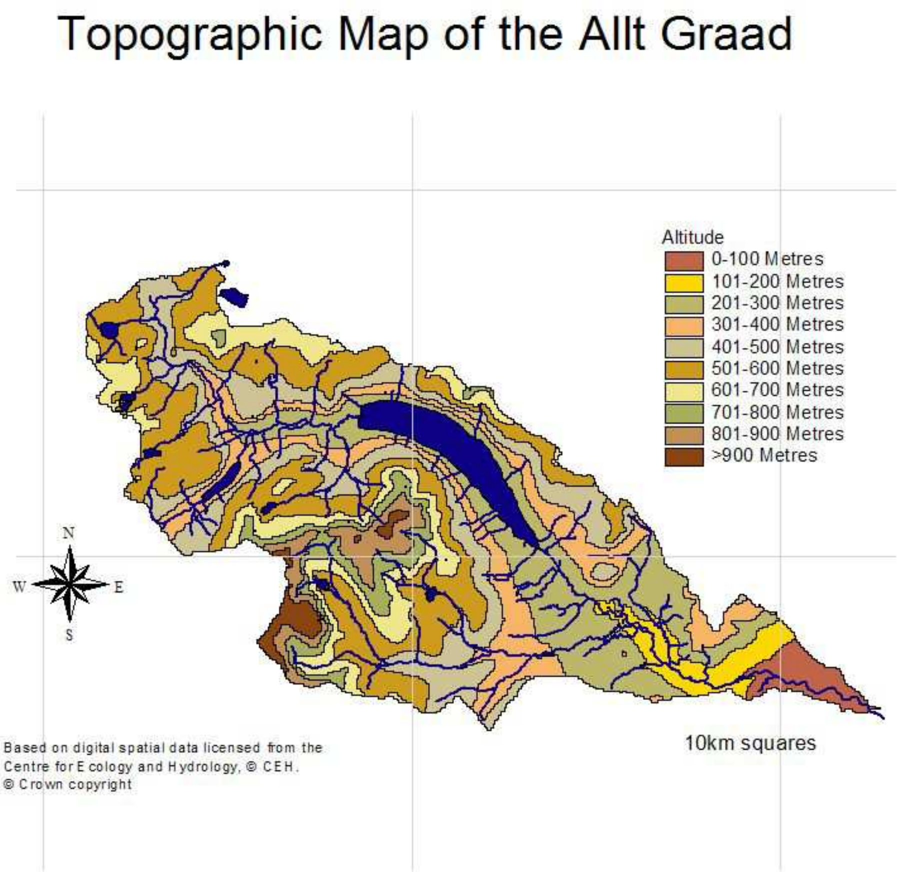
The Alness flows into the north shore of the Cromarty Firth near the town of Alness. The main stem of the Alness, between its mouth and Loch Morie, is largely fringed with native woodland and in sections flows through steep sided ravines.

The Alness system above Loch Morie is extensive, with Abhainn Toll a Choin, Abhainn na Glasa and their tributaries draining the open moorland of Kildermorie deer forest. The Lower Alness has one large tributary, the Blackwater, which flows through Strath Rusdale and several smaller tributaries, the most significant of which are the Tollie Burn which flows through Ardross Castle and Allt na Seasgaich near Boath. There is a small dam at the outfall of Loch Morie which was constructed by the Alness DSFB in the 1970s. This is designed to store water to be released as artificial spates to attract fish upstream during the summer. This dam is fitted with a fish pass which gives salmon access to Loch Morie and above. In the town of Alness near the mouth of the river there is a weir which provides water for the Dalmore Distillery. A Denil fish pass has been installed in the weir to provide access for migratory fish. The intake to the distillery lade is screened with a louvered screen array to prevent smolts from entering the lade.



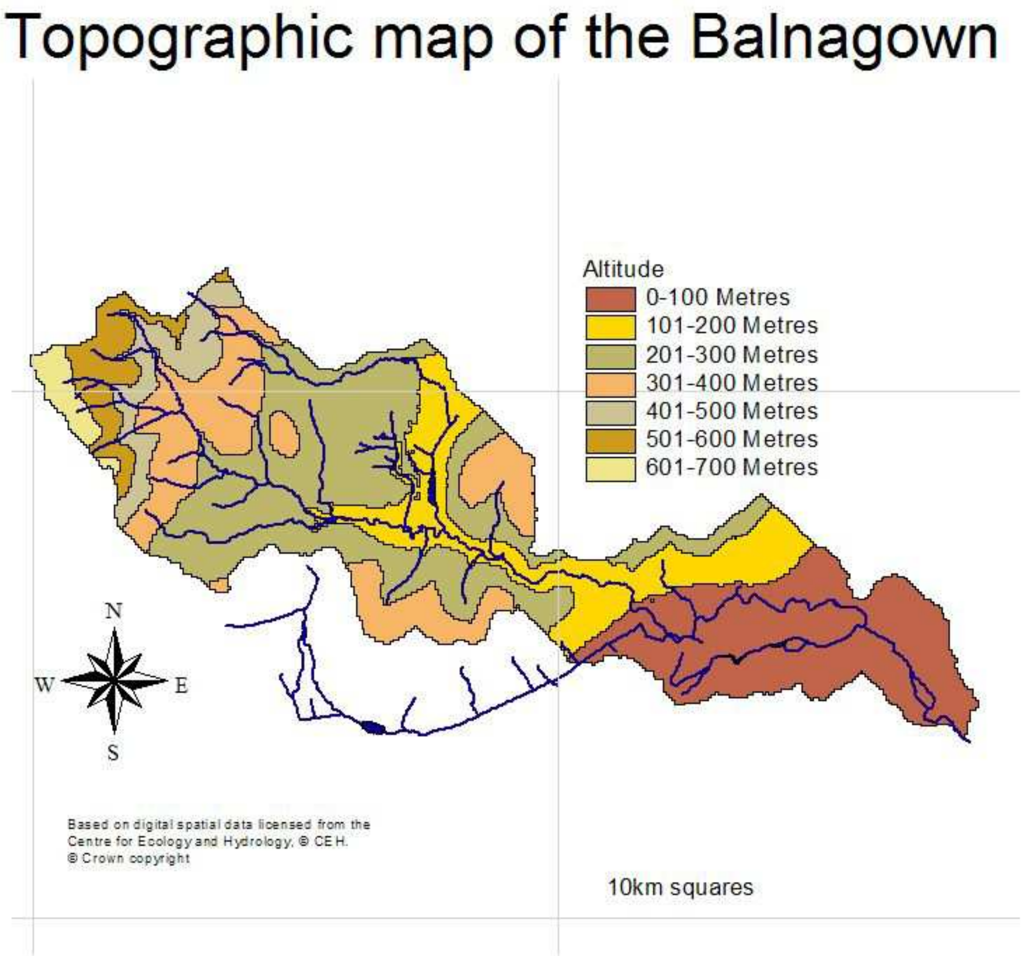
3.1.3 Allt Graad topography and description

The Allt Graad rises between the northern slopes of Ben Wyvis and Kildermorie Deer Forest. It flows east to Loch Glass, which is the North of Scotland Water Authority reservoir serving the Dingwall area. There is an impassable weir at the outlet of Loch Glass, which prevents both upstream and downstream movement of fish. Because of this the area above Loch Glass was not covered in the 2001 survey. The map below shows the topography of the catchment it can be seen that from Loch Glass the Allt Graad flows at a gentle gradient for 8 kilometers before it reaches the Black Rock Gorge. The gorge is a very narrow and spectacular ravine with a series of falls which prevent the upstream passage of migratory fish.



3.1.4 Balnagown topography and description

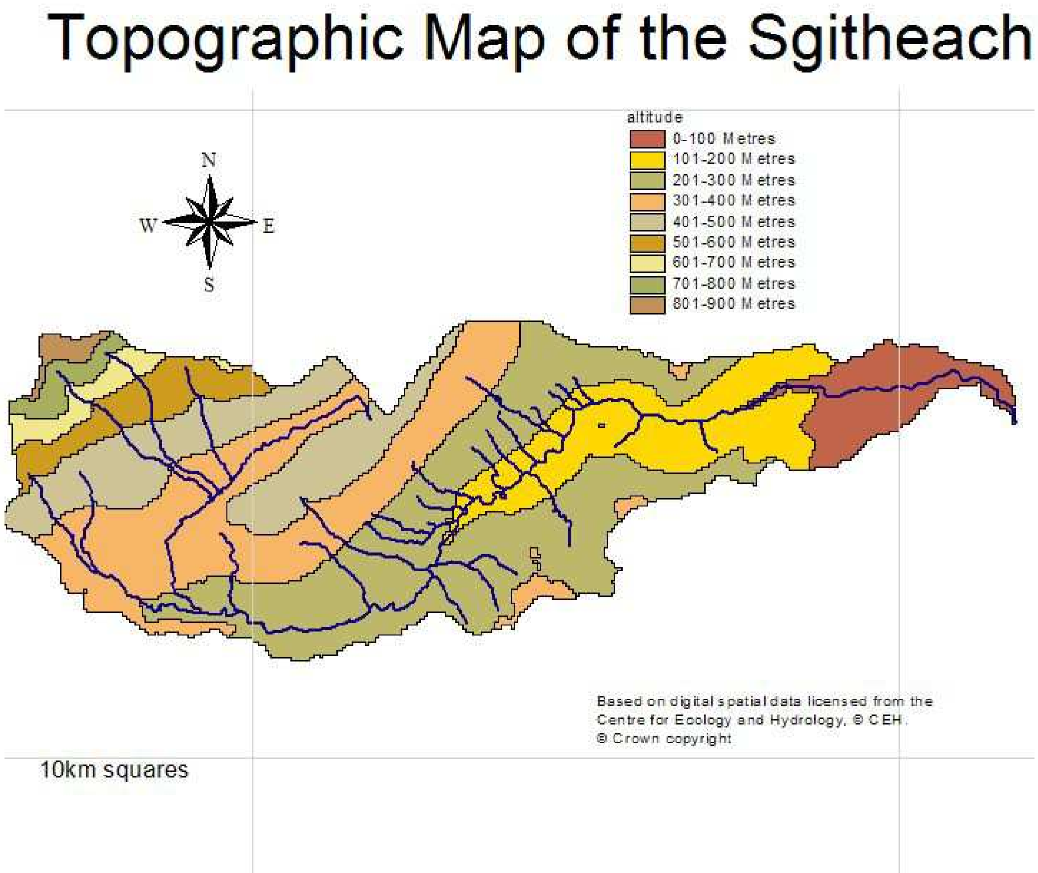
The Balnagown rises on the eastern slopes of Beinn Tharsuinn and falls 320 m in its 25 km course to the sea through Strath Rory. From the topographic map below it can be seen that many of the upper tributaries of the Balnagown are very steep. The Balnagown passes through steep gorges in its middle sections before flowing over flatter land around the village of Kildary and entering the Cromarty Firth at Nigg Bay.



3.1.5 Sgitheach topography and description

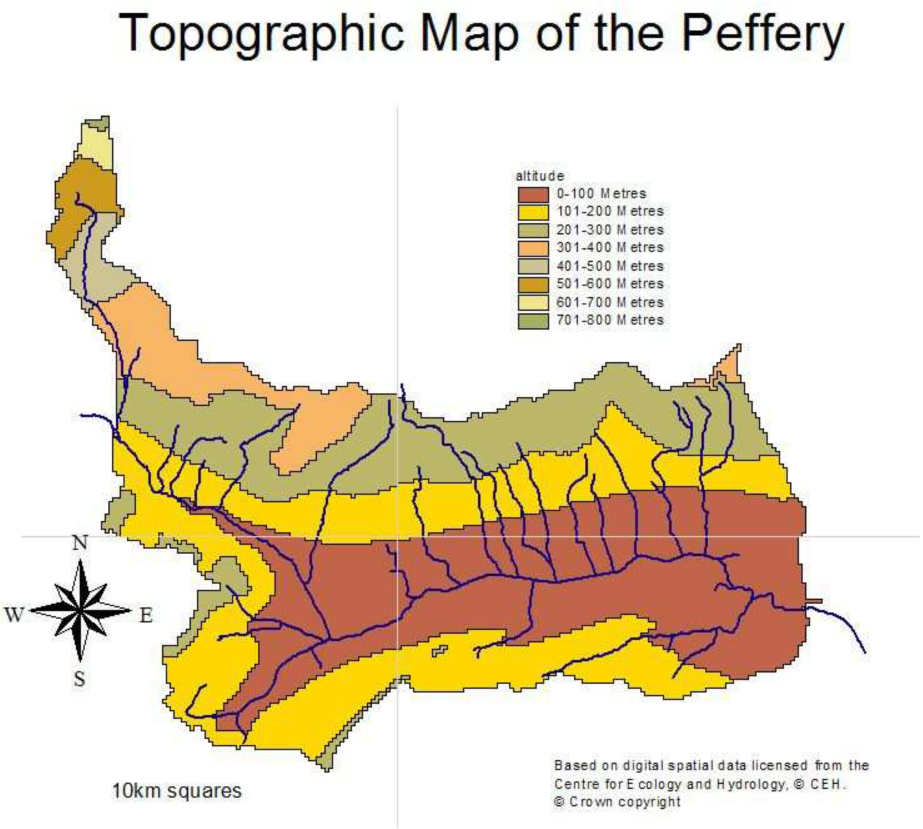
The River Sgitheach rises on the southern slopes of Ben Wyvis at an altitude of over 500m. From the topographic map below it can be seen that after a steep descent from its source, the Sgitheach then flows through the gently sloping Strath Sgitheach, before falling steeply again near Swordale. Below Swordale the Sgitheach slopes gently for a further 4km before reaching the Cromarty Firth south of Evanton.

At the time of surveying in 2001 all the tributaries other than An Leth-allt were either dry or too steep to support viable fish populations.



3.1.6 Peffery topography and description

The Peffery drains the southern slopes of Ben Wyvis. Although its headwaters begin above 500m the majority of the catchment lies below 100m in altitude in a broad valley with deep soil cover. There are no stillwaters on the Peffery and it runs off quickly after rainfall. The middle and lower reaches of the Peffery were extensively straightened and dredged by arterial drainage works in the 1960s and 70s. There is weir in Dingwall and a SEPA gauging weir at the Strathpeffer Sewage Treatment Works.

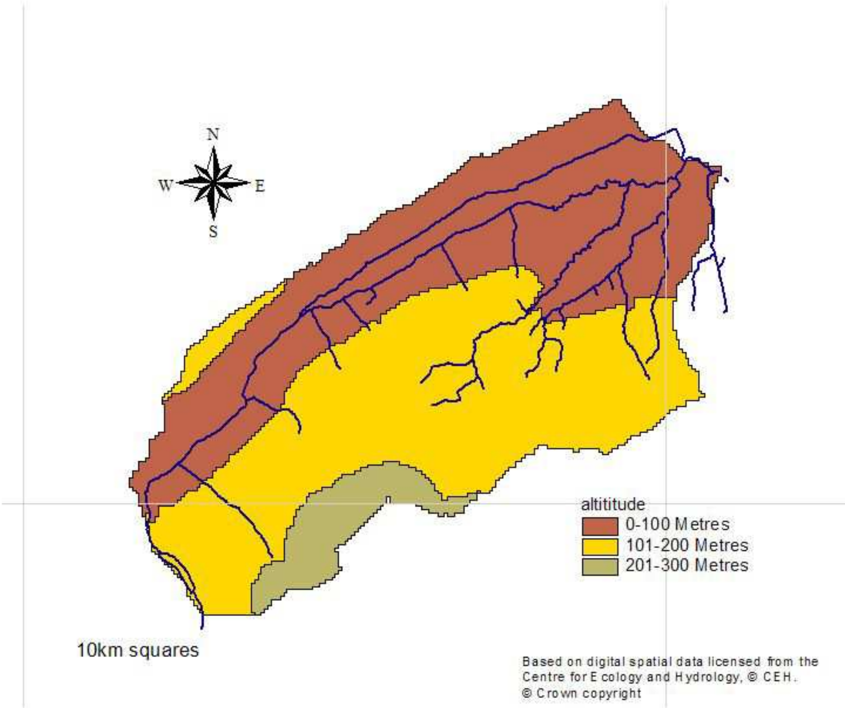


3.1.7 Newhall Burn topography and description

The Newhall Burn and its tributaries drain the central northern slopes of the Black Isle and run into the Cromarty Firth near Jemmimaville. The Newhall Burn and Kinbeachie Burn in the North of the catchment have a gentle gradient whilst the more southerly tributaries are steeper.

The Newhall catchment slopes gently from south to north and is generally low lying compared to most other rivers in the Cromarty region. The majority of watercourses are below 100 m in altitude. Compared with many other rivers in the region there is a lack of still water and water storage in the catchment.

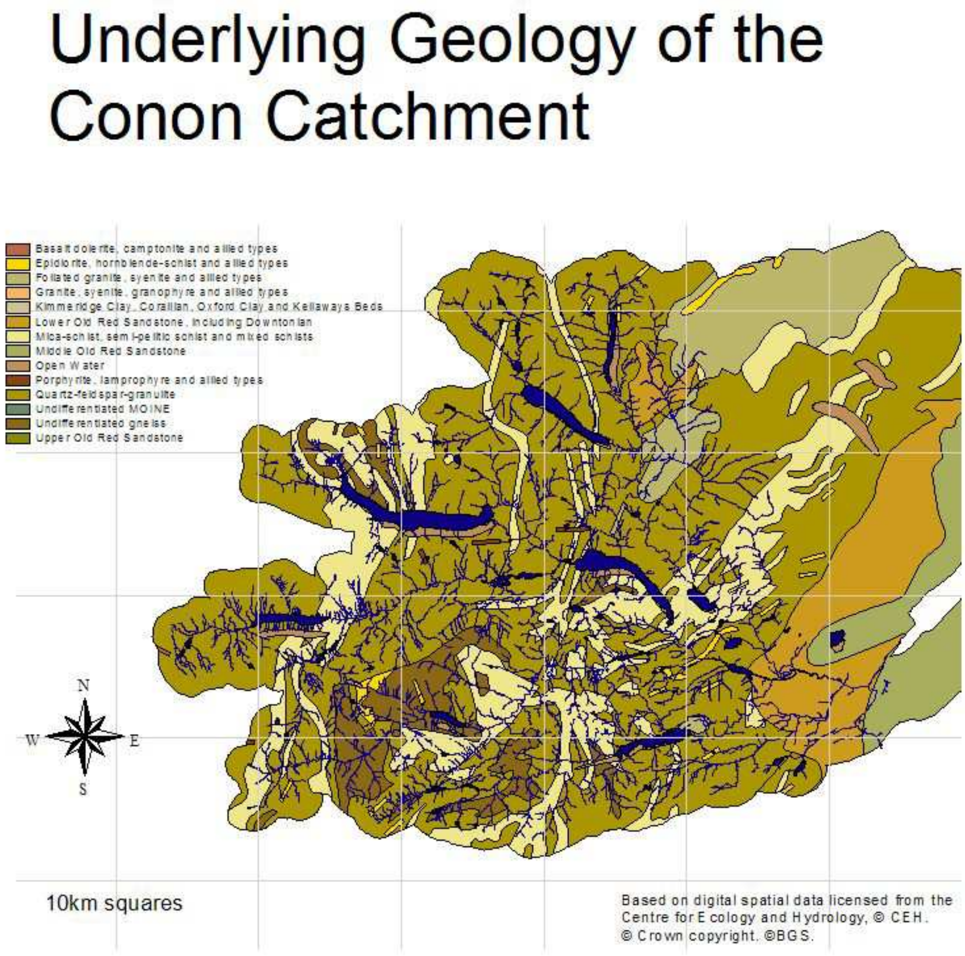
Topographic Map of the Newhall Burn



3.2 Map and summary text of catchment geology for each Management Unit.

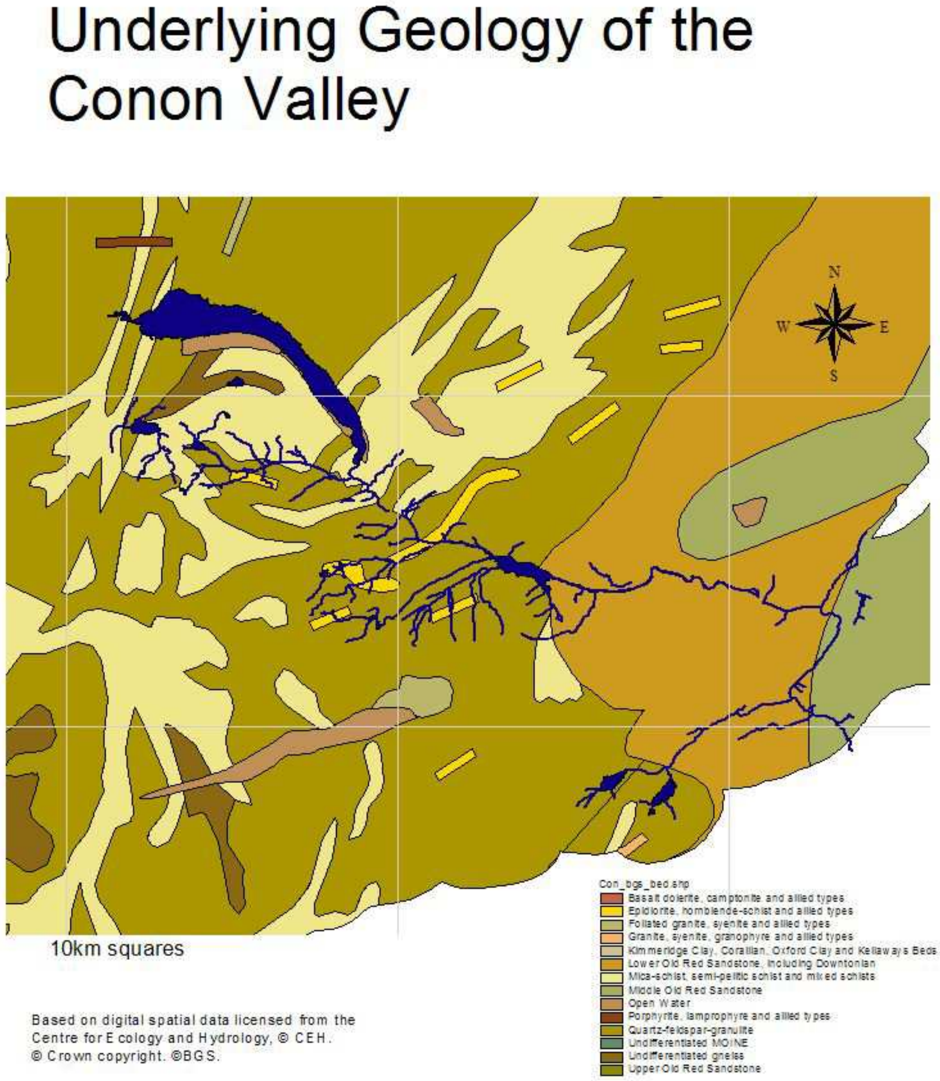
3.2.1 Conon Geology

The underlying geology of the upper catchments of the Conon system is dominated by granite and schists, with the lower catchment mostly red sandstone. The underlying geology combined with the effects of glaciation result in the rugged mountainous nature and steep valley sides of the upper catchments. This contrasts with the rolling sandstone foothills to the east of the region. The underlying geology of the upper catchments combined with thin soils and rainfall in excess of 2 metres per year make them particularly vulnerable to the loss of nutrients. The granite / schist bedrock makes some areas acid sensitive when combined with extensive conifer afforestation.



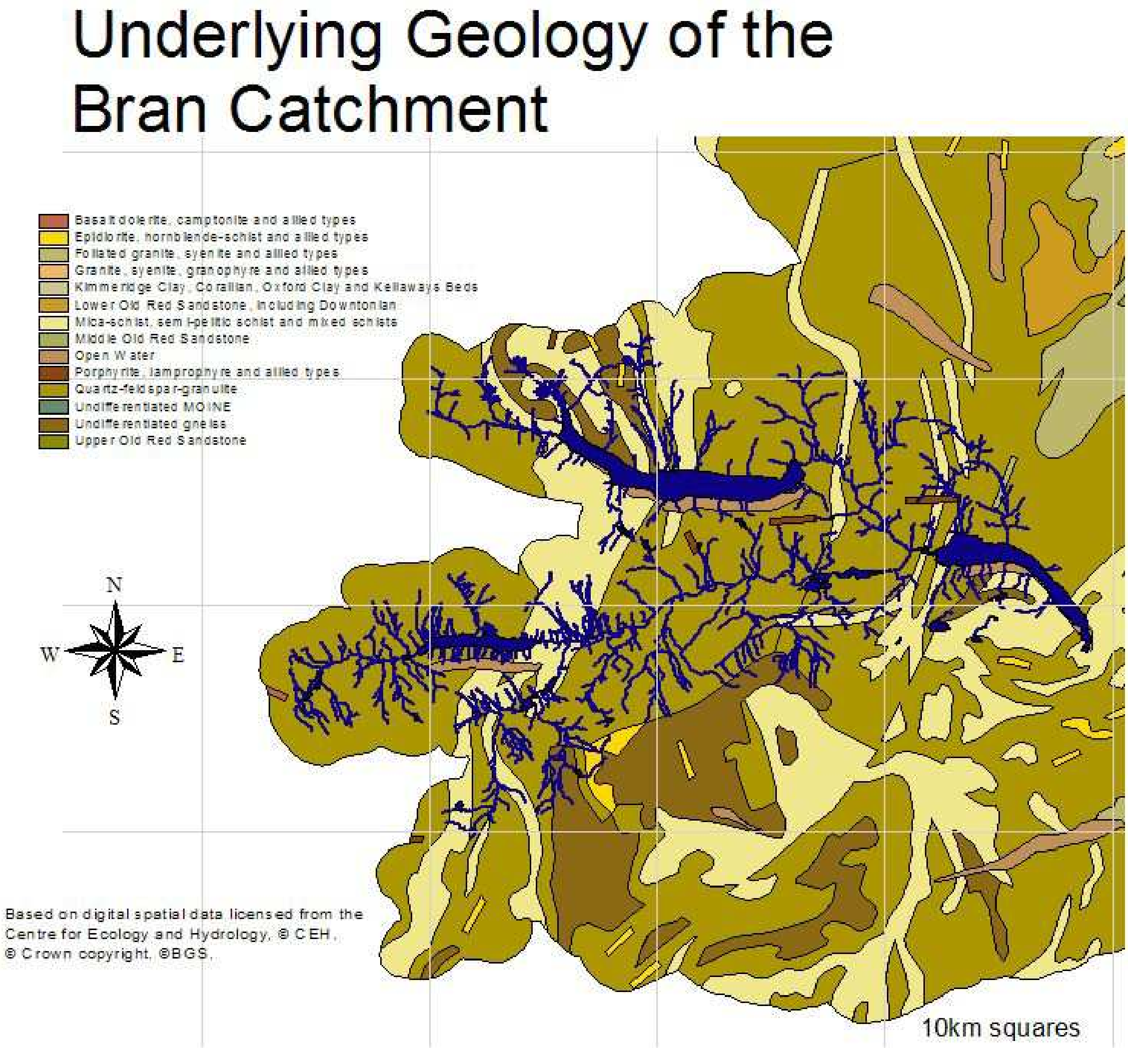
3.2.1.1 Main stem of Conon Geology

The Lower Conon flows over a bed rock of lower old red sandstone overlain by deep soils. In contrast the Upper Conon flows over quartz-feldspar-granulite bedrock with shallow poor soils. There are also bands of mica schist which cross the Upper Conon and these are most evident at the gorge and falls below Loch Luichart.



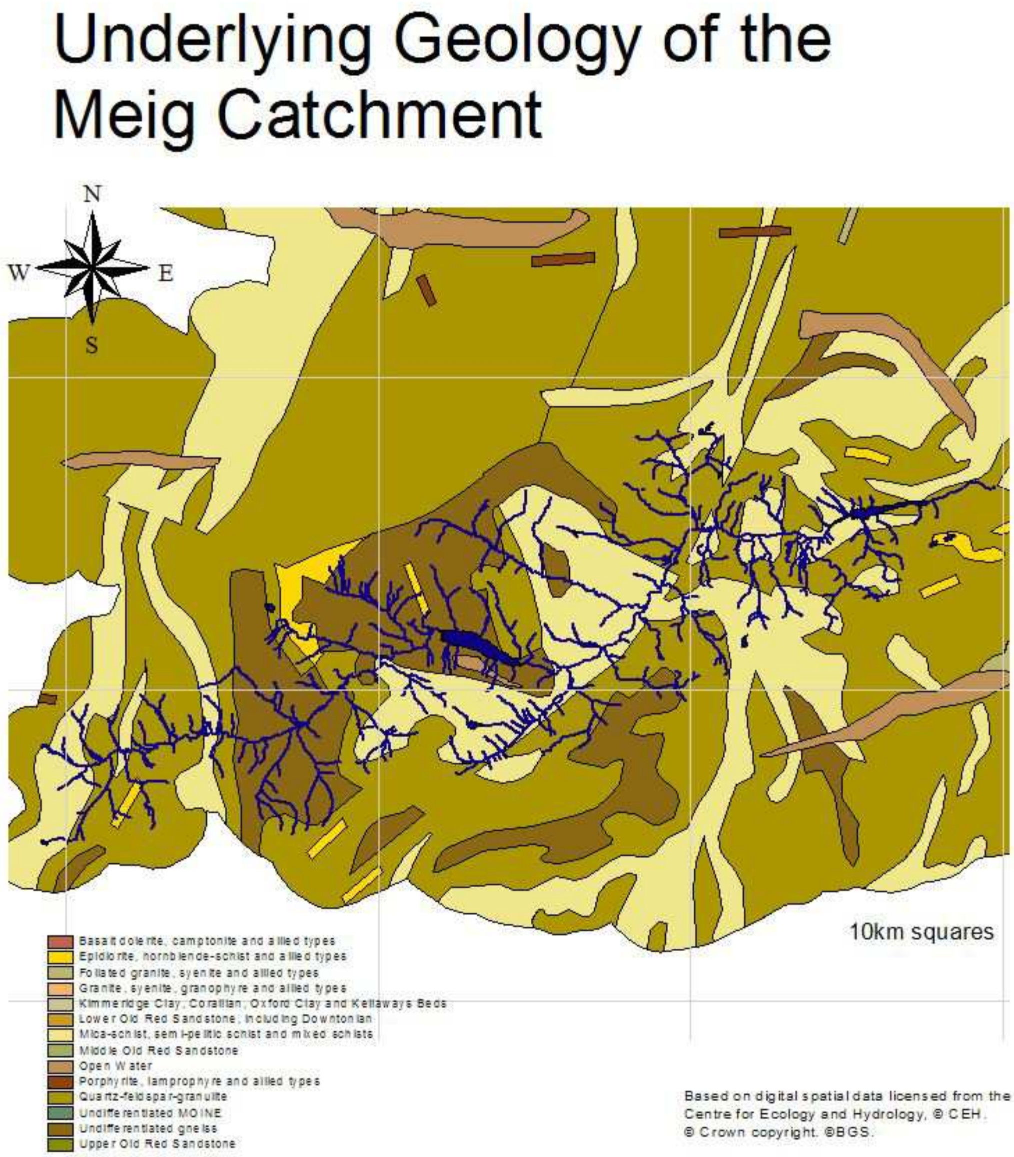
3.2.1.2 Bran Geology

The main plain of the Bran Valley from Luichart to Achnasheen has an underlying geology of quartz-feldspar-granulite. A band of mica-schist crosses the Bran above Loch Luichart and forms the Achanalt Falls and Gorge. A further band of schist crosses the Bran between Achnasheen and Loch Rosque, this can be seen at the falls at Allt Mhartuin and Allt Gharagainn above Loch Gowan which limit upstream access for salmon.



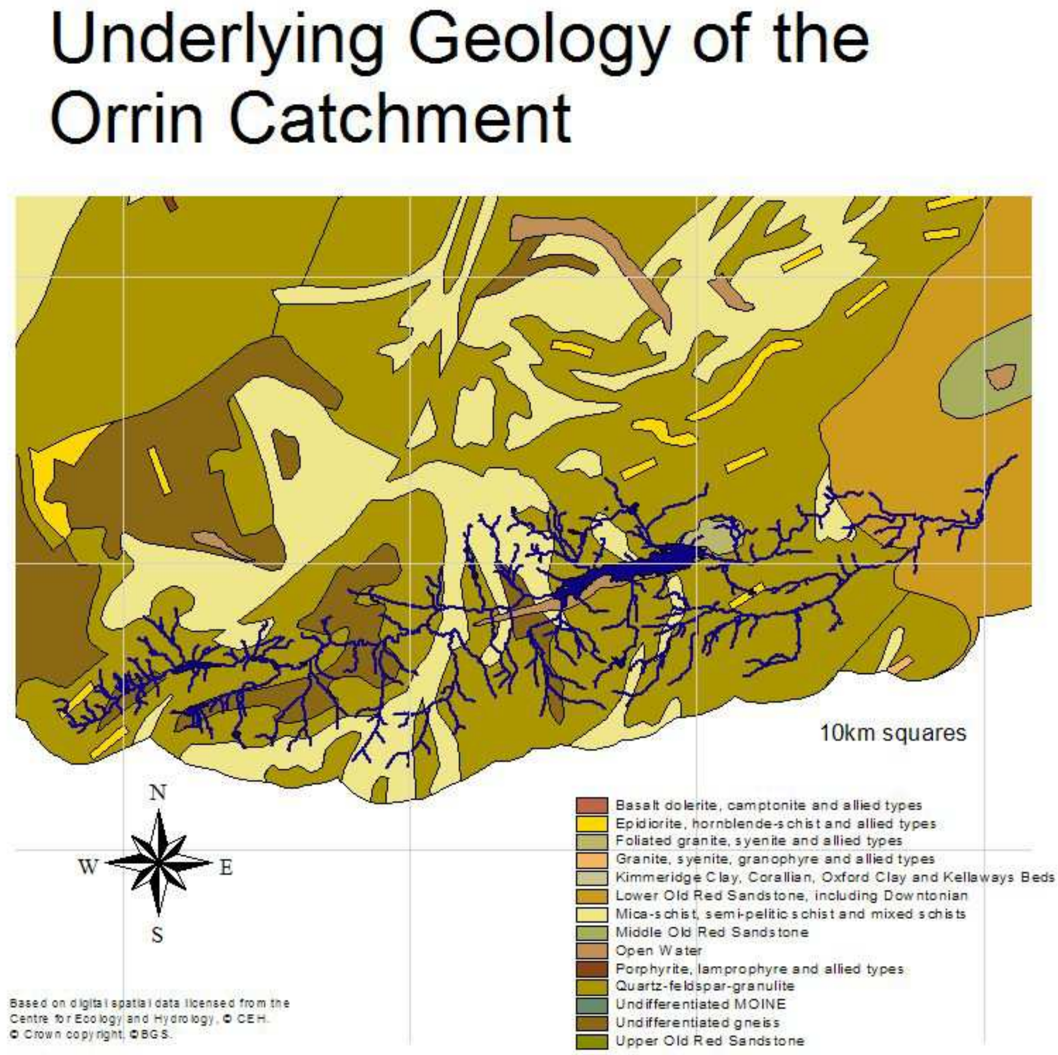
3.2.1.3 Meig Geology

The underlying geology of the Meig is relatively complex. The lower and upper reaches flow over a bedrock of quartz-feldspar-granulite. There are bands of mica-schist which form the gorge below Meig Dam and low falls between the Reservoir and Strathconon Village. Gneiss and schist form the steep valley sides and falls at Corriefeol.



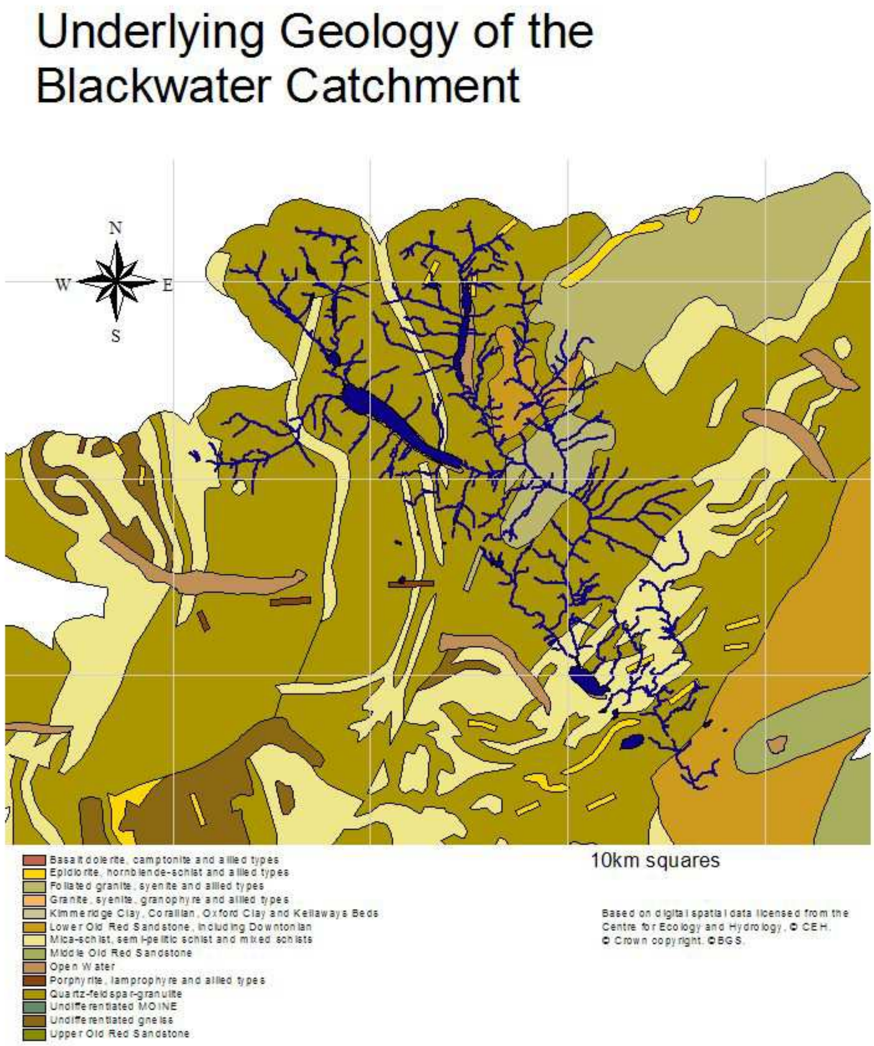
3.2.1.4 Orrin Geology

The lower reaches of the Orrin flow over lower old red sandstone down to the junction with the Conon. Where the lower old red sandstone joins a more extensive area of quartz-feldspar-granulite there is an outcrop of conglomerate which forms the Falls of Orrin. Upstream of Orrin Falls there are several bands of mica-schist and gneiss which cross the quartz-feldspar-granulite. The proportion of gneiss and schist increases in the uppermost parts of the Orrin catchment.



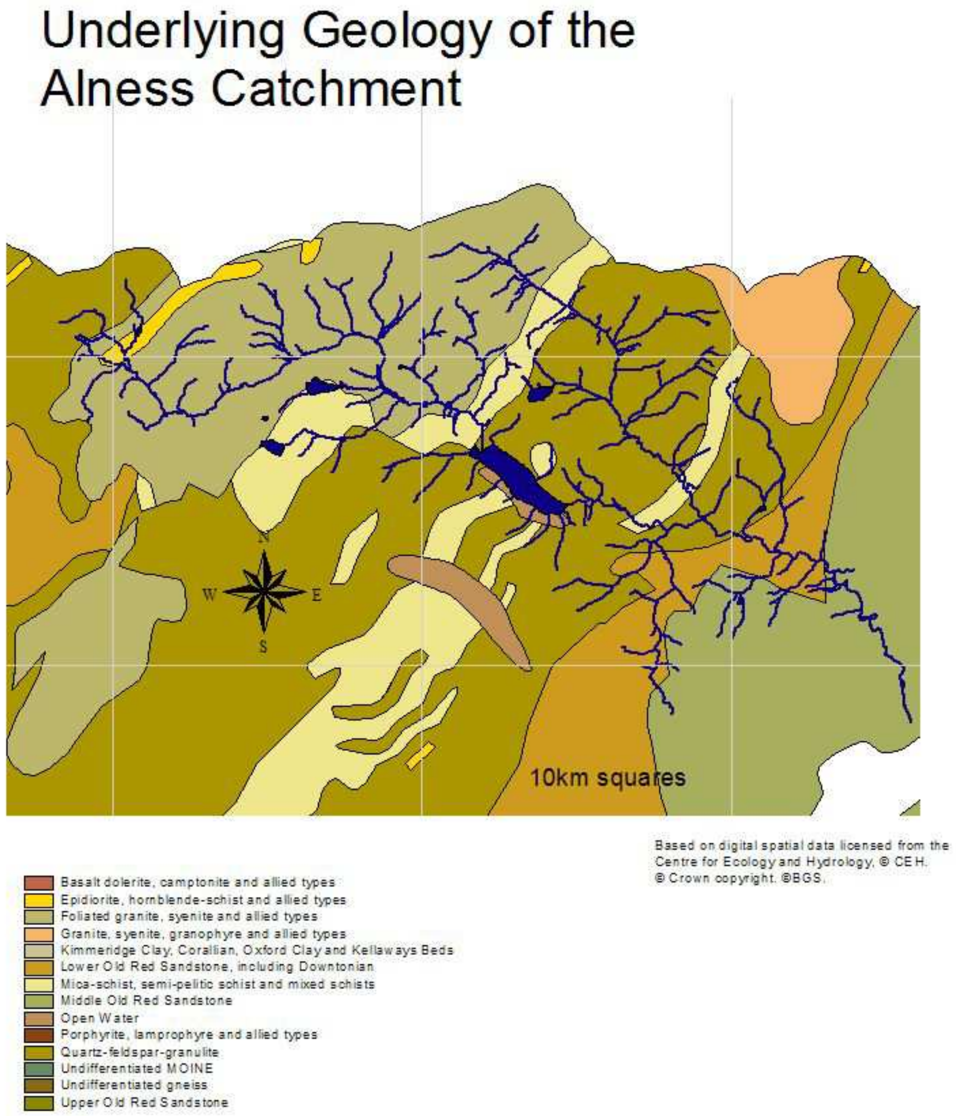
3.2.1.5 Blackwater Geology

The Blackwater catchment is dominated by an underlying geology of quartz-feldspar-granulite with some lower old red sandstone in its lower reaches. The falls at Rogie and Silver Bridge are due to outcrops of schist. There is an extensive area of foliated granite around the junctions of Glascarnoch, Vaich and Rannoch with the Blackwater. Two watercourses in the Blackwater system have been shown to be particularly vulnerable to acidification, the Allt Fionnaidh which flows into Loch na Croic and the Rogie Burn. Electro-fishing shows the Rogie Burn to frequently have missing year classes and virtually no juvenile salmon survive in Allt Fionnaidh, despite a high level of salmon spawning in both. The reason for this is partly explained by the underlying geology of these two burns, which flow over the band of mica-schist which crosses the Blackwater. The extensive conifer afforestation of these burns combined with their geology results in a level of acidification which juvenile salmon can not survive.



3.2.2 Alness Geology

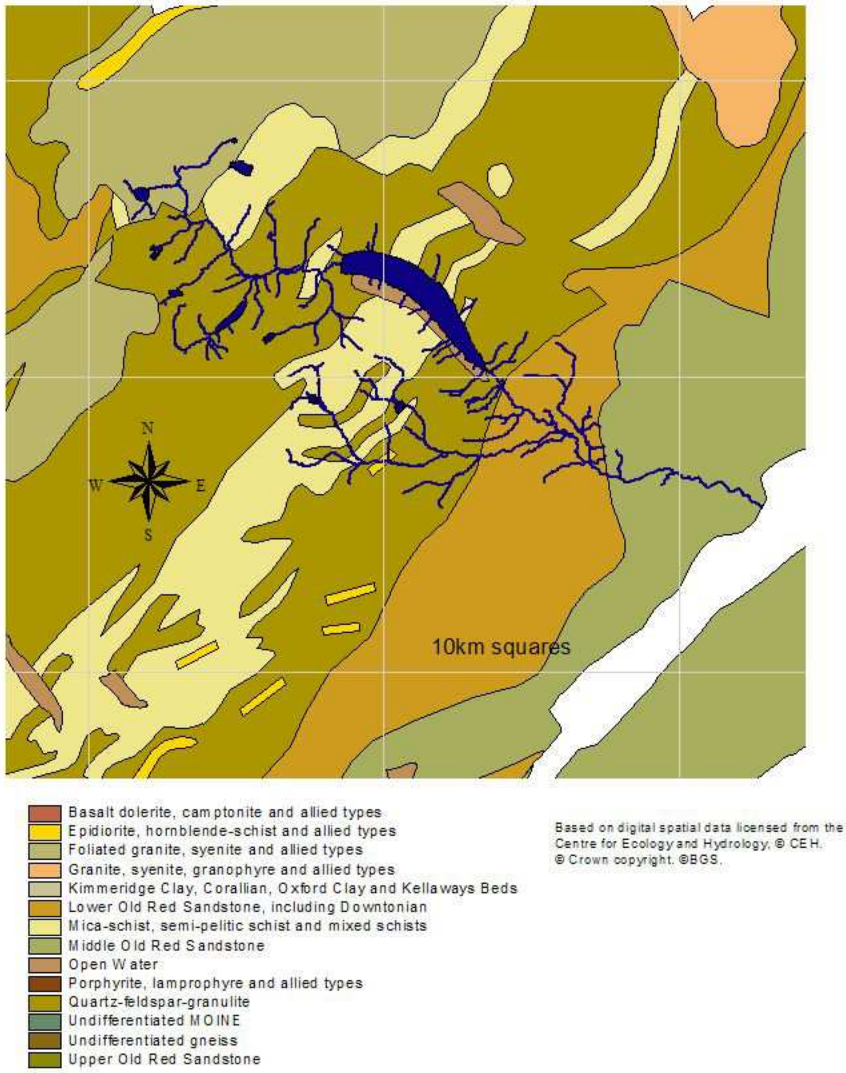
The upper reaches of the Alness have an entirely different geology from the middle and lower reaches. The upper catchment is largely underlain by foliated granite with a band of mica-schist immediately above Loch Morie. The middle reaches are underlain by quartz-feldspar-granulite, whilst from just below the Blackwater junction the Alness flows over middle & lower old red sandstone. The middle and upper catchment have thin soils compared to the deeper richer soils of the lower catchment.



3.2.3 Allt Graad Geology

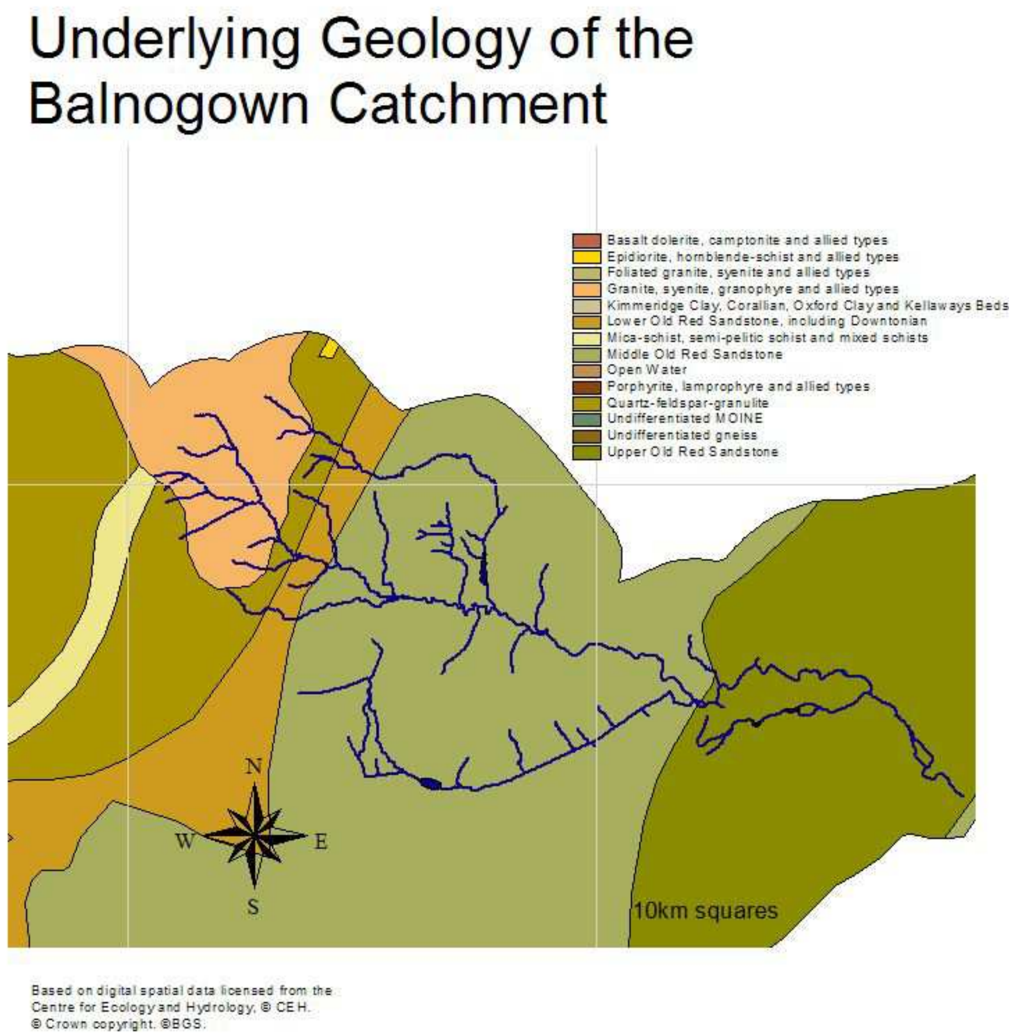
The upper reaches of the Allt Graad flow over foliated granite, with a band of mica-schist running from south/west to north/east under Loch Glass. Downstream from Loch Glass, the Allt Graad flows over lower old red sandstone and then middle old red sandstone. The Black Rock Gorge is formed at the junction between the middle and lower old red sandstone.

Underlying Geology of the Allt Graad



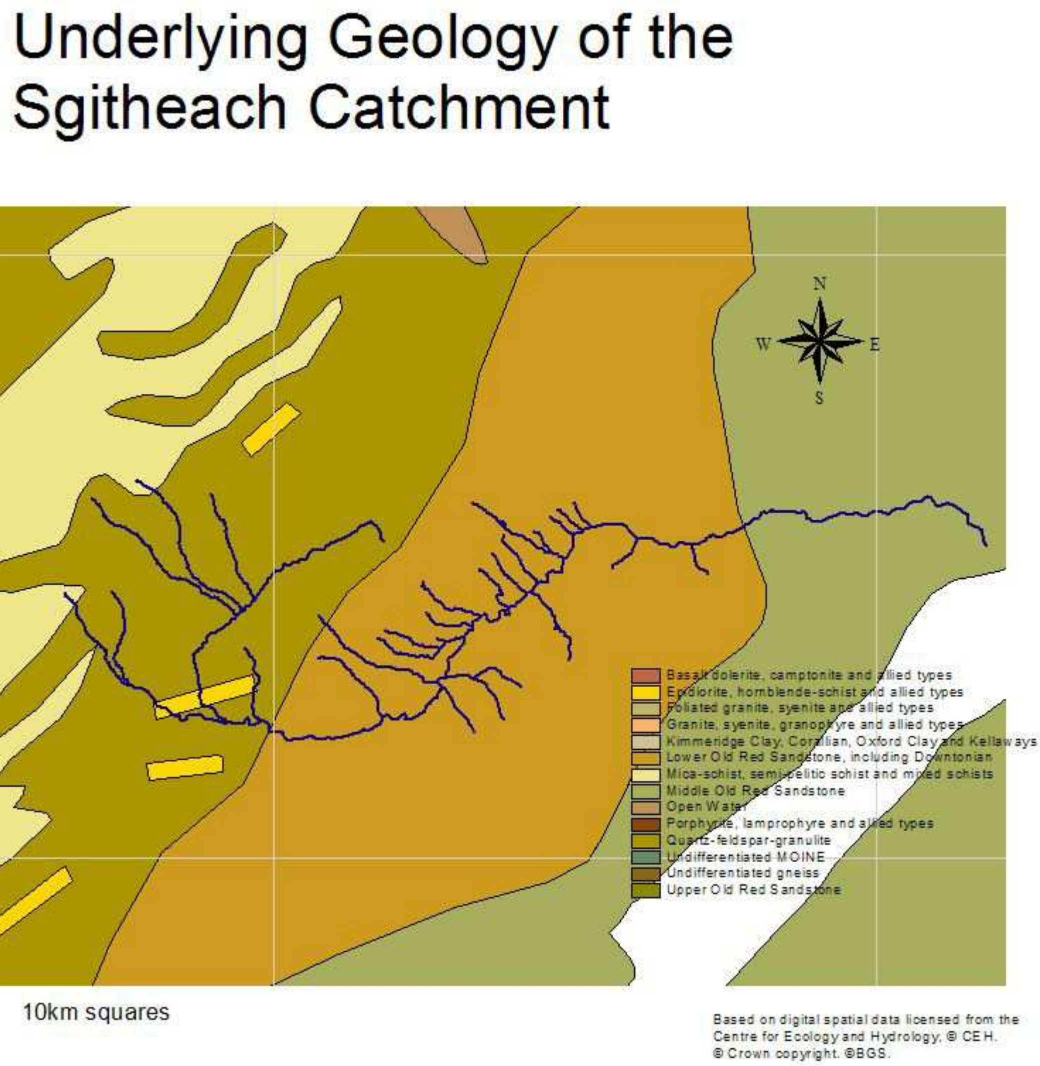
3.2.4 Balnagown Geology

Only the highest headwaters of the Balnagown drain granite and quartz-feldspar-granulite. The vast majority of the Balnagown flows over middle and upper old red sandstone with a small band of lower old red sandstone.



3.2.5 Sgitheach Geology

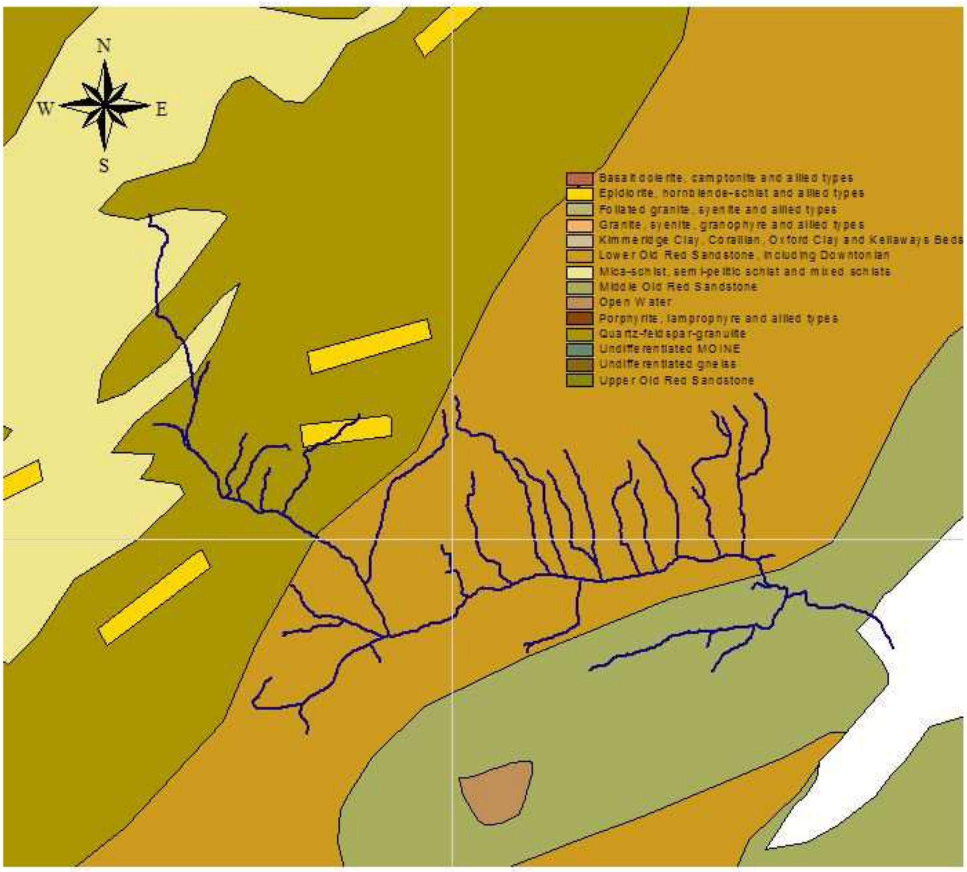
The headwaters of the Sgitheach drain an area of quartz-feldspar-granulite on the slopes of Ben Wyvis. The majority of the Sgitheach then flows over lower old red sandstone, before a change to middle old red sandstone. The series of falls which bar migration of salmon to the middle and upper reaches of the Sgitheach are at the change between lower & middle old red sandstone.



3.2.6 Peffery Geology

The underlying geology of the Peffery is split into two sections. The upper reaches are underlain by mica-schist and then quartz-feldspar-granulite with thin soils. The middle and lower reaches are underlain by middle and lower old red sandstone with deeper soils.

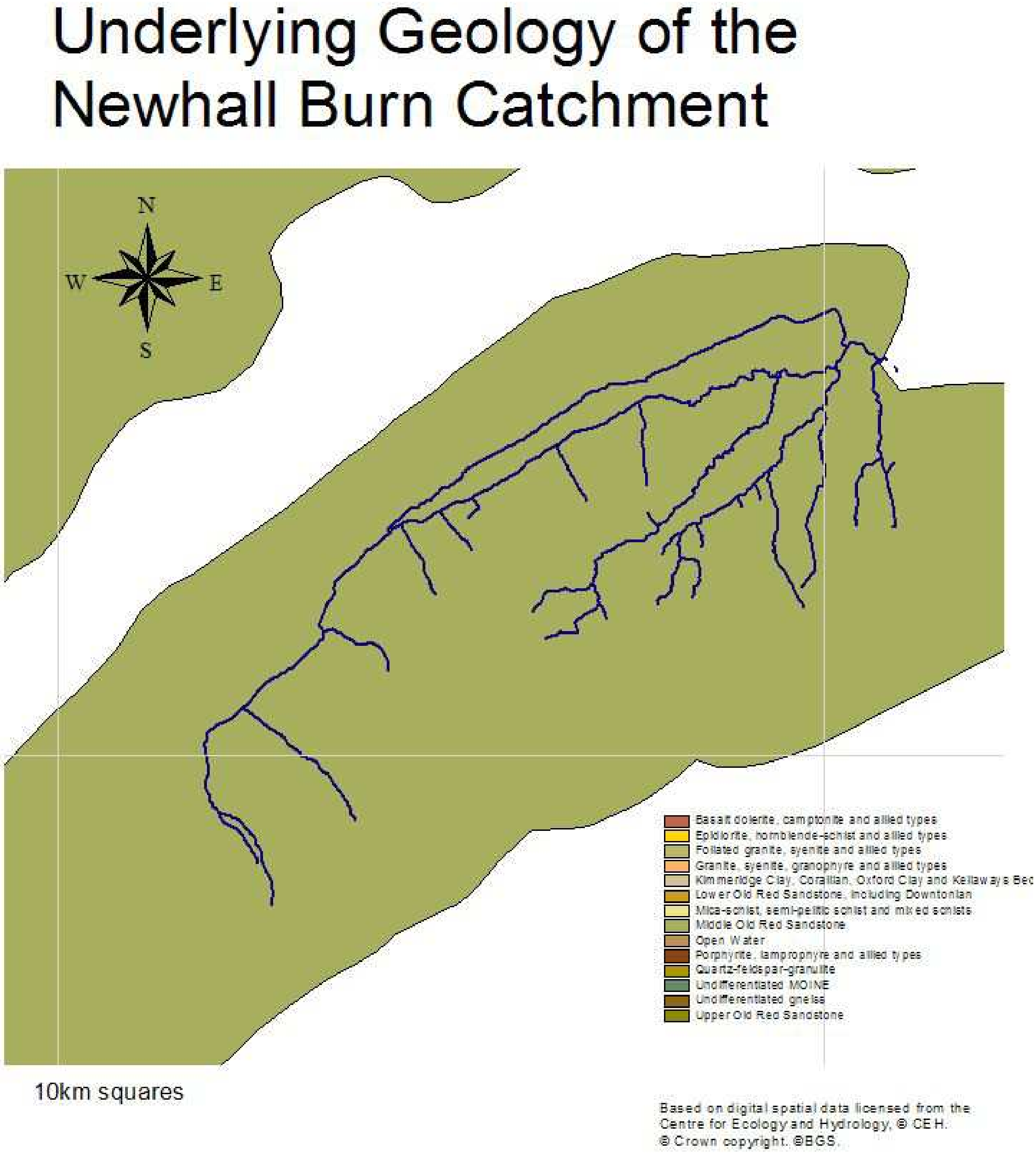
Underlying Geology of the Peffery Catchment



10km squares

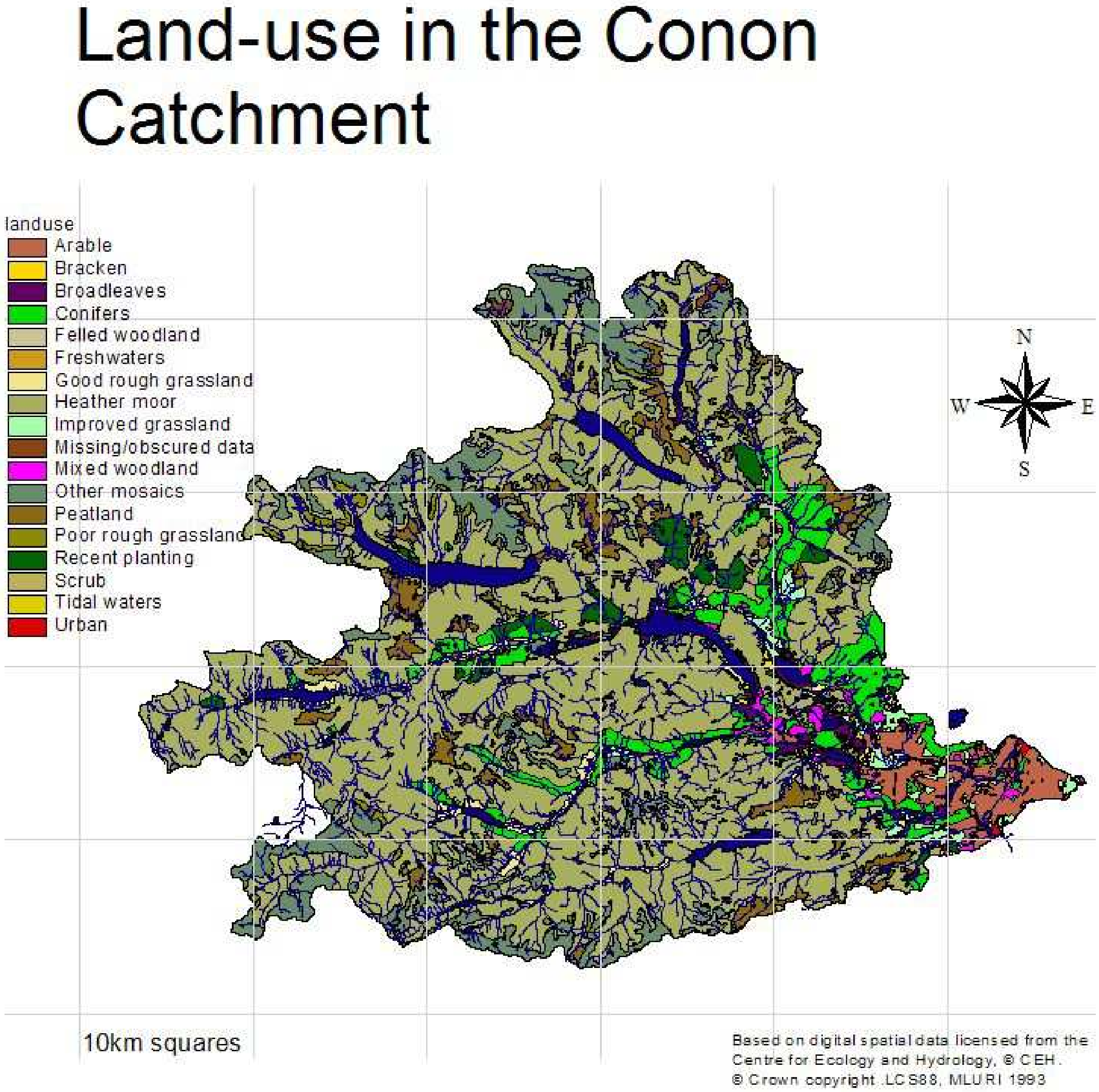
3.2.7 Newhall Burn Geology

The underlying geology of the Newhall Burn catchment is perhaps the simplest in the region being entirely middle old red sandstone overlain by relatively deep soils.



3.3 Maps and summary text detailing major land-use within management units

3.3.1 Land-use in the Conon Catchment



From a fishery perspective land-use both historical and recent has had an important influence on fish stocks and habitats. Historical deforestation of upland areas, followed by sheep and deer grazing has changed the landscape, nutrient status and hydrology of the catchment. The planting of large areas of non native conifers and associated drainage works has had a further influence on fish stocks. The construction of the Conon Basin Hydroelectric scheme in the 1950's has had both a direct effect on fish migration and indirect effects on fish habitat. The Conon Scheme is described in detail by Payne 1988 and summarised a Historical Survey of the Conon prepared for SNH in 2002 (report F00PA40)

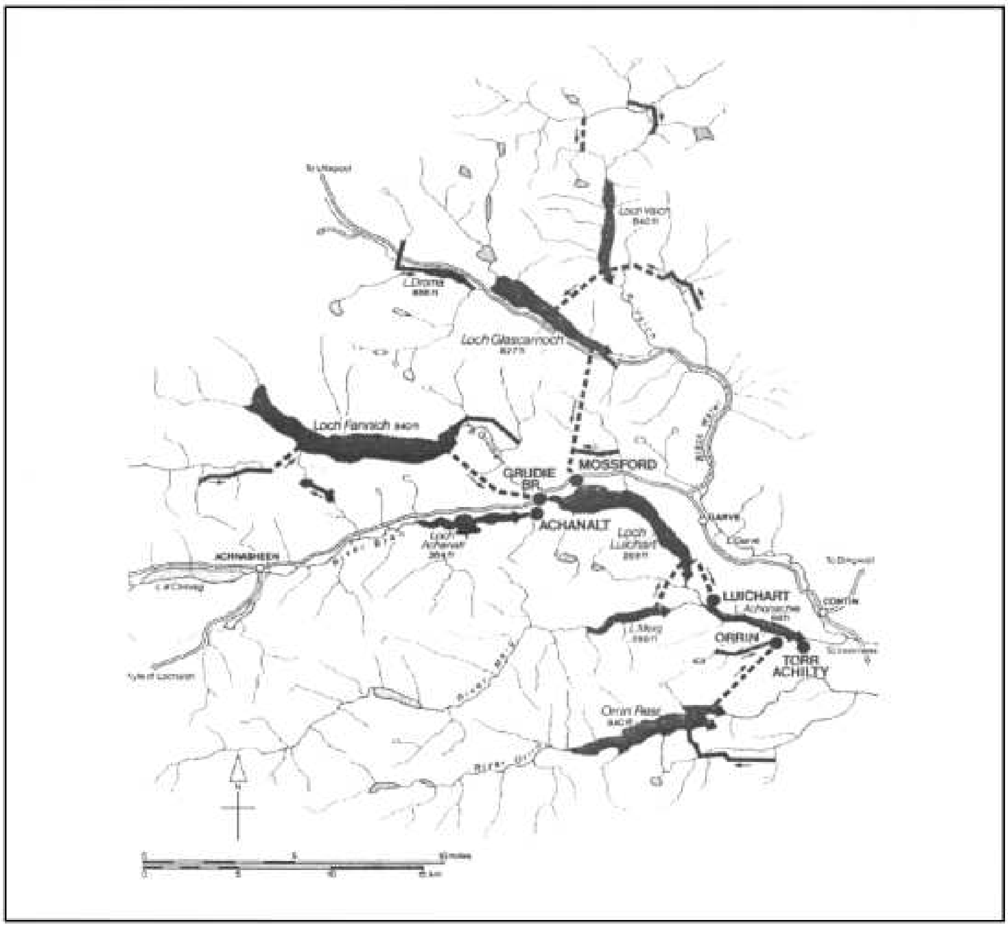
Hydro development in the Conon system

The upper Conon hydroelectric scheme involves a large and complex system of water transfers, storage, control and power generation (Payne, 1988). The scheme is likely to exert a considerable effect on the downstream floodplain.

The Conon scheme includes eight dams, nine tunnels, numerous diversions and six power stations with a total generating capacity of over 100mW (Fig.3.1). It also includes an unusual cascade development with the water, which passes through the Mossford, Grundie Bridge and Achanalt power stations channelled into Loch Luichart, through the Luichart power station into Loch Achonachie and through the Torr Achilty power station. Torr Achilty receives all of the water involved in the Conon scheme.

Construction of the Fannich part of the scheme was carried out in the period 1946 to 1951. It involved the construction of numerous aqueducts and tunnels to increase the flow into Loch Fannich, the raising of Loch Fannich and the transfer of water to the 24mW Grundie Bridge power station. The construction to transfer water from the loch involved a complex sloping tunnel driven from the hillside above the Grundie Bridge power station some 30m below the Loch. Above the power station the water is conveyed by a single steel pipe which branches to feed two turbines in the power station.

Figure 3.1 Sketch map of the Conon hydro scheme

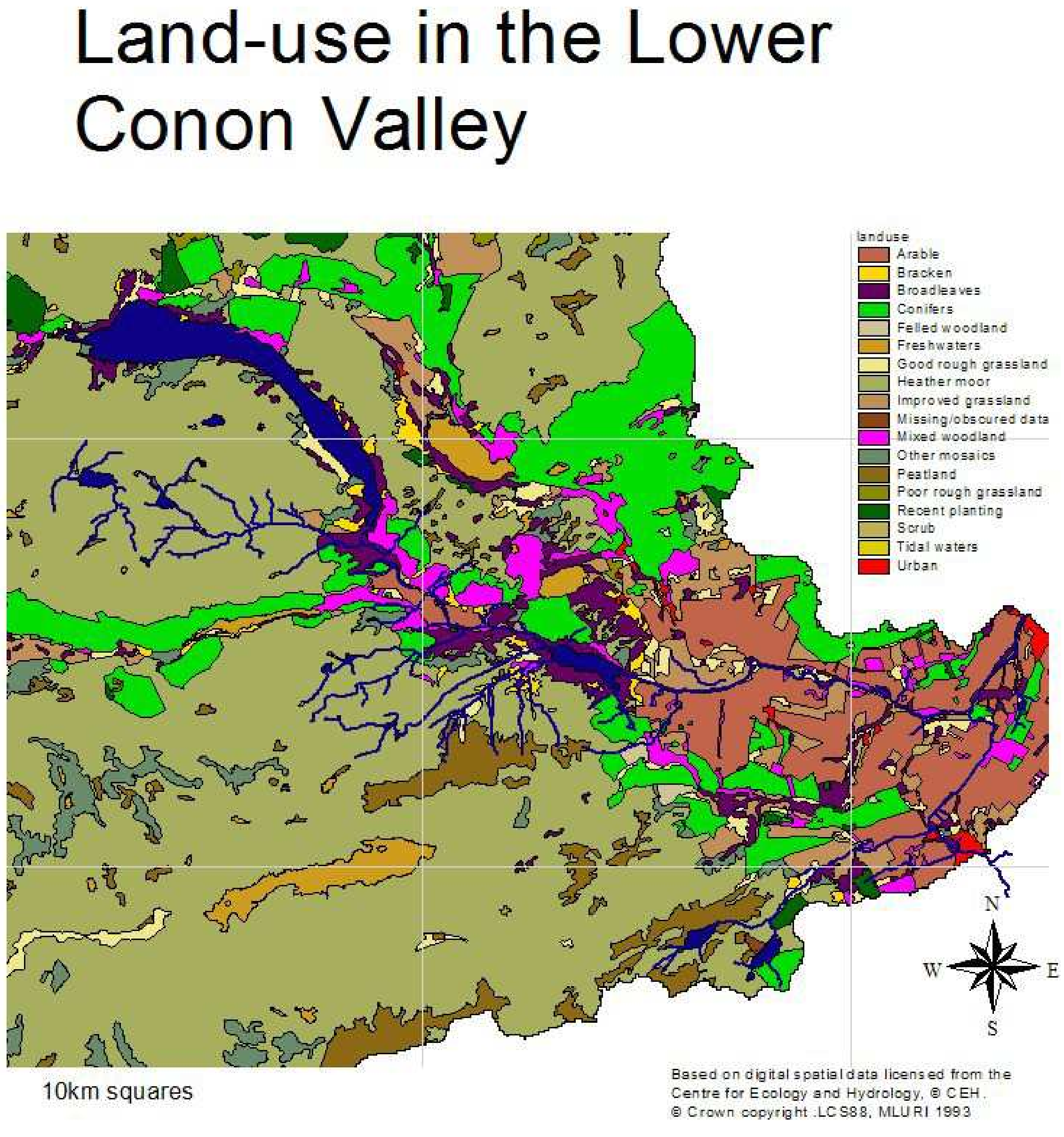


The Glascarnoch-Luichart-Torr Achilty part of the scheme was constructed in the period 1951 to 1957. It involved the construction of two dams, the Glascarnoch, a concrete gravity and earthfill dam, and the Vaich, an earthfill with concrete core dam. This created two artificial lochs whose natural catchments were supplemented by water transfers and in turn the water from Loch Vaich was transferred into Loch Glascarnoch. An 8km long tunnel then took the water to the 24mW Mossford power station on Loch Luichart. A small barrage was built on the River Bran at the eastern end of Loch Achanalt and the water passed through the 2.4mW Achanalt power station. Water from the three power stations, Grundie Bridge, Mossford and Achanalt, was discharged into Loch Luichart, which was created by the construction of a mass gravity dam. A further artificial loch was created by the construction of the concrete gravity, buttress and earthfill Meig dam and water was transferred from Loch Meig into Loch Luichart. Below Loch Luichart the water was passed through the 34mW Luichart power station. Finally a mass gravity dam and 15mW power station were constructed on the Conon at Torr Achilty creating Loch Achonachie. The principal function of the Torr Achilty dam was to even out the flow of water downstream, and as such is the only dam fitted with floodgates.

Construction of the Orrin part of the scheme was carried out in the period 1955 to 1961. It involved the construction of a mass gravity dam some 15km upstream of the Conon-Orrin confluence. The dam wall was some 300m long and created an artificial loch 8km in length. Water from the loch is transferred through a 5km long concrete lined tunnel and steel pipeline to the 18mW Orrin power station and discharged into Loch Achonachie. The Orrin dam also included four fish passes which were also incorporated into the Torr Achilty, Luichart, Meig and Achanalt constructions. It is said (Payne, 1988) that some of these fish passes have extended the migratory range of salmon in the Conon catchment.

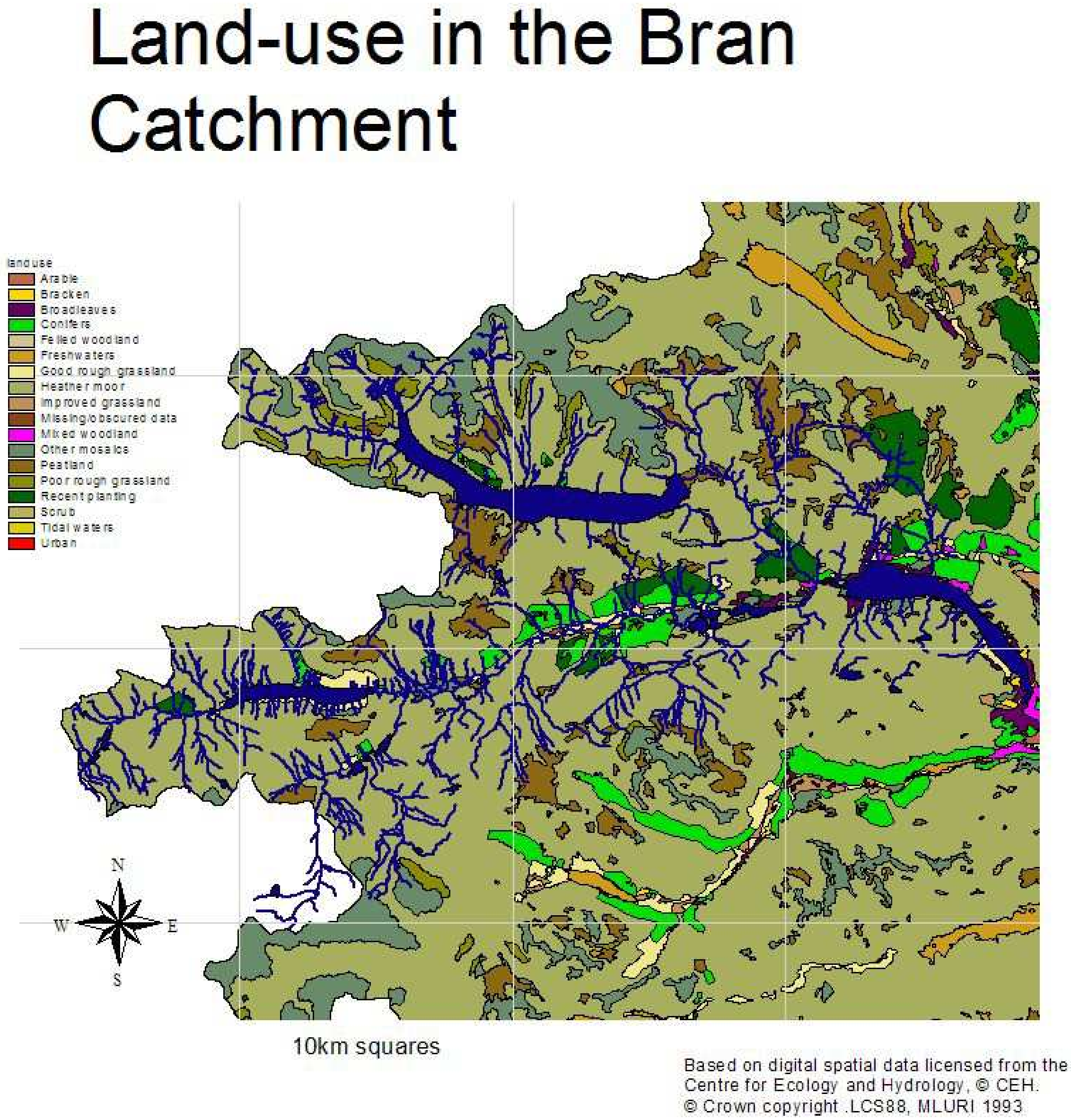
3.3.1.1 Land-use in the Lower Conon Valley

The broad floodplain downstream of Tor Achilty Dam is largely covered by arable and improved grassland. The banks of the Lower Conon are largely wooded with native trees and designated as an SAC for floodplain alder woodland. The largest urban areas in the Conon valley are at the mouth of the river at Conon Bridge and Maryburgh. Upstream of Tor Achilty, the Upper Conon valley has steeper sides covered with conifer plantations, whilst the valley floor is a mixture of improved grassland and mixed woodland.



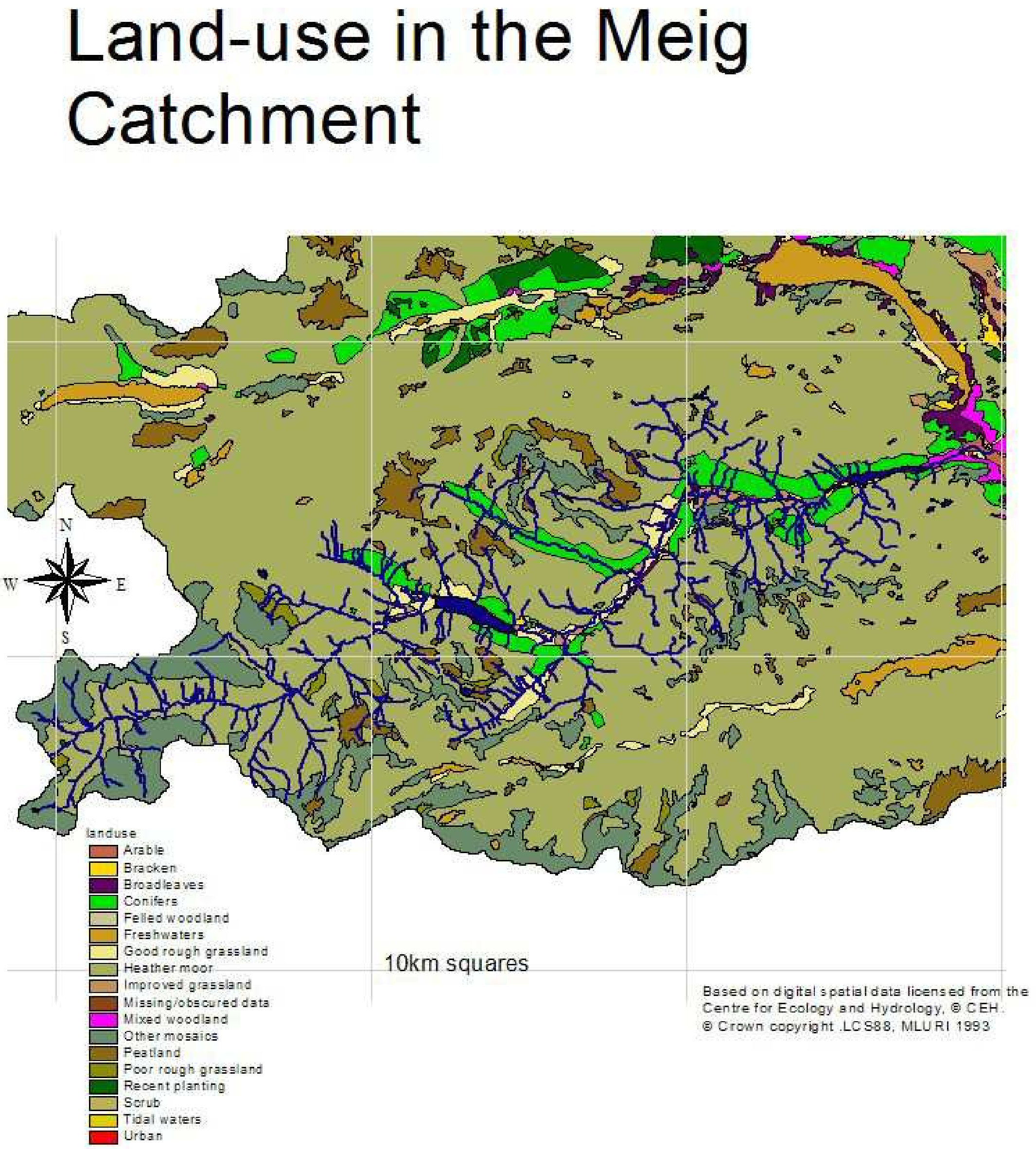
3.3.1.2 Land-use in the Bran Catchment

The Bran catchment drains large areas of heather moorland and peatland but has less exposed bedrock and scree than the steeper sided Meig and Orrin catchments. This upper catchment landscape is a product of historical deforestation and subsequent overgrazing by livestock and deer. (See Historical Survey of the Conon prepared for SNH in 2002 report F00PA40). There are some areas of conifer plantation particularly upstream of Achanalt. There are some small areas of mixed woodland around Loch Luichart but overall the Bran catchment is largely devoid of native woodland. This is apparent in the heavily grazed and degraded riparian zone of the Bran from Achanalt upstream.



3.3.1.3 Land-use in the Meig Catchment

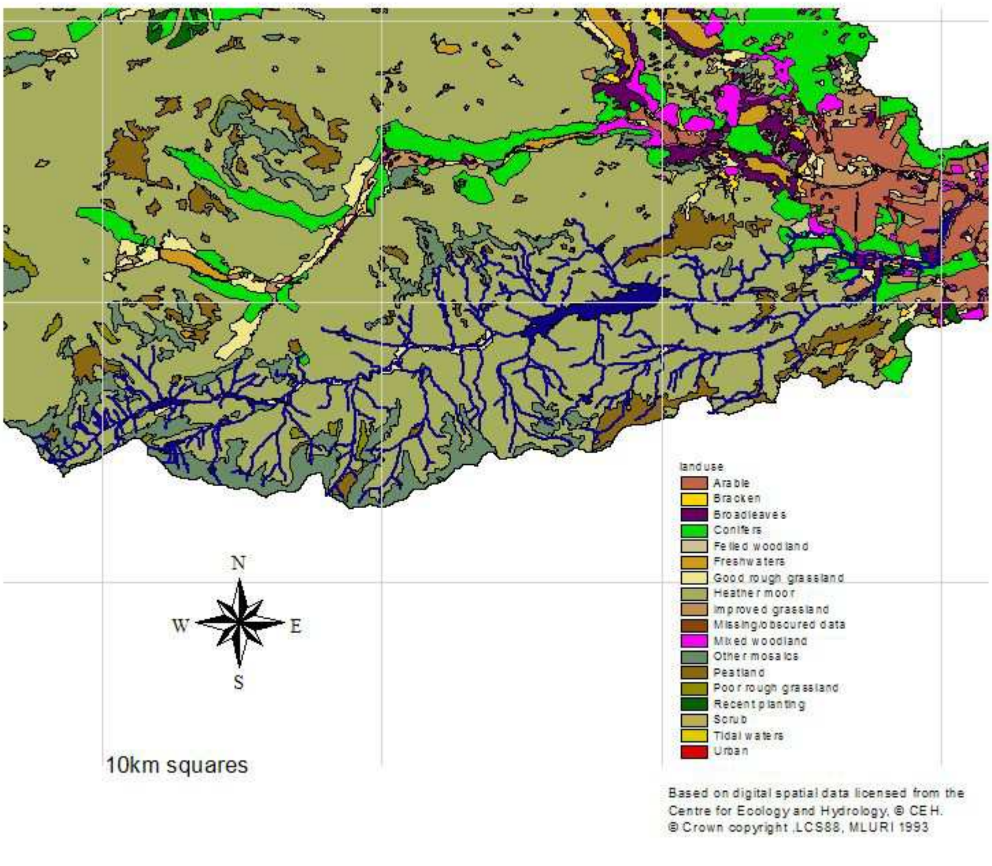
The Upper Meig drains a catchment of heather moorland, bare rock and scree. Like the Bran, the Upper Meig has suffered from historical deforestation and overgrazing. A few riparian trees survive in inaccessible places which deer cannot reach. The middle and lower reaches of the Meig were heavily planted with conifers during the 1950's. There are also areas of good rough grassland in the bottom of the steep sided valley. There is some native woodland in the Lower Meig valley and riparian alders in much of the Middle Meig, although there is a lack of regeneration because of grazing pressure. Strathconon Estate has done some good work restructuring the conifer woodland in Glen Meinnich to bring it in line with the Forestry & Water Guidelines.



3.3.1.4 Land-use in the Orrin Catchment

The upper and middle reaches of the Orrin drain a steep sided catchment of exposed rock and heather moorland. The present land-use arises from historical deforestation, overgrazing by livestock and more recently by deer. There are some areas of good rough grassland at the bottom of the steep valley sides of the Upper Orrin. There are two small areas of conifer plantation in the Upper Orrin but otherwise a lack of trees and riparian woodland. Below Orrin Dam there are more riparian alders where the steep banks give them protection from deer. Below the deer fence at Fairburn there is a fringe of native woodland which extends downstream to the confluence with the Conon. There are areas of Rhododendron encroaching into this riparian woodland in places. There are extensive conifer plantations around Fairburn and a mixture of improved grassland and arable near the confluence with the Conon.

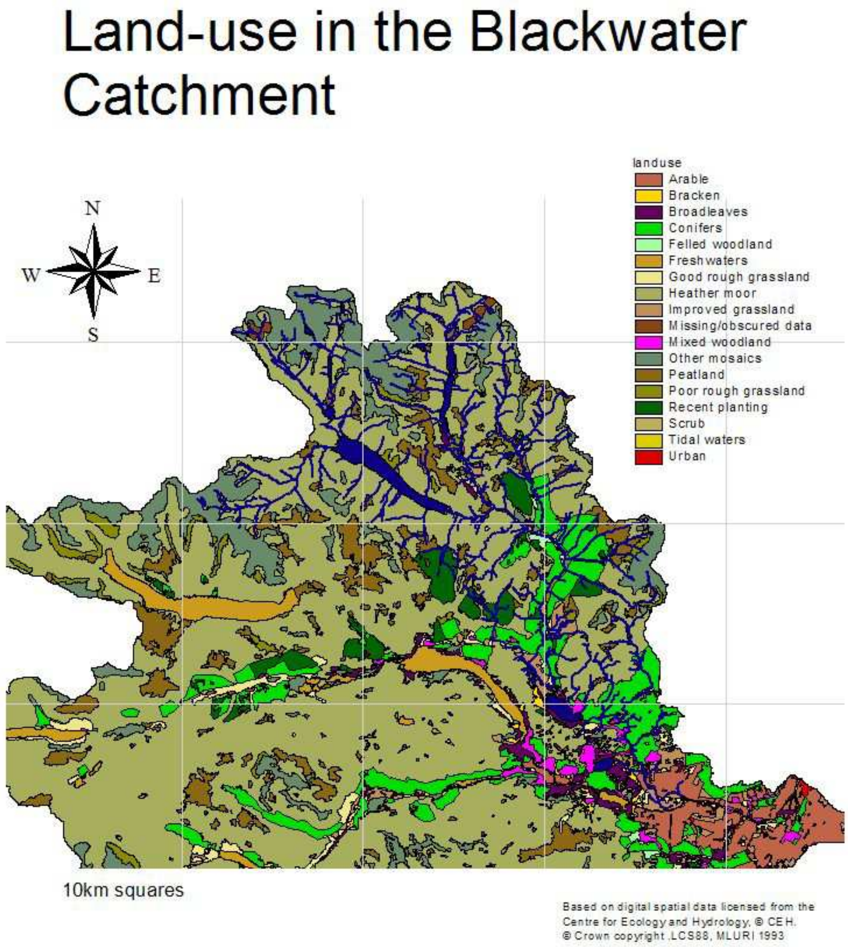
Land-use in the Orrin Catchment



3.3.1.5 Land-use in the Blackwater Catchment

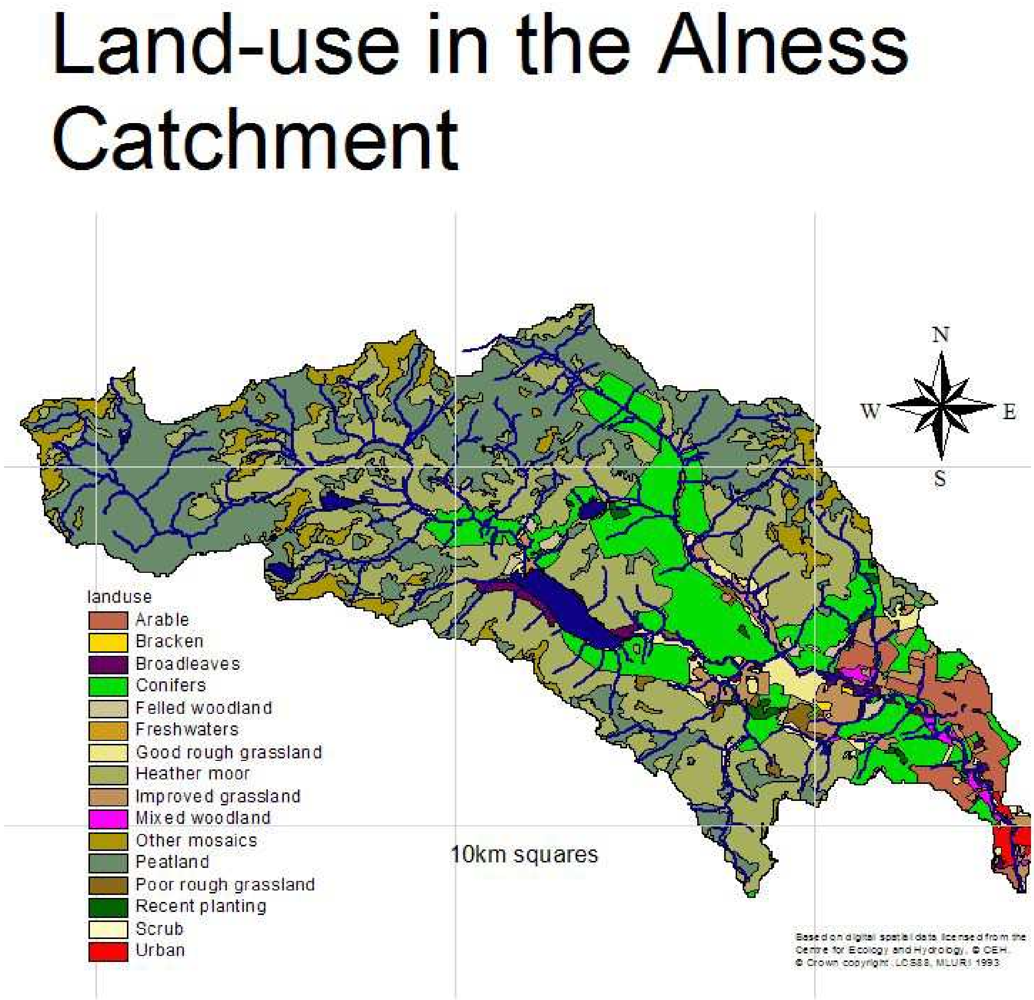
The Upper Blackwater catchment is dominated by heather moorland and peatland, formed by similar historical land-use to the neighbouring catchments. There is an area of improved grassland in Strath Vaich, which is heavily grazed by sheep and has a degraded riparian zone. There is a stand of native woodland on the western side of Strath Vaich but this does not extend to the river bank.

The middle and lower Blackwater valley is heavily afforested with conifers planted in the 1950's. The riparian zone within the conifer plantation at Strath Rannoch is not planted with conifers but is surrounded by deer fencing. Recent co-operation between the Forestry Commission Scotland and the Cromarty DSFB has started a project to plant alders and willows along the banks of Strath Rannoch. In the middle reaches of the Blackwater there is a buffer strip of native woodland with mature alders along the banks. On the north bank of the Lower Blackwater between Contin and Garve there are extensive conifer plantations. Where this coincides with an underlying geology of mica schist, the tributaries are subject to acid flushes which limit or prevent salmon survival. There is an area of arable and improved grassland where the Blackwater joins the Conon valley, with a buffer strip of native woodland along the river bank.



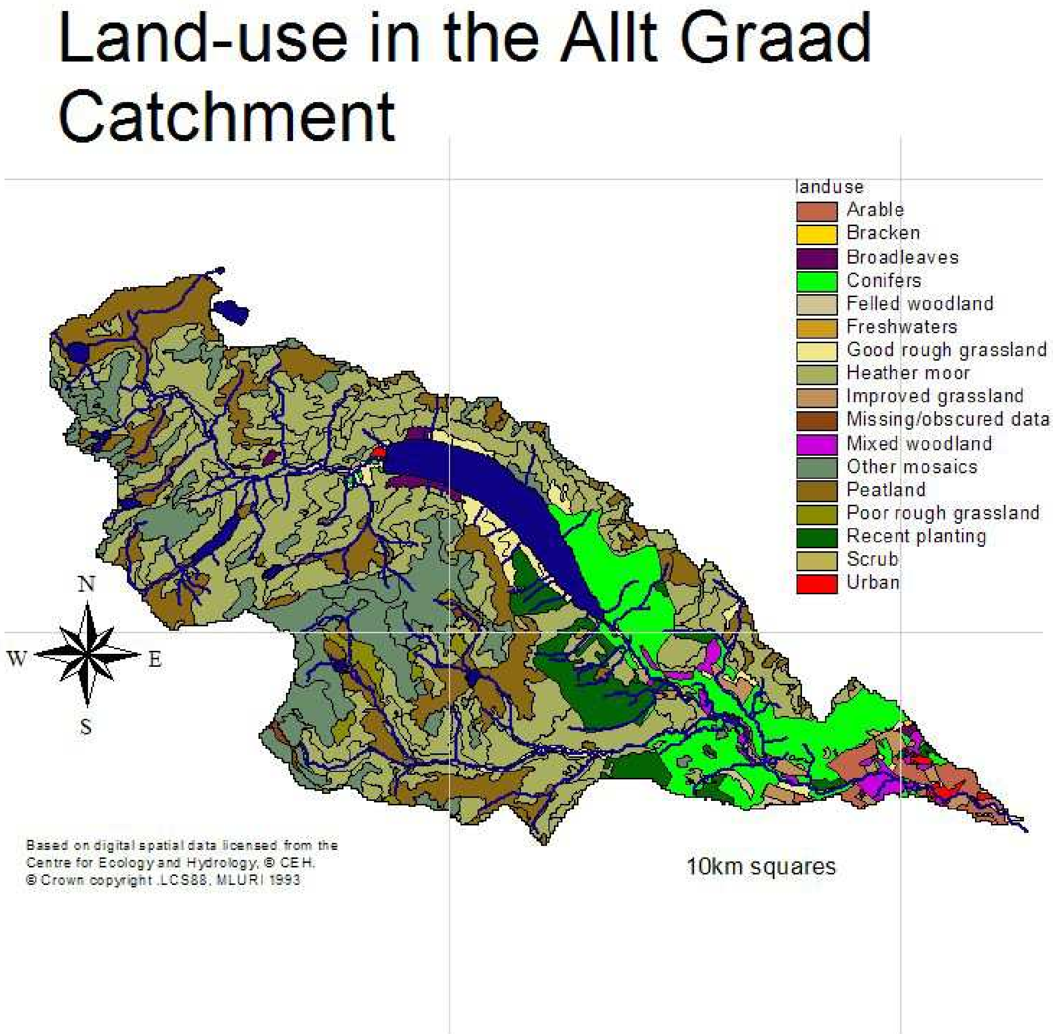
3.3.2 Land-use in the Alness Catchment

Urban development in the Alness catchment is concentrated around the mouth of the river and the town of Alness. There has been considerable conifer afforestation within the catchment; much of this is centred on the middle reaches of the Alness and on the Blackwater system.



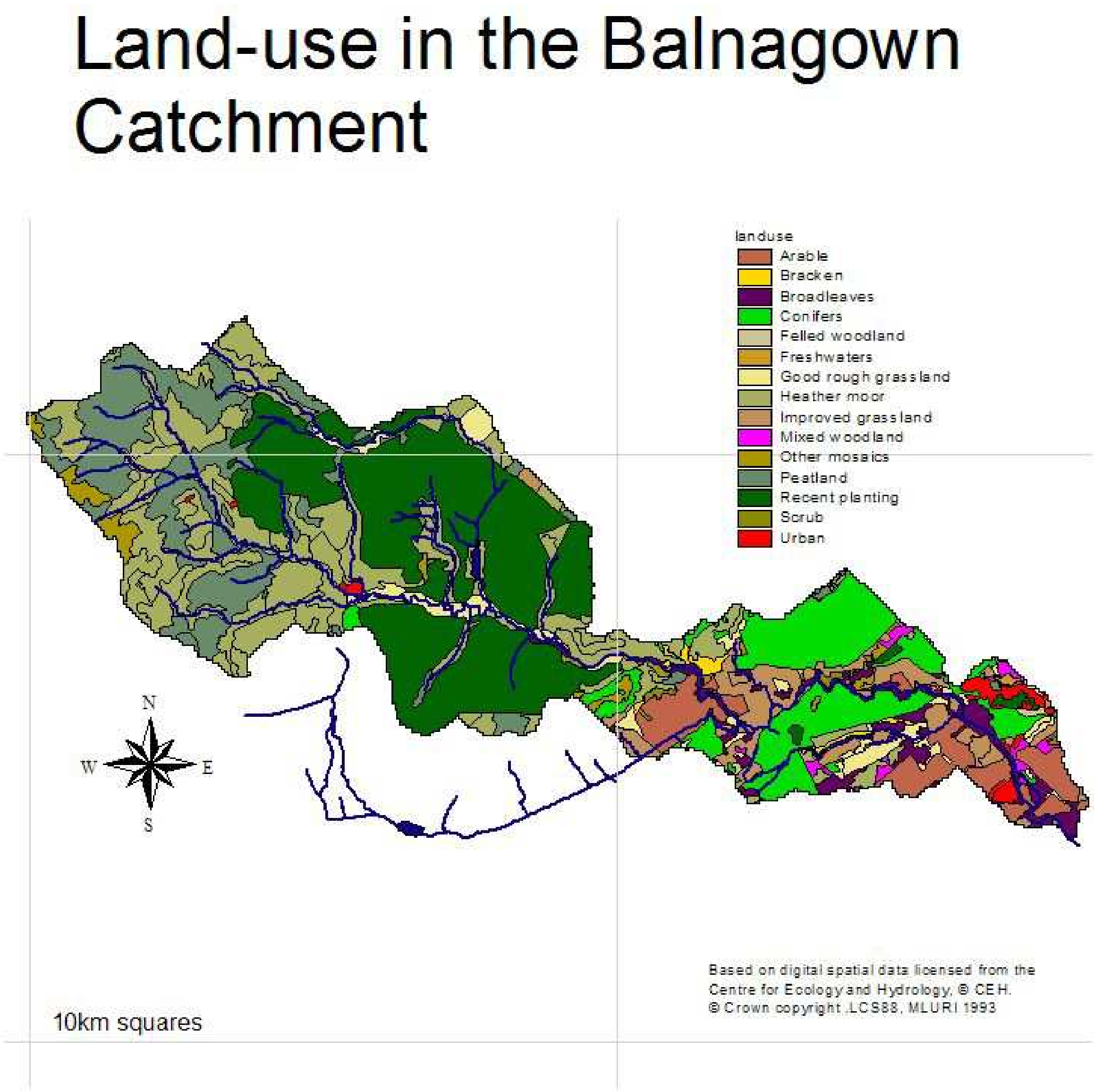
3.3.3 Land-use in the Allt Graad Catchment

The upper part of the Allt Graad catchment above Loch Glass is mixture of heather moorland and peatland. The middle reaches of the Allt Graad between Loch Glass and the Black Rock Gorge are very heavily afforested, with conifer plantations surrounding the river and all its tributaries, except Allt na Caorach which drains an area of open moorland.
The lower reaches of the Allt Graad from the Black Rock Gorge downstream flow through an area of mixed woodland to the main urban development in the catchment at Evanton. The lowest reaches from Evanton downstream are surrounded by improved grassland and arable farmland but have a buffer strip of native woodland along the banks.



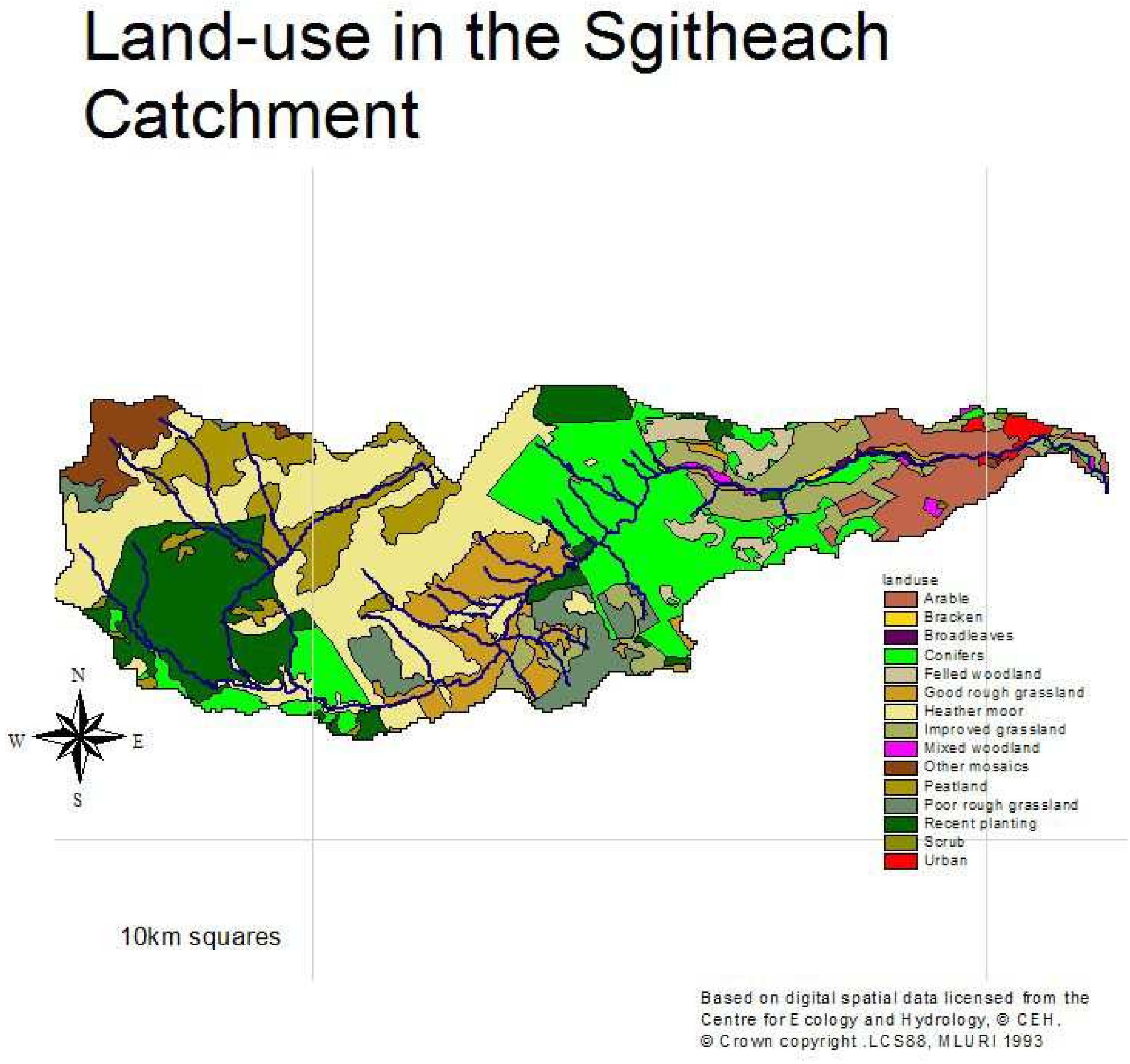
3.3.4 Land-use in the Balnagown Catchment

The map below shows land use in the Balnagown catchment from the Landsat 88 dataset. The main urban development is around Kildary and Milton near the mouth of the river. Included in this land-use type are quarries at Strath Rory Bridge and near Kildary. It can be seen that most of the upper river flows over open peatland and heather moorland. The catchments of the burns flowing into the middle reaches are significantly affected by conifer afforestation. There are also extensive conifer plantations in the lower catchment. Most of the broadleaved woodland in the catchment is centred on the river in its lower and middle reaches.



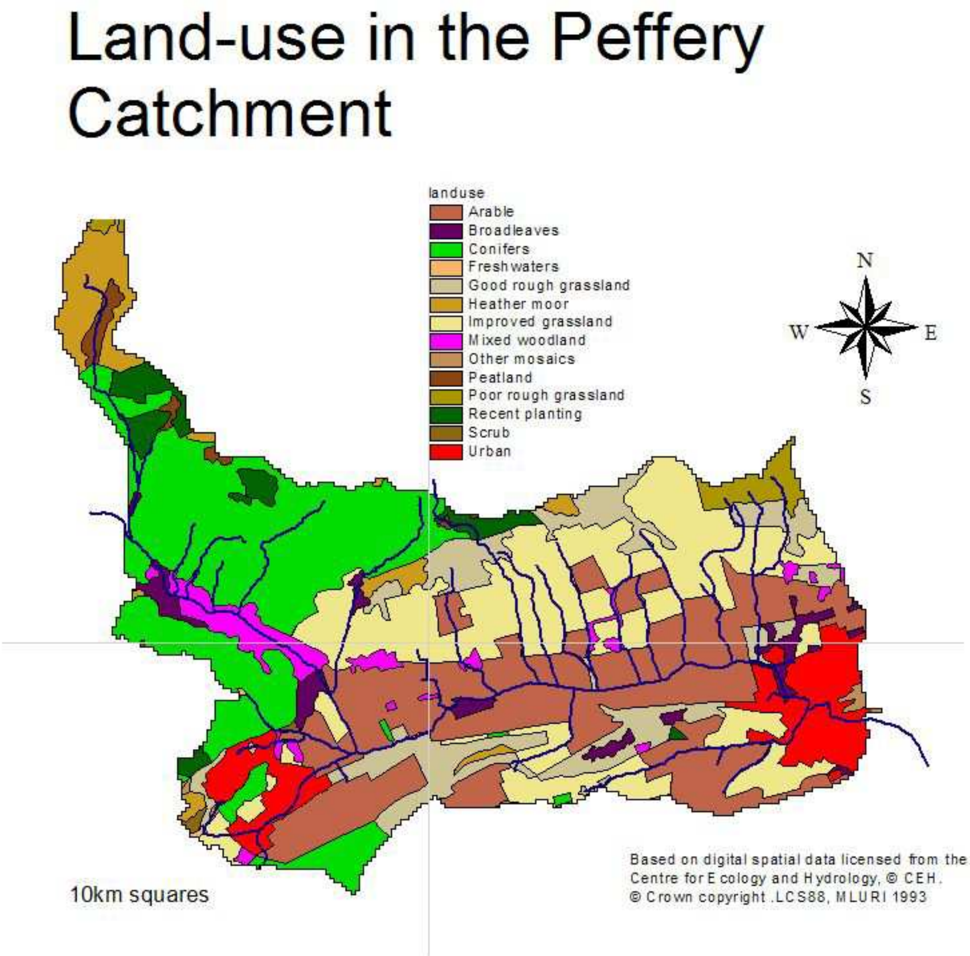
3.3.5 Land-use in the Sgitheach Catchment

The map below shows the extent of urban land-use within the Sgitheach catchment. This is confined to the lower reaches of the river and comprises of the small settlements of Swordale, Milton of Katewell and the village of Evanton.
The extent of conifer afforestation can clearly be seen and this is likely to have contributed to the lack of water in several tributary burns.
As the river flows through its middle reaches in Strath Sgitheach, there is extensive sheep and cattle grazing between the areas of afforestation.
The predominant land-use in the lower catchment below Swordale is arable.



3.3.6 Land-use in the Peffery Catchment

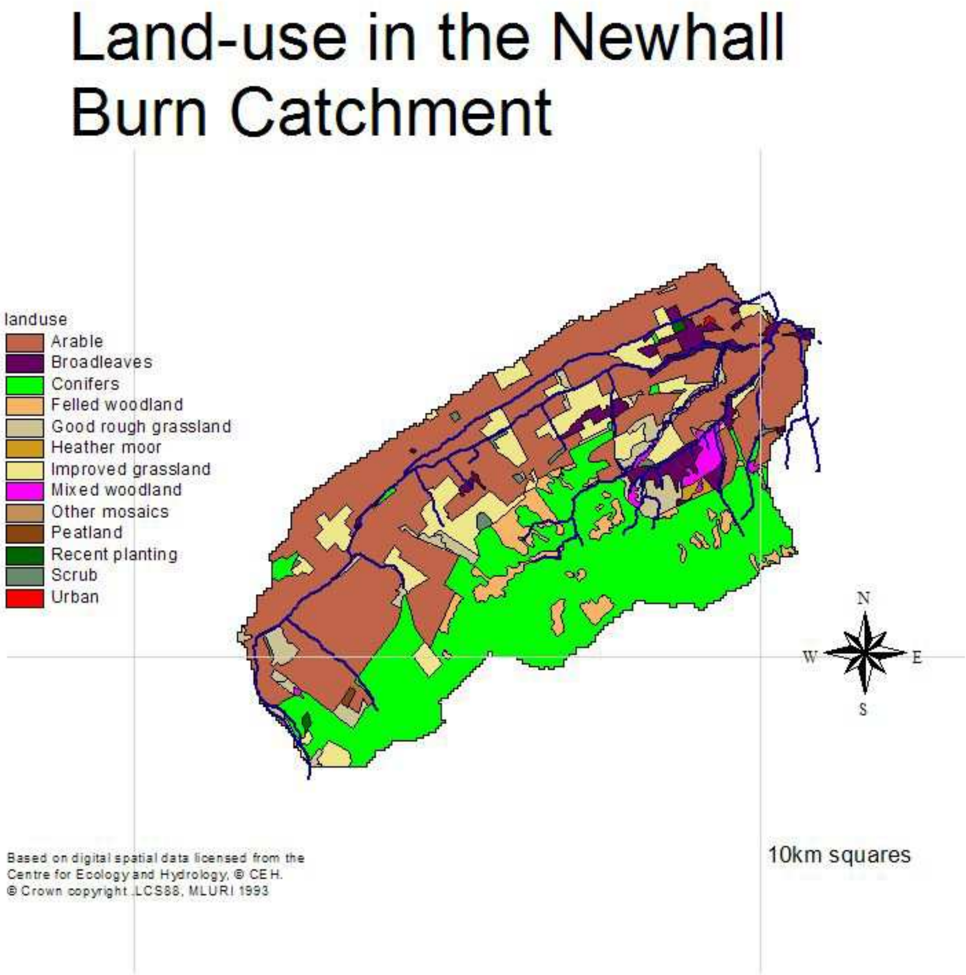
The upper reaches of the Peffery above Achterneed flow through extensive areas of broadleaved and mixed woodland along the valley bottom. However the upper catchment drains a large area of conifer forest on the slopes of Ben Wyvis.
The middle reaches of the Peffery and its tributaries run through intensively farmed arable land in the bottom of the Peffery valley, with improved grassland on the valley sides. This section of the Peffery has been extensively modified by dredging and straightening carried out as part of arterial drainage works. With both Strathpeffer and Dingwall in the Peffery catchment there is a greater area of urban development than in any other catchment in the region.



3.3.7 Land-use in the Newhall Burn Catchment

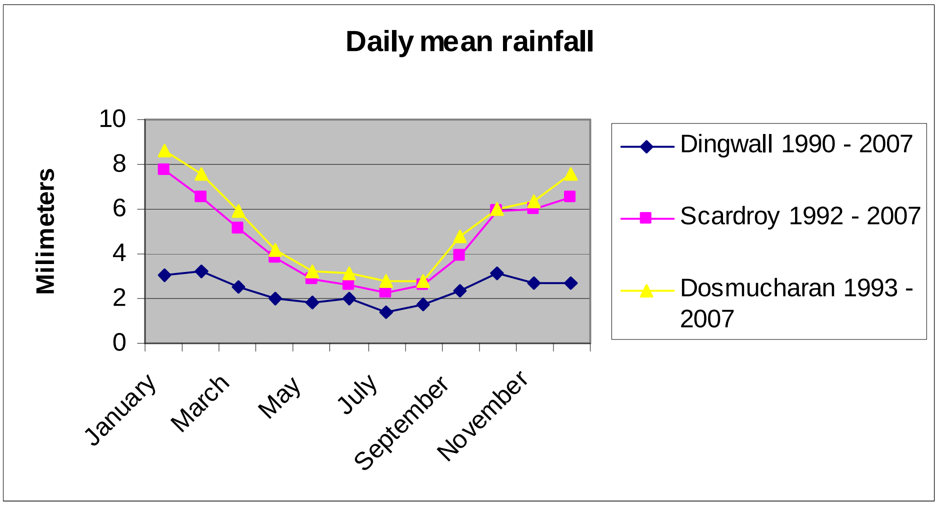
Most of the Kinbeachie and Newhall burn catchments to the North and West drain intensively farmed arable land with some improved grassland. This part of the catchment is significantly impacted by the effects of agriculture, with straightened and dredged channels and a heavy silt load from field run-off and drainage.

The Braelangwell and Ballycherry burns to the East of the catchment, have upper reaches which are impacted by extensive conifer afforestation, which when surveyed in 2001 did not comply with Forestry and Water Guidelines. The middle and lower reaches of the Ballycherry, Newhall and Braelangwell burns have some broad-leaved and mixed woodland in their riparian zones and livestock has been excluded from large sections of bankside. However the field drainage from surrounding arable land runs through the riparian buffer strip and acts as a damaging source of siltation. There is no significant urban development in the Newhall catchment.



3.4 Summary of climate characteristics (air temperature, rainfall etc)

The climate of the region is greatly modified by the mountains to the west which create a colder wetter climate then in the warmer drier east of the region. The total annual rainfall in the west of the region exceeds 2000mm per year. The chart below shows the difference in daily mean rainfall between Scardroy on the River Meig, Dosmucheran on the Bran and Dingwall to the east.



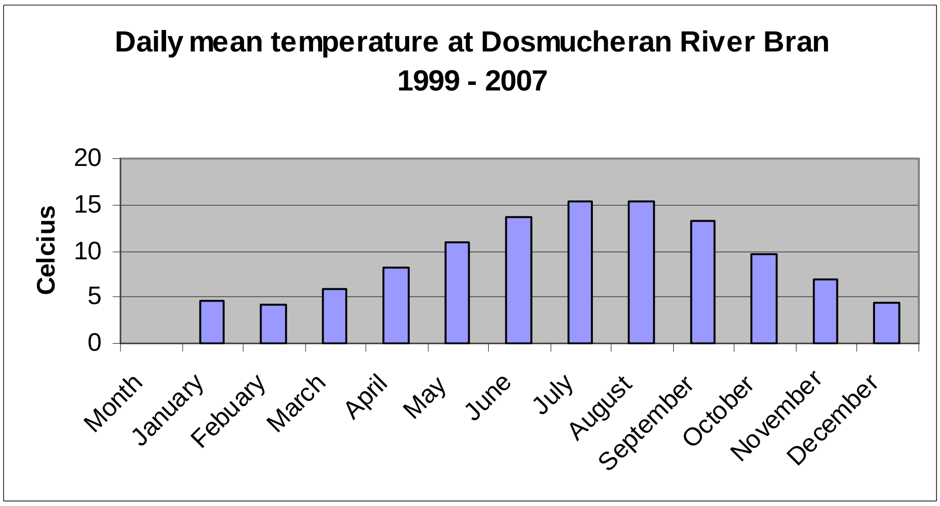
Data supplied by SEPA

It can be seen that there is less seasonal variation in rainfall to the east of the region than there is in the west. In both east and west the driest months are between May and September. The winter months are wetter in both the east and west of the region but this difference is much more significant in the west. Rainfall patterns in Scotland are changing, with the country 20% wetter than it was in 1961. This change has been more significant regionally, with the North of Scotland experiencing a 70% increase in winter rainfall over the same period. There has been a 20% increase in the levels of maximum five day precipitation since 1961 which increased the frequency of flooding. SNH report F00DA40 gives a detailed description of flood events in the Conon Valley. Since 1829 major flood events which have inundated the Conon floodplain occurred approximately every 10 years, both prior to and since hydro scheme construction. This report records an increase in flood frequency since the 1980’s.

There has been little change in the number of consecutive dry days since 1961 in the North of Scotland and no trend towards increasing droughts. There has been a 70% decrease in the number of days of snow cover across Scotland since 1961.

Changes in climatic conditions are also reflected in temperature change. Scotland's temperature records indicate that average spring, summer and winter temperatures have risen by more than 1 degree C since 1961, with a smaller rise in autumn temperatures. Twenty four hour maximum temperatures have also increased by more than 1 degree C since 1961. Minimum temperatures have increased across Scotland but not at the same rate as maximum temperatures and not significantly in the North of Scotland. Across all of Scotland there has been a 28% reduction in the number of days of ground frost since 1961 with most of this change occurring since the early 1980's.

The daily mean temperatures at Dosmucheran on the River Bran are shown below.



Data supplied by SEPA

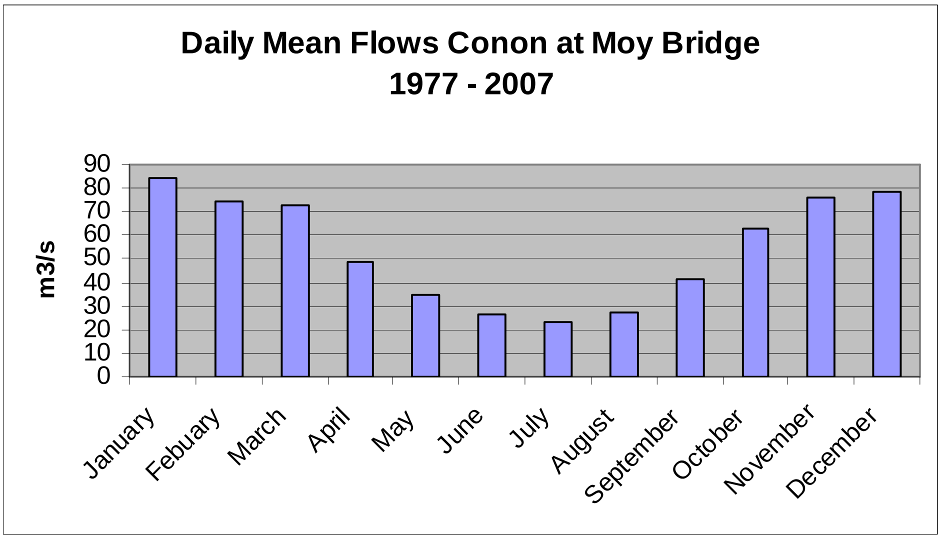
Highest temperatures are recorded in July and August with lowest in December, January and February

In river temperature data loggers showed a similar pattern in water temperatures. They also showed colder conditions in the upper catchment which delayed ova incubation. Temperature data loggers showed a much greater diurnal temperature variation in the upper catchment particularly in the spring.

3.5 Details of flow characteristics.

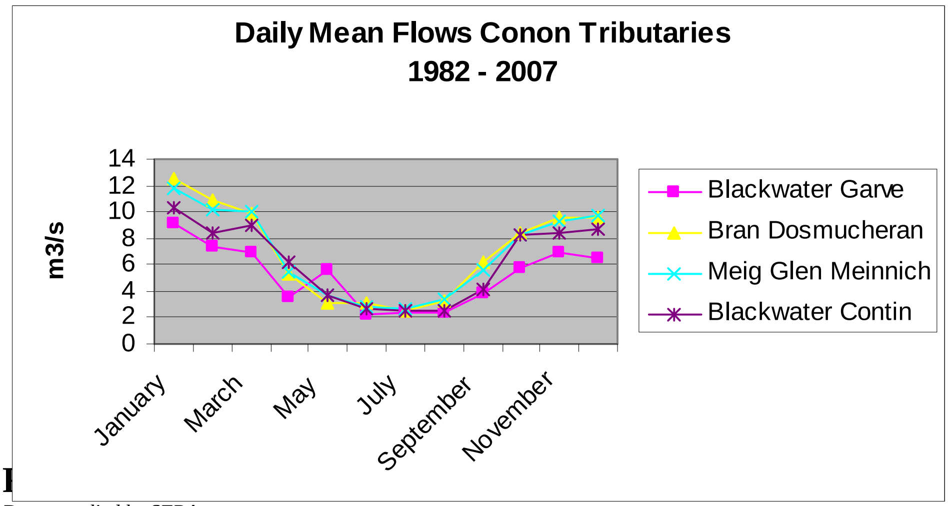
3.5.1 Conon

The daily mean flows in the main stem of the Conon at Moy Bridge are shown below. Despite regulation, the flows show a similar seasonal pattern to the rainfall in the upper catchment described in the previous section.



Data supplied by SEPA

The daily mean flows for the Meig Bran and Blackwater are shown in the chart below. Of these the Blackwater sites are both regulated flows, whilst the Meig and Bran sites are above impoundments and are unregulated. The significance of high winter rainfall can be seen in the flows of both regulated and unregulated rivers.



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Data supplied by SEPA

Flow regulation in the Conon System

The construction of the Conon Basin Hydro Scheme by the North of Scotland Hydro Electric Board during the 1950's regulated the flows of the Conon and its tributaries. The details of the flows and how they were to be delivered were set out in a 'Scheme Agreement' which is copied below.

Fannich Project

6. For the protection of the Grampian Electricity Supply Company (hereinafter called "the Company") the following provisions shall unless otherwise agreed between the Company and the Board apply and have effect (that is to say):- For protection of Grampian Electricity Supply Company

(1) The Board shall discharge or deliver into the River Grudie such quantities of water as shall secure the following flows down the said river immediately below the site of the Grudie Bridge generating station -

(a) during each and every week over a period of not less than seventy-two hours in the months of November, December, January, February, March and April not less than two hundred million gallons of water and

(b) during each and every week over a period of not less than seventy-two hours during the months of May, June, July, August, September and October not less than one hundred and forty million gallons of water.

(2) For the purpose of measuring the quantities of water to be so discharged or delivered as aforesaid the Board shall erect and maintain to the reasonable satisfaction of the Company at a point suitable for the purpose a proper and suitable measuring gauge over or through which the said water so discharged or delivered shall flow and which gauge shall be open at all times to the inspection and examination of the authorised officials of the Company.

(3) In the event of failure in any of the works of the scheme or stoppage for the purpose of maintenance or repairs so as to make it impossible to fulfil the provisions of this section the Board shall, if so desired by the Company, deliver immediately below the Grudie Bridge generating station at such periods and times as may be agreed, quantities of water to make up deficiencies due to such failure or stoppage.

(4) If any difference arises between the Company and the Board under this section such difference shall be referred to a single arbitor to be agreed on between the parties or failing agreement to be nominated by the President of the Institution of Civil Engineers.

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6. (1) On completion of the Torr Achilty reservoir the Board shall discharge or deliver into the River Conon by means of a fish ladder or otherwise twenty million gallons of water per day and shall maintain a flow of not less than one hundred and twenty million gallons per day at a point in the River Conon immediately below the tailrace of the Torr Achilty generating station and the outlet of the fish ladder.

(2) On completion of the Glascarnoch reservoir and the Vaich reservoir the Board shall deliver or discharge at or near the dams forming Glascarnoch and Vaich reservoirs by means of valves or otherwise sufficient water to maintain in the Black Water:-

(a) A flow of not less than eight million gallons per day at Black Bridge carrying the Garve-Ullapool road over the Black Water; 15cu

(b) A flow of not less than seventeen and one-half million gallons per day immediately above the Falls of Rogie on the Black Water; and 33cu

the Board shall make up the natural freshets in the Black Water as measured immediately above Loch Garve to one hundred and twenty million gallons per day on six occasions each of 48 hours during the period August, September and October in each year.

(3) On completion of the Rannoch aqueduct the Board shall only abstract through this aqueduct water from the River Rannoch when the flow in this river immediately below the point of abstraction exceeds one and one-half million gallons per day.

(4) On completion of the Glen Beag Aqueducts the Board shall only abstract through these aqueducts water from the Abhainn a' Ghlinne Bhig, the Allt Bheargais and the stream draining the Crom Loch when the flow in the Abhainn a' Ghlinne Bhig at Deanich Lodge exceeds eight million gallons per day and on ten occasions each of two consecutive days during the period June, July, August, September and October in each year the Board shall release the natural flow at the points of abstraction of Glen Beag Aqueducts.

(5) On completion of the Luichart reservoir the Board shall discharge or deliver into the River Conon by means of a fish ladder or otherwise twenty million gallons per day from mid-March to mid-October in each year and five million gallons per day for the remainder of the year and the Board shall make up the flow (including spill from the dam) in the River Conon immediately below the outlet from the fish ladder to one hundred and twenty million gallons per day on thirty days between mid-March and mid-October in each year.

(6) On completion of the Loch Meig reservoir the Board shall discharge or deliver into the River Meig by means of a fish ladder or otherwise twenty millio[n] gallons per day from mid-March to mid-October in each year and five million gall[ons] for the remainder of the year and the Board shall make up the flow (including sp[ill] from the dam) in the River Meig immediately below the outlet from the fish ladde[r] to one hundred and twenty million gallons per day on thirty days between mid-Mar[ch] and mid-October in each year.

(7) The Board shall provide and maintain all such works or other apparatus as be required to provide access for salmon to the upper reaches of the River Meig to Loch Luichart and the River Bran.

(8) On completion of the Droma aqueducts the Board shall only abstract water through the Outfall aqueduct when the combined flows in Allt a' Mhadaidh and All Leacachain at the points of abstraction exceed two million gallons per day. Wh the flow as measured at the point of abstraction is less than 2 million gallons day all the water in Allt a' Mhadaidh and Allt a' Leacachain and also any water flowing into Loch Droma will go west to the Falls of Measach as before. When t flow is over 2 million gallons per day such proportion shall be released of 2 million gallons per day as is obtained by reducing by $\frac{2}{3}$ of 1 million gallons pe for each one million gallons in excess of 2 million gallons per day. By this form when a flow of 5 million gallons per day is reached, no water would be released.

(9) The provisions of the Scheme with respect to compensation water shall be accepted by all persons interested as full compensation for all water which the Board impound, abstract, divert or use for the purposes of the Scheme.

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- Orrin Project

(1) On completion of the Orrin reservoir the Board shall discharge or deliver in each year into the River Orrin at or near the dam forming Orrin Reservoir by means of a fish pass or otherwise:-

(a) a flow of 20 million gallons a day during the months of March, April, May and July; 37 cusec

(b) a flow of 12 million gallons a day during the months of September, October and November; 22.2 cusec

(c) a flow of 10 million gallons a day during the months of January, February, June, August and December; and 18 cusec

(d) in addition freshets to a total of 620 million gallons in each year in such quantities, at such times and with such allowance for natural spates as may be agreed between the Board and the Conon District Fishery Board.

(2) The Board shall provide and maintain all such works or other apparatus as may be required to provide access for salmon to the upper reaches of the River Orrin.

(3) The provisions of this Clause shall be accepted by all persons interested as full compensation for all water which the Board impound, abstract, divert or use for the purposes of the Scheme.

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Current Flow Regime Agreed Between Scottish and Southern Energy and Cromarty Firth Fishery Board and Licensed Under Controlled Activities Regulation by SEPA.

The Conon Basin Flow Regime has been modified from the original Scheme Agreement over time. Many of the changes have been made in response to an increasing understanding of the behaviour of salmon at obstructions to migration. In particular radio-tracking projects have helped to improve upstream passage whilst smolt trapping and balloon tagging have helped with downstream passage. The current flow regime which has been incorporated into the CAR Licence for the Conon Hydro scheme is set out below.

Droma

On completion of the Droma Aqueducts, SSE shall only abstract water through the Droma Aqueduct when the combined flows in Allt a' Mhadaidh and Allt Leacachain at the points of abstraction exceed 2MGD.

Strath Rannoch

On completion of Strath Rannoch Aqueduct SSE shall only abstract through this aqueduct water from the River Rannoch when the flow in this river immediately below the point of abstraction exceeds 1.5 MGD

Tor Achilty

"The board shall discharge or deliver into the River Conon by means of a fish ladder or otherwise twenty million gallons of water per day and shall maintain a flow of not less than one hundred and twenty million gallons per day at a point in the River Conon immediately below the tailrace of the generating station and the outlet of the fish ladder."

Glascarnoch / Vaich

Sufficient water to maintain in the Blackwater:-
(a) A flow of not less than 8MGD at the Black bridge carrying the Garve - Ullapool road over the Blackwater.
(b) A flow of not less than 17.5MGD immediately above the Falls of Rogie on the Blackwater.

The flow is measured by phoning the River Gauge as stated below. A reading of 0.149 means that the correct amount of compensation is being passed.

New Agreement
During July, August and September 2004 the flow measured at Falls of Rogie will 26.9 MGD (reading of 0.192 from river gauge). This is water from the 1440 mg freshet allowance. Outwith this period the flow reverts to 17.5 MGD.

Glen Beag

Summer Agreement 1st April to 30th September

(a) No water is to be abstracted until the flow at Deanich Lodge exceeds 23 mgd (b) SSE may divert any water above 23 mgd until the amount diverted reaches 50 mgd

(c) When the amount diverted reaches 50 mgd, any excess is to be released until the total amount reaches 50 mgd at Deanie Lodge.

(d) All residual flows after releasing 50 mgd may be diverted.

(e) The flow in the Allt Leacach and the Allt a Coire Chairn Bhain are to be released

Winter Agreement 1st October to 31 March

No water is to be intercepted until the flow at Deanich Lodge exceeds 8 mgd

Luichart Compensation and Freshet Release

Mid March to Mid November compensation will be 20 MGD and 5 MGD for the remainder of the year. This will account for 15MGD for 30 days from the Freshet allowance for the period mid October to mid November.

Freshets will be released every Monday and Friday from June to end October inclusive. Each freshet will commence at 09:00 and end at 11:00 the following day. Each freshet will account for 35MG from the freshet allowance. The freshet will be delivered via the newly refurbished west fish pass (No2) gate No R40b.

Compensation

1st Jan to 15 March	5MGD
15 March to 15 November	20MGD
15 November to 31 January	5MGD

Freshets

1st freshet commences 2 June at 09:00
Last freshet commences 30 October at 09:00

Use of Freshet Allowance

Annual Freshet Allocation	3000MG
43 freshets @ 35MG each	1505MG
Additional Comp. 30 days @ 15MG	450MG
Remaining	1045MG

The Luichart fish pass will come out of service on the 13th October and not be returned until 15th March.

From the 14th October until the 15th November the freshet gate will be used to provide the fish pass flow.

From the 15th November until the 15th March the comp set will be used to provide the compensation.

Meig Compensation and Freshet Release.

Mid March to Mid November compensation will be 20 MGD and 5 MGD for the remainder of the year. This will account for 15MGD for 30 days from the Freshet allowance for the period mid October to mid November.

Freshets will be released every Thursday from June to mid November inclusive. Each freshet will commence at 09:00 and end at 09:00 the following day. Each freshet will account for 35MG from the freshet allowance. The freshet will be delivered by fully opening the Freshet Gate R40b and increasing the flow over the fish pass gate R43a to 15 inches.

Compensation

1st Jan to 15 March	5MGD
15 March to 15 November	20MGD
15 November to 31 January	5MGD

Freshets

1st freshet commences 1 June at 09:00
Last freshet commences 10 November at 09:00

Use of Freshet Allowance

Annual Freshet Allocation	3000MG
23 freshets @ 35MG each	805MG
Additional Comp. 30 days @ 15MG	450MG
Remaining	1745MG

Glen Marksie Smolt Freshet

From 3rd April to 29th May (8 weeks) the Glen Marksie intake will be turned out to allow the passage of smolts. This will be deducted from the Meig Freshet allocation as detailed below.

Average flow from Glen Marksie = 12.42 cusecs = 6.689 MGD

Remaining Meig Freshet Allocation		1745MG
56 days @ 6.689MGD	375MG	
Remaining		1370MG

Orrin Compensation and Freshet Release

Date	Month	Comp Flow (mgd)	Machine Flow (mgd)	Fish pass Flow (mgd)	Allocation used mgd
1 to 31	January	10	10		310
1 to 29	February	10	10		290
1 to 31	March	10	10		310
1 to 30	April	10	10		300
1 to 31	May	10	10		310
1 to 14	June	10	10		140
15 to 30	June	20	15	5	320
1 to 31	July	20	15	5	620
1 to 31	August	15	15		465
1 to 30	September	15	15		450
1 to 31	October	15	15		465
1 to 30	November	12	12		360
1 to 31	December	10	10		310
Total allocation used in 2005					4650

Total annual compensation under CS		5062
Used in 2005		4650
Unused in 2005	412	

Freshet Allowance CS 620

Total left from comp and freshet 1032

A 28 day smolt freshet will be provided during May/June called by the Conon District Salmon Fishery Board (CDSFB) at the rate of an additional 27.5 mgd. This will be supplied by an appropriate fish pass passing 30ins to provide surface attraction for the smolts. If this 28 day period encroaches on the period 15 to 30 June then the compensation flow will be reduced to 10 mgd (provided by the compensation set) until the end of the smolt freshet. During the period of the smolt freshet every endeavour will be made to maximise the running of the Orrin P/S.

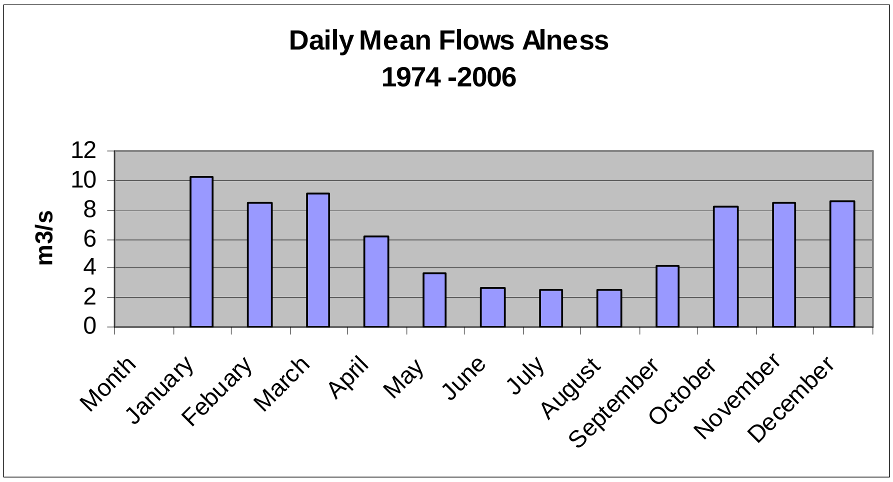
Total unused	1032
Smolt Freshet	770

Total unallocated 262

This will be called if required by the CDSFB in the form of freshets supplied at the rate of an additional 16mgd.

3.5.2 Alness

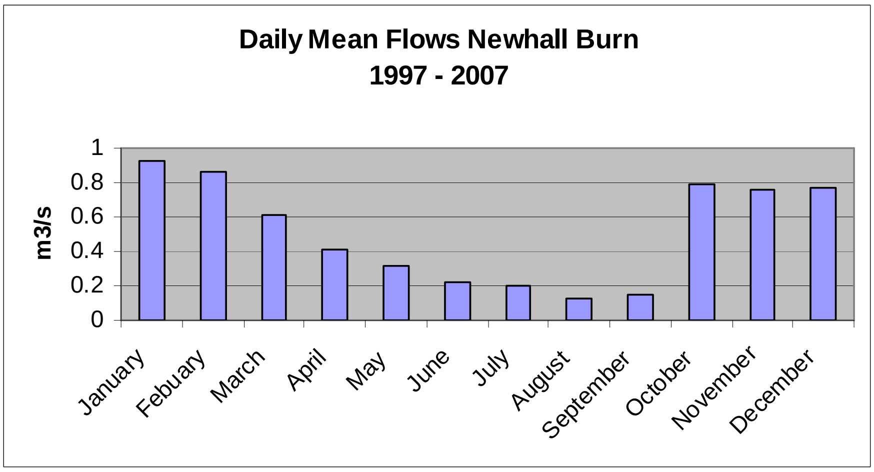
The daily mean flows for the Alness are shown in the chart below. The flows show a similar pattern to regional rainfall, with high winter flows and low flows in June, July and August. The Alness is largely unregulated but a weir at Loch Morie has been used to release water stored in Loch Morie to provide freshets for angling in dry summers. The lack of storage in Loch Morie means that these freshets are infrequent and short lived. The Upper Alness catchment is to the north and is not as wet as the more westerly Conon tributaries. Because of this the Alness is more susceptible to periods of low flow, which combined with the steepness of the upper catchment can limit the extent of upstream migration.



Data supplied by SEPA

3.5.7 Newhall Burn

The Newhall Burn flows are much lower than the rivers to the west of the region.
The combination of lower rainfall on the low lying Black Isle than in the mountains to the west, lack of storage in the catchment and intensive land-use restricts flows. The Newhall Burn is susceptible to prolonged periods of drought in the summer which can last into autumn.



Data supplied by SEPA

Section 4. Present status of fish and fisheries

4.1 List of fish species present in each Management Unit.

Cromarty Firth

In 2005 SEPA carried out fisheries surveys in the Cromarty Firth using a combination of beam trawls, fyke netting and seine netting. They recorded; plaice, cod, saithe, lesser pipefish, 3-spined stickleback, eelpout, pollack, herring, goby, whiting, butterfish, flatfish juv, great pipefish, sea trout and flounder. For more detail see SEPA Marine Technical Note MR TN 01/07.

1.1 Conon
Eel, *Anguilla anguilla*
Pike, *Esox lucius*
3-spined stickleback, *Gasterosteus aculeatus*
Rainbow trout, *Onchorhyncus mykis*
Flounder, *Platichthys flesus*
10-spined stickleback, Pungitius pungitius
Atlantic salmon, *Salmo salar*
Sea trout, *Salmo trutta trutta*
Brown trout, *Salmo trutta fario*
Perch, *Perca fluvialis*
Sea Lamprey, *Petromyzon marinus*
River Lampery, *Lampetra fluviatilis*
Brook Lamprey, *Lampetra planeri*
Minnow, *Phoxinus phoxinus*

1.2 Bran
Eel, *Anguilla anguilla*
Pike, *Esox lucius*
Perch, *Perca fluvialis*
Minnow, *Phoxinus phoxinus*
Arctic Charr, *Salvelinus alpinus*
Brown Trout, *Salmo trutta. fario*
Atlantic salmon, *Salmo salar*

1.3 Meig
Eel, *Anguilla anguilla*
Sea trout, *Salmo trutta trutta*
Brown trout, *Salmo trutta. fario*
Atlantic salmon, *Salmo salar*
Arctic Charr, *Salvelinus alpinus*
Minnow, *Phoxinus phoxinus*
Pike, *Esox lucius*
Perch, *Perca fluvialis*

1.4 Orrin

Sea trout, *Salmo trutta trutta*
Brown trout, *Salmo trutta fario*
Atlantic salmon, *Salmo salar*
Eel, *Anguilla anguilla*
Arctic Charr, *Salvelinus alpinus*
Rainbow trout, *Oncorhyncus mykis*

1.5 Blackwater
Atlantic salmon, *Salmo salar*
Sea trout, *Salmo trutta trutta*
Brown trout, *Salmo trutta fario*
Eel, *Anguilla anguilla*
Rainbow trout, *Onchorhyncus mykis*
Minnow, *Phoxinus phoxinus*
Pike, *Esox lucius*
Lampetra sp

2 Alness
Eel, *Anguilla anguilla*
Atlantic salmon, *Salmo salar*
Sea trout, *Salmo trutta trutta*
Brown trout, *Salmo trutta fario*
Arctic Charr, *Salvelinus alpinus*
3-spined stickleback, *Gasterosteus aculeatus*
Rainbow trout, *Onchorhyncus mykis*

3 Allt Graad
Atlantic salmon, *Salmo salar*
Sea trout, *Salmo trutta trutta*
Brown trout, *Salmo trutta fario*
Eel, *Anguilla anguilla*

4 Balnagown
Eel, *Anguilla anguilla*
Atlantic salmon, *Salmo salar*
Sea trout, *Salmo trutta trutta*
Brown trout, *Salmo trutta fario*

5 Sgitheach
Eel, *Anguilla anguilla*
Atlantic salmon, *Salmo salar*
Sea trout, *Salmo trutta trutta*
Brown trout, *Salmo trutta fario*

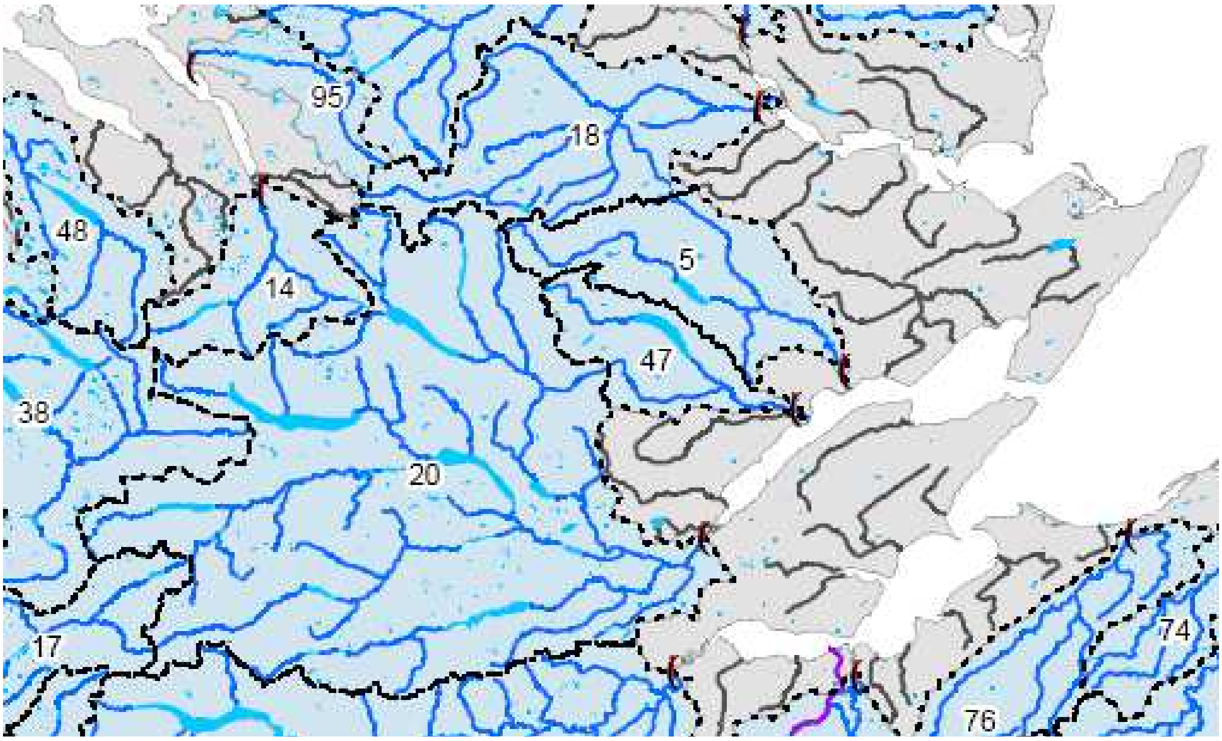
6 Peffery
Eel, *Anguilla anguilla*
Sea trout, *Salmo trutta trutta*
Brown trout, *Salmo trutta fario*
3-spined stickleback, *Gasterosteus aculeatus*
Lampetra sp

7 Newhall Burn
Eel, *Anguilla anguilla*
Atlantic salmon, *Salmo salar*
Sea trout, *Salmo trutta trutta*
Brown trout, *Salmo trutta fario*

8 Coastal Burns
Eel, *Anguilla anguilla*
Atlantic salmon, *Salmo salar*
Sea trout, *Salmo trutta trutta*
Brown trout, *Salmo trutta fario*
3-spined stickleback, *Gasterosteus aculeatus*
Lampetra sp.

4.2 The extent of the known distribution of each species and their local biological characteristics.

SEPA Designated Salmonid Waters in the Cromarty Firth Region



20 Conon, 5 Alness, 47 Allt Graad (Glass)

The SEPA designated salmonid waters are shown on the map above.

THE SURFACE WATERS (FISHLIFE) (CLASSIFICATION) (SCOTLAND) DIRECTIONS 2007

The Scottish Ministers, in exercise of the powers conferred by section 40 of the Environment Act 1995(**a**) and of all other powers enabling them in that behalf, having carried out consultation with the Scottish Environment Protection Agency (hereinafter referred to as "SEPA") as required by section 40(6) of that Act, hereby give SEPA the following Directions:

Citation, commencement and interpretation

1. (1) These Directions may be cited as the Surface Waters (Fishlife) (Classification) (Scotland) Directions 2007 and shall come into force on 16 October 2007.

(2) In these Directions, "the Regulations" means the Surface Waters (Fishlife) (Classification) (Scotland) Regulations 1997(**b**).

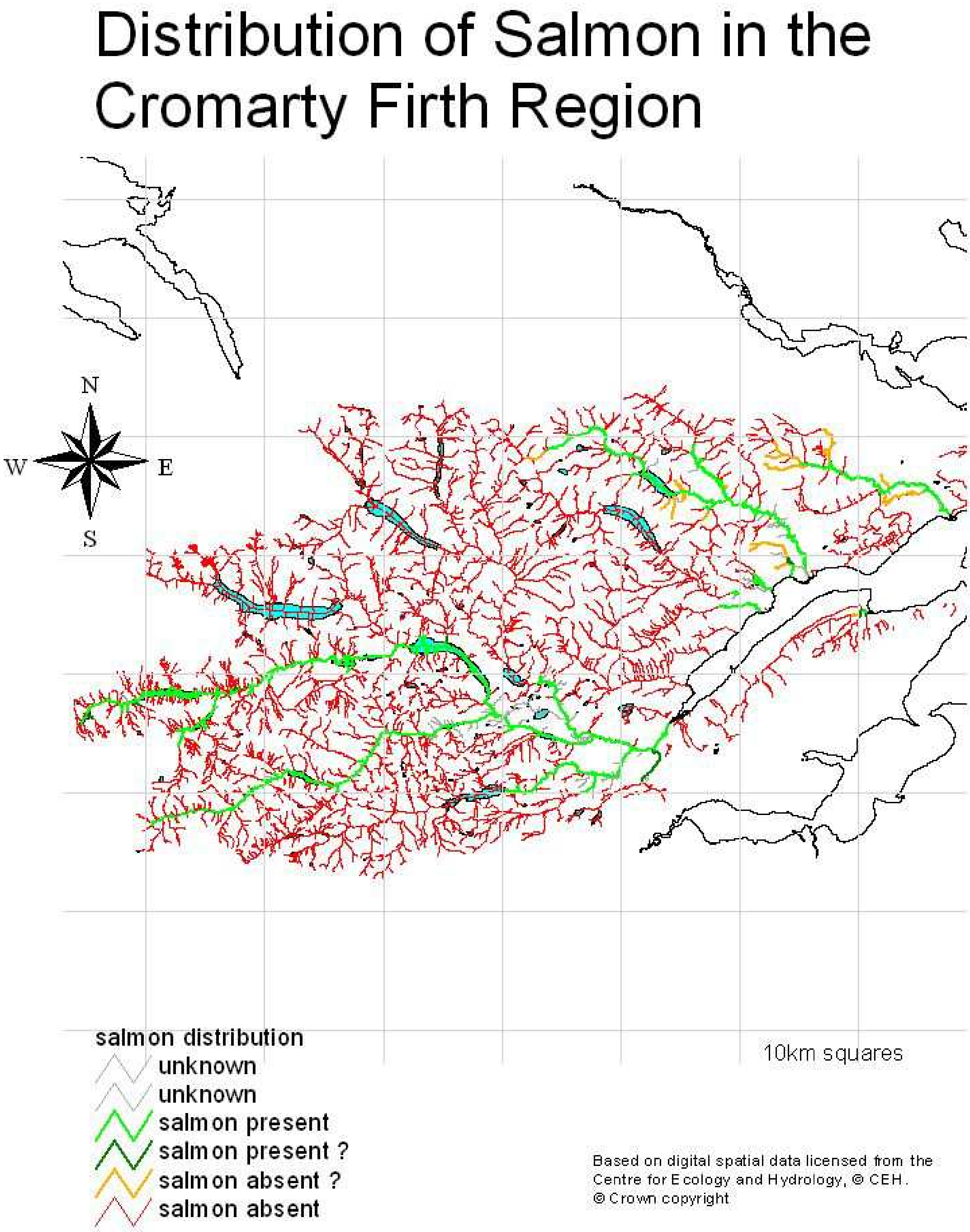
Waters to be treated as classified as salmonid waters under the Regulations

2. (1) SEPA shall treat the waters specified in column 1 of Schedule 1 to these Directions, from their up stream mapped limit downstream to the lower limit of the waters and including all tributaries thereof, unless otherwise indicated in column 3 of that Schedule, as waters classified as salmonid waters under the Regulations.

(2) For the purpose of identifying the lower limit of the waters classified by virtue of sub-paragraph (1) above, there is set out in column 2 of Schedule 1 to these Directions a grid reference corresponding to a point located at the lower limit of the water specified in the corresponding entry in column 1 of that Schedule.

Salmon Distribution

The distribution of Atlantic salmon in the region is shown on the map below. This map along with details of barriers to migration is held by FRS and was derived from information supplied during the first phase of this contract. Details of barriers to migration are discussed in Section 8 of this plan.



Brown trout and sea trout distribution

Brown trout are widely distributed in the region in both river and still water habitats. Brown trout are present at most electro-fishing sites although frequently at low densities because of the criteria used for site selection (see Section 9).

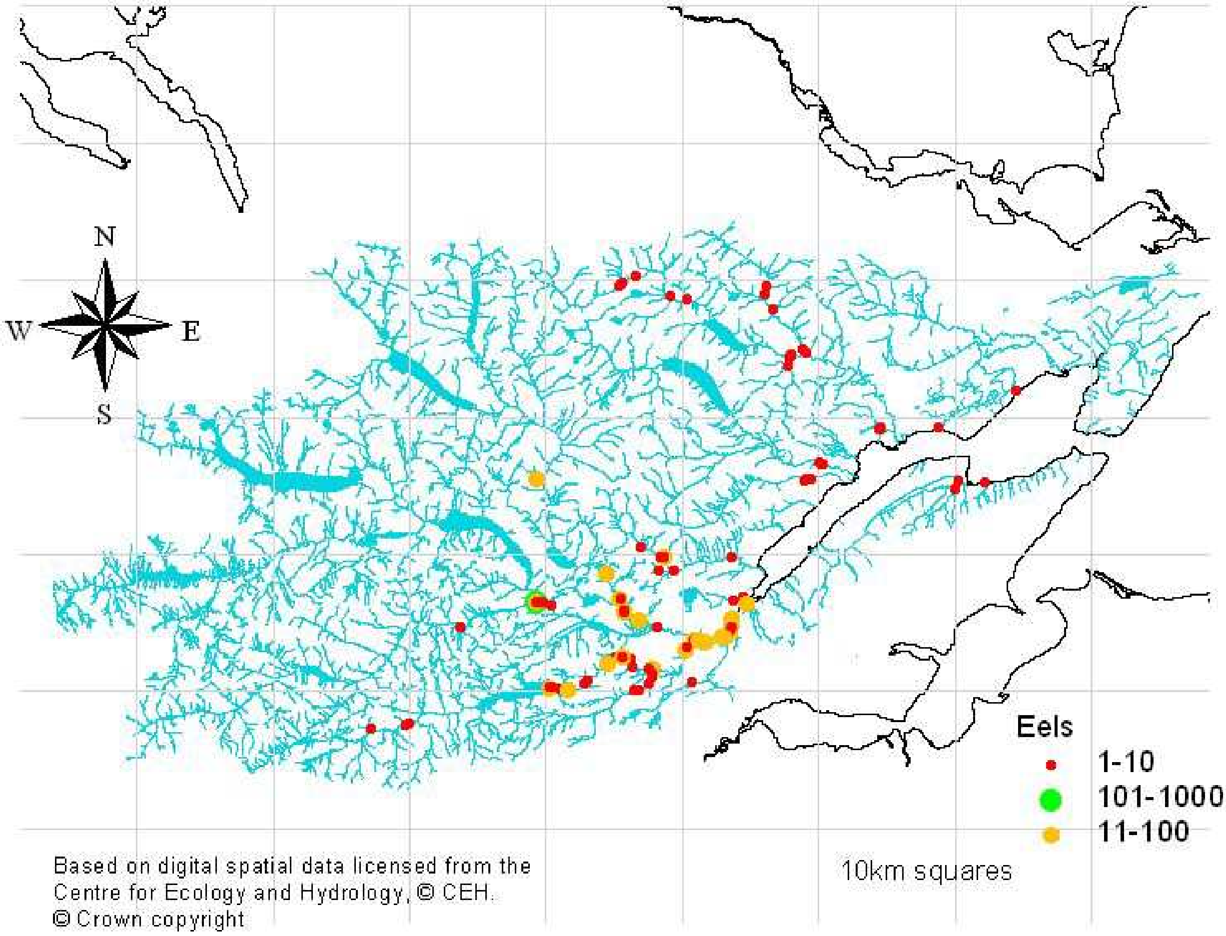
A proposed hill loch project will investigate the distribution of brown trout populations in hill lochs. Ferox trout are known to be present in the Conon catchment in the lochs of the Bran and Blackwater. Ferox are also known to be present in Loch Morie in the Alness catchment.

In the Conon the distribution of sea trout is largely confined to the Conon and the lower reaches of the Orrin, Blackwater and Meig. Sea trout are present in the Alness with the main stem from Loch Morie downstream, the Blackwater and lower tributaries being particularly important.

Sea trout are also present in the Sgitheach and Allt Graad in the same area occupied by salmon. The Balnagown has a population of sea trout which historically extended as far upstream as Loch Sheilah. Sea trout are present in the Peffery, Newhall Burn and other smaller coastal burns. Habitat in all these watercourses has been degraded by intensive agriculture and forestry and sea trout populations have declined from previous levels.

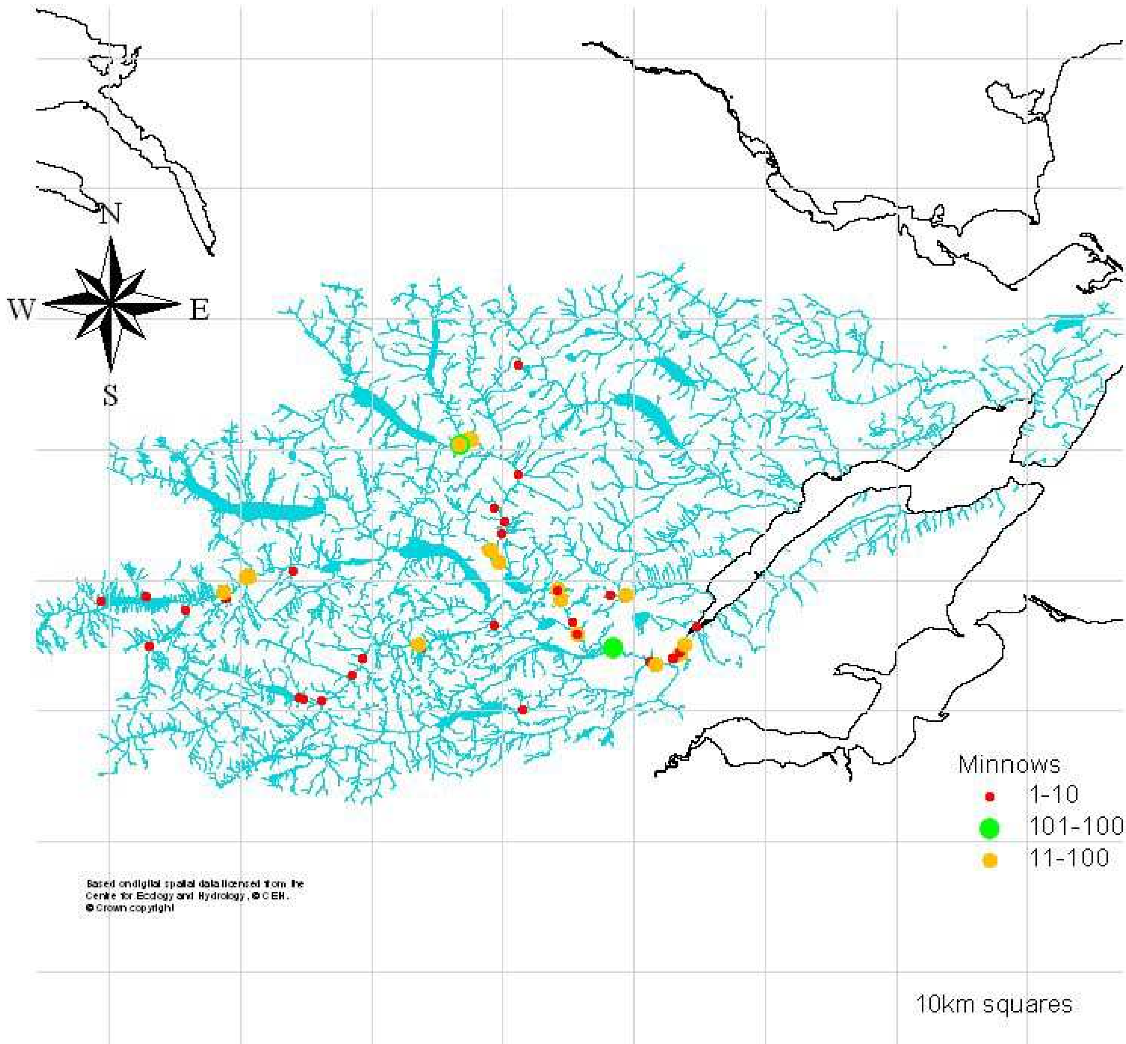
The Moray Firth Sea trout Project starting in 2008 will investigate the distribution of sea trout stocks in the region

Distribution of Eels at electrofishing sites



The distribution of eels in the Cromarty Firth region is shown on the map above. The distribution is widespread throughout the region. Highest numbers of eels are recorded in lower catchment areas particularly in the main stem of the Conon, Lower Orrin, Blackwater and Lower Meig.

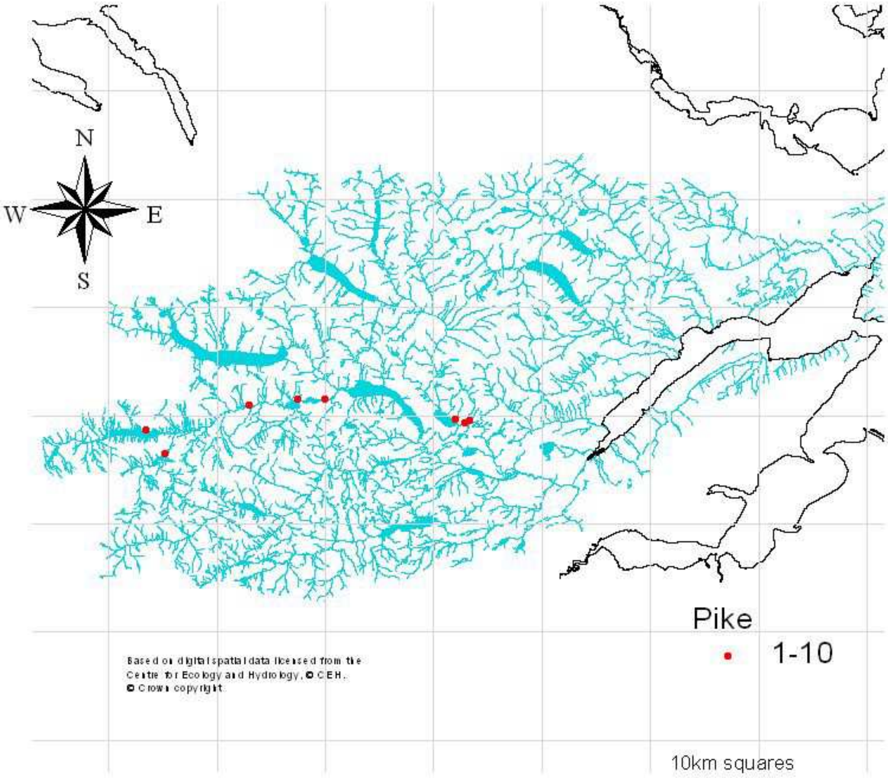
Distribution of Minnows at electro-fishing sites



The distribution of minnows at electro-fishing sites is shown on the map above.

The distribution is centred on the Conon system and is largely due to introductions by visiting trout anglers, who import live minnows to use as bait and then release unused minnows after fishing.

Distribution of Pike at electro-fishing sites

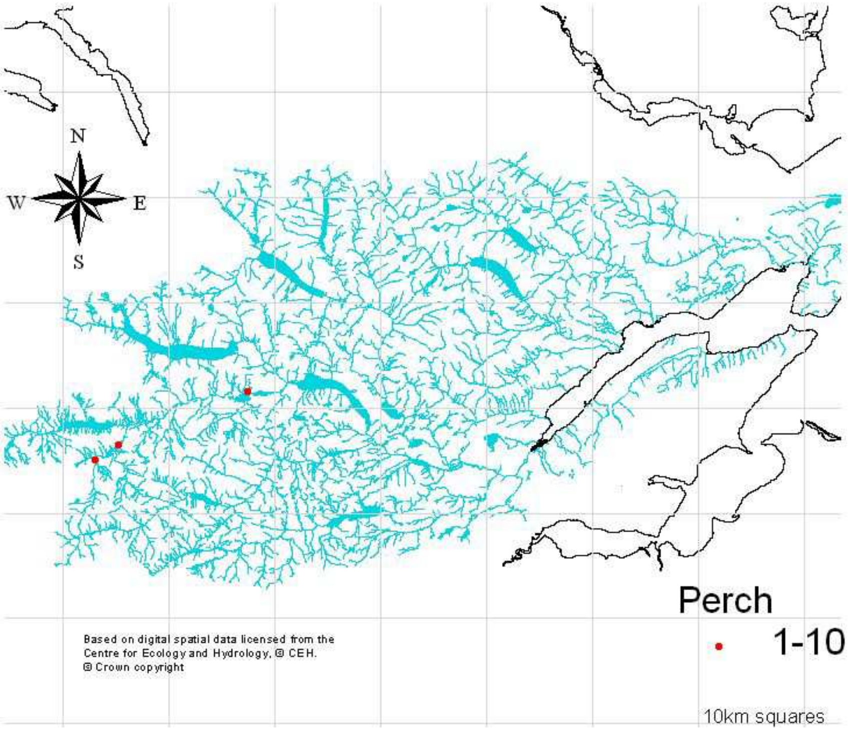


The distribution of pike at electro-fishing sites is shown on the map above. The actual distribution is wider than is shown from electro-fishing records, and is centred on the loch systems of the River Bran and Blackwater. Pike are also present in the main stem of the Conon and in the slower reaches of the Lower Bran.

Pike are also present in Loch Ussie and Loch Achilty.

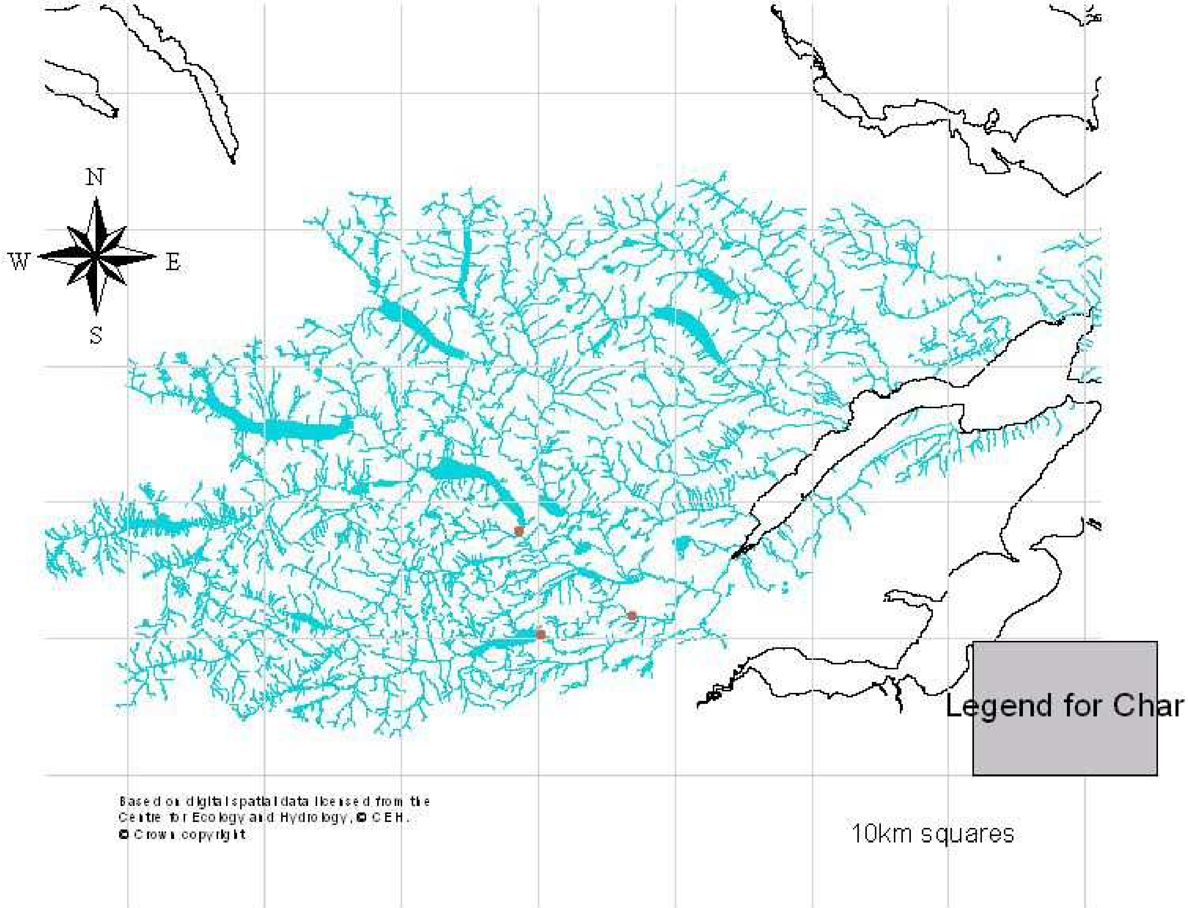
Pike are not endemic to the region but have been introduced historically as a food fish and more recently for angling.

Distribution of Perch at electro-fishing sites



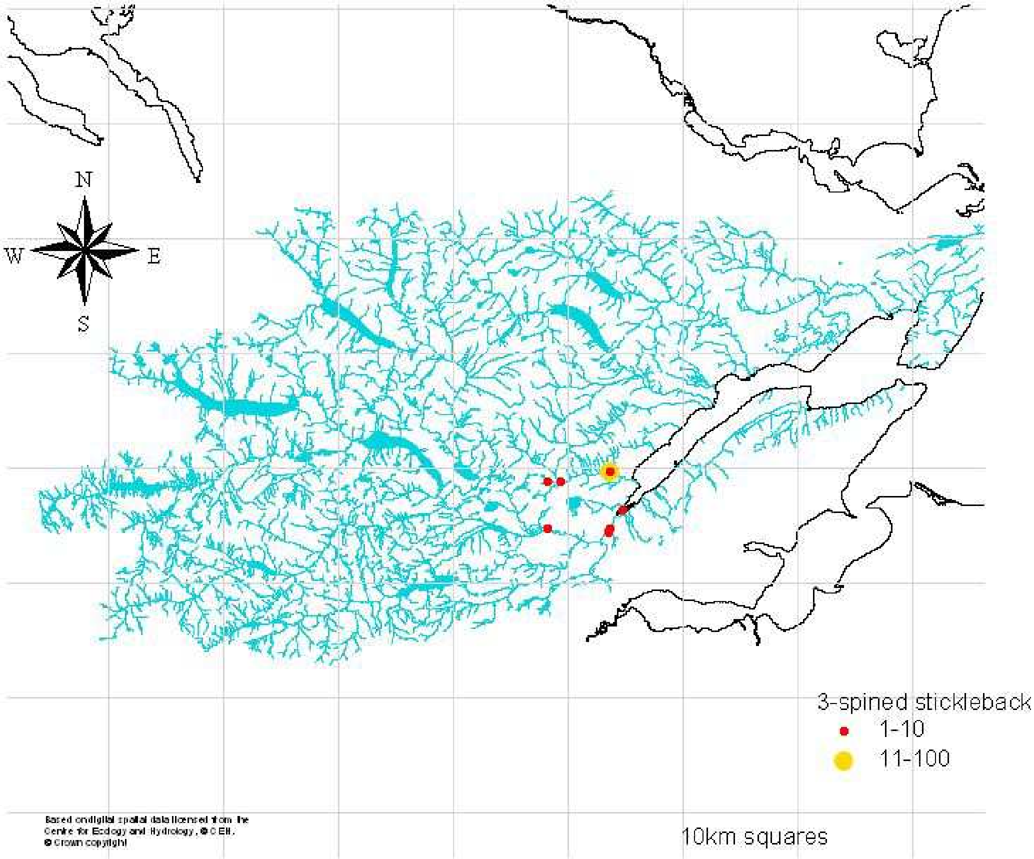
The distribution of perch at electro-fishing sites is shown on map above. The distribution is centred on the lochs of the Bran system. Perch are present in Loch Gowan, Loch Rosque, Loch a Chullin and Loch Achanalt as well as the Lower Bran. Perch have also been recorded from the main stem of the Conon and Loch Achonachie.

Distribution of Arctic Charr at electro-fishing sites

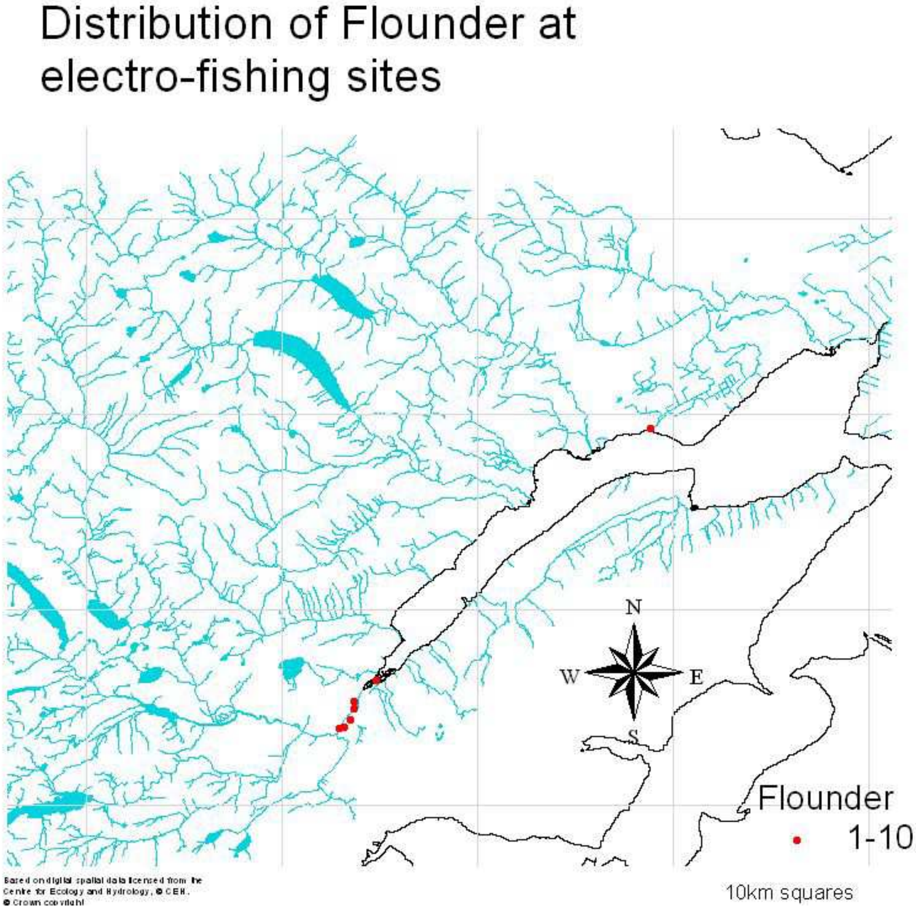


The distribution of Arctic Charr caught during trapping and electro-fishing operations is shown on the map above. These records represent accidental captures of charr originating from loch systems upstream. A study of the larger loch systems and also hill lochs is needed to establish the distribution of charr in the region and to investigate stock structure. There is anecdotal evidence of charr being caught in the lochs of the Upper Orrin and the Bran system. A search of estate records might give more information on charr populations. Arctic charr are known to be present in Loch Morie on the Alness system.

Distribution of 3-spined stickleback at electro-fishing sites

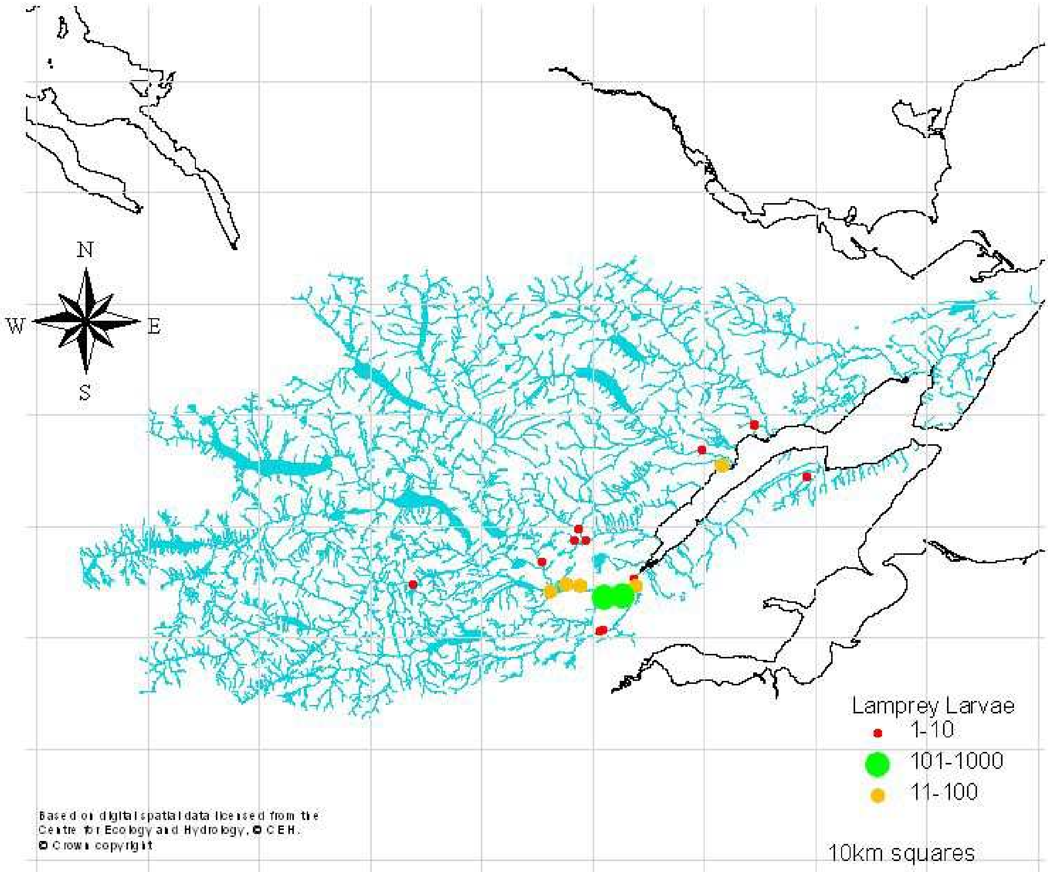


The map above shows the distribution of 3-spined sticklebacks at electro-fishing sites. The distribution is centred on the lower reaches of the Conon and Peffery. Many of the electro-fishing sites selected for monitoring salmonids are too fast flowing to be optimal stickleback habitat. A comprehensive lamprey survey is likely to produce more stickleback records and give a more accurate distribution.



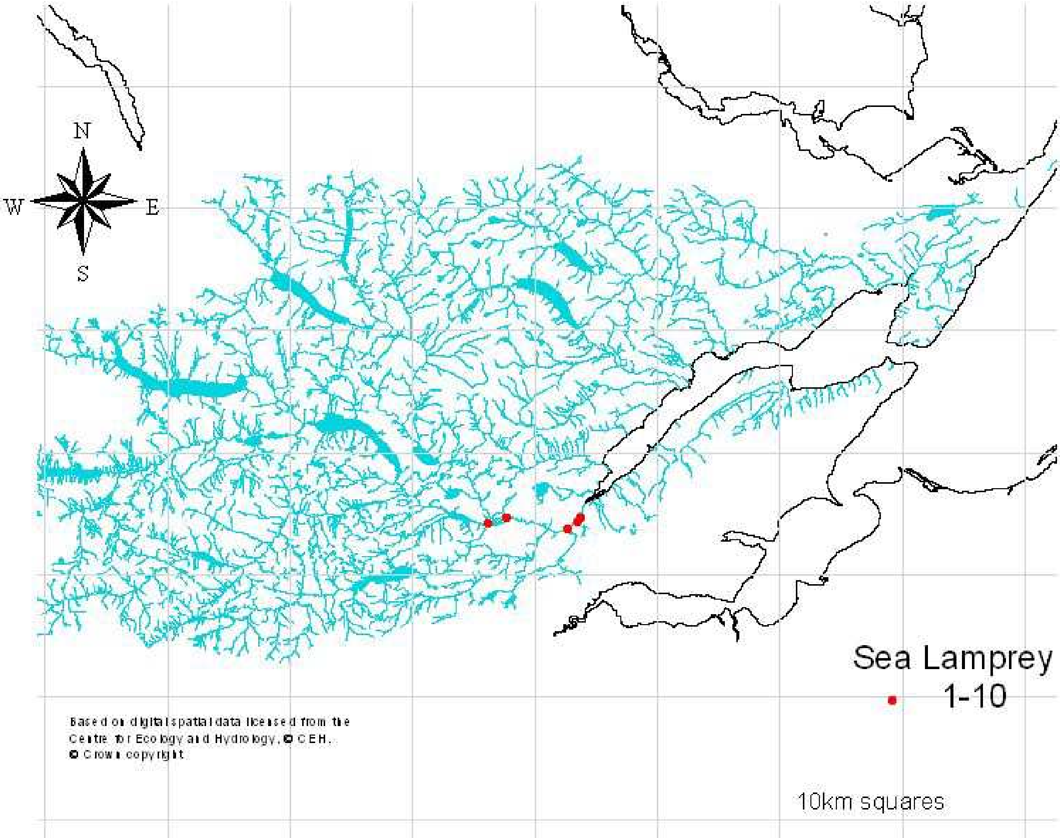
The map above shows the distribution of flounder at electro-fishing sites. As would be expected from an estuarine species, the records are in the lower reaches of rivers below obstacles to migration.

Distribution of lamprey larvae at electro-fishing sites



Because River and Brook lamprey cannot be reliably distinguished at the larval ammocete stage they are recorded as lamprey larvae. The sand / silt habitat needed by ammocetes is patchy in distribution and often contains high concentrations of ammocetes, particularly in lower and main stem rivers. Lamprey larvae in upper catchments, above obstacles to migration are most likely to be Brook lamprey, whilst both Brook and River lampreys may be present downstream.

Distribution of Sea lamprey at electro-fishing sites



The distribution of sea lamprey at electro-fishing sites is shown on the map above. These records are of ammocetes which can be distinguished from Lampetra sp but occur in the same sand / silt habitats. There are also records of adult sea lamprey spawning in the main stem of the Conon from ghillies and anglers.

4.3 Stock structure.

Conon

Historically the Upper Orrin provided the largest area of high altitude habitat in the Conon catchment. Prior to 1959 the Upper Orrin supported a significant spring salmon fishery which declined following hydro construction. The present spring run on the Conon consists of 2 sea-winter fish and peaks in April and May with very few fish in March. There is then a later run of grilse and summer salmon. Prior to 2000 the grilse run began in June, peaked sharply in July and tailed off quickly through August with few fresh grilse in September. However in recent years the grilse run has arrived later, with a peak in August and fresh fish throughout September. There has been an increasing number of large summer salmon in recent years but no evidence of a separate autumn run.

There is a stock of over-wintering finnock in the main stem of the Conon as far upstream as Tor Achilty Dam. Sea trout appear to be confined to the lower reaches of the Conon system with few reported upstream of Rogie and Orrin Falls. There is a run of sea trout to the Lower Blackwater in April which is followed by the main run from July onwards. The main finnock run is from July onwards, with increasing numbers in the tidal reaches of the Conon through September.

Alness

The Alness has a small spring run but is mainly a grilse and summer salmon river. The grilse and summer salmon runs arrive from June onwards and like the Conon have peaked in August in recent years. Unlike the Conon the Alness has historically had a run of larger autumn grilse and salmon. There are fresh grilse arriving into the lower reaches of the Alness into October.

Allt Graad

The restricted spawning grounds sited in the lower reaches of the Allt Graad support summer salmon, grilse and sea trout stocks.

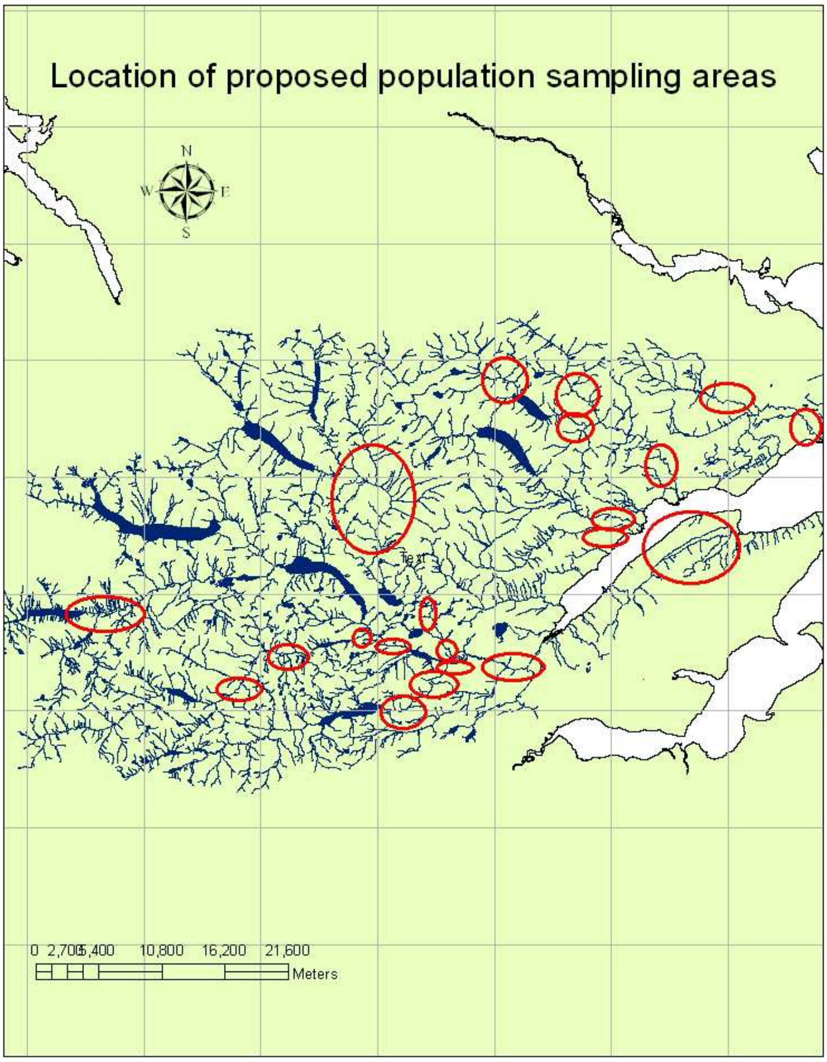
Balnagown

The Balnagown has a summer salmon and grilse run but also a more significant sea trout run. Sea trout historically spawned as far upstream as Loch Sheilah. With extensive forestry development in the catchment the current distribution of sea trout is uncertain.

Many of the smaller catchments in the Cromarty Firth region support stocks of sea trout and grilse. The Peffery historically was a productive sea trout river but has much declined in recent years with extensive afforestation and drainage works.

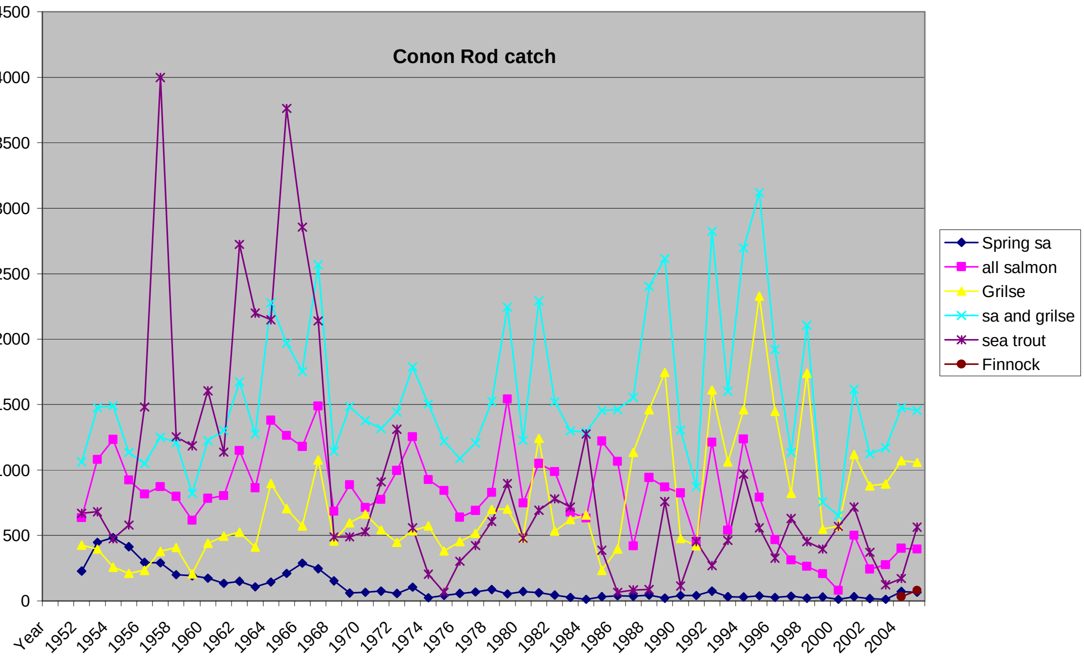
4.3.1 Genetic Structuring of Stocks

Following discussion with staff at FRS a number of sampling areas were agreed to start to assess the distribution of salmon populations within the Cromarty Firth region. Sites were selected to assess the extent of structuring between and within rivers as well as the effects of a long term stocking programme in the Conon catchment.



4.4 Trends in abundance

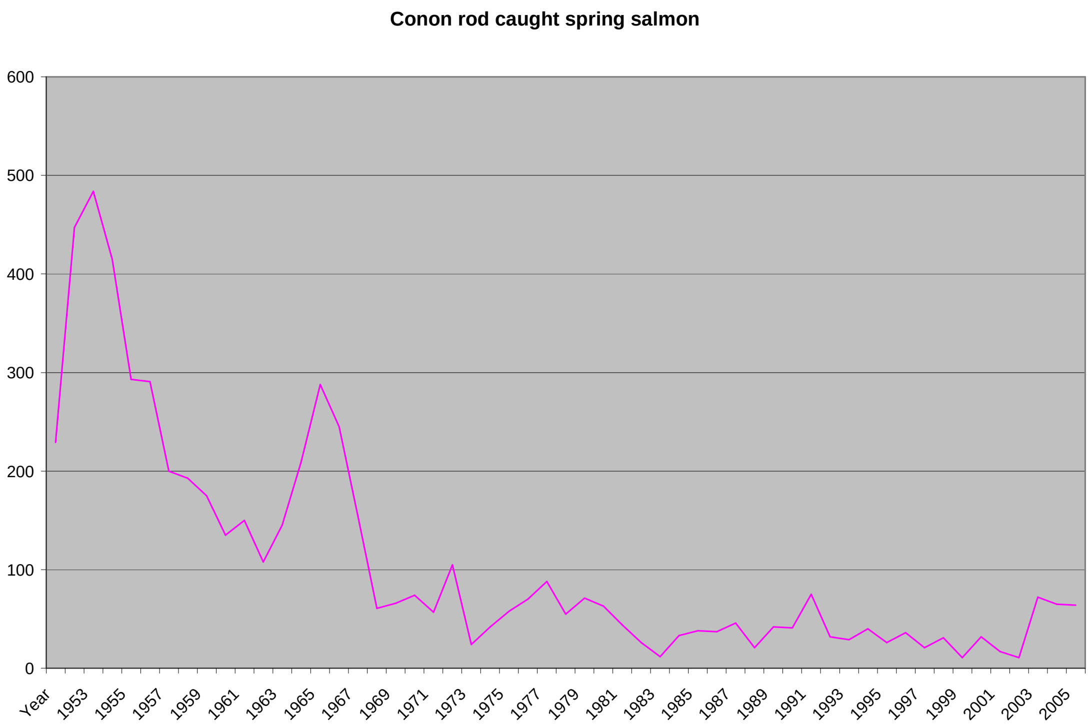
Conon Salmon Trends



The Conon rod catch from 1952 to 2006 is shown on the chart above. Despite the regulated flow, the Conon rod catch is inherently weak as an indicator of stock because so much of the angling effort is concentrated in the lowest 11 km of the river. In a wet year, fish pass quickly upstream of the rod fishery, to the relative safety of tributaries and lochs.

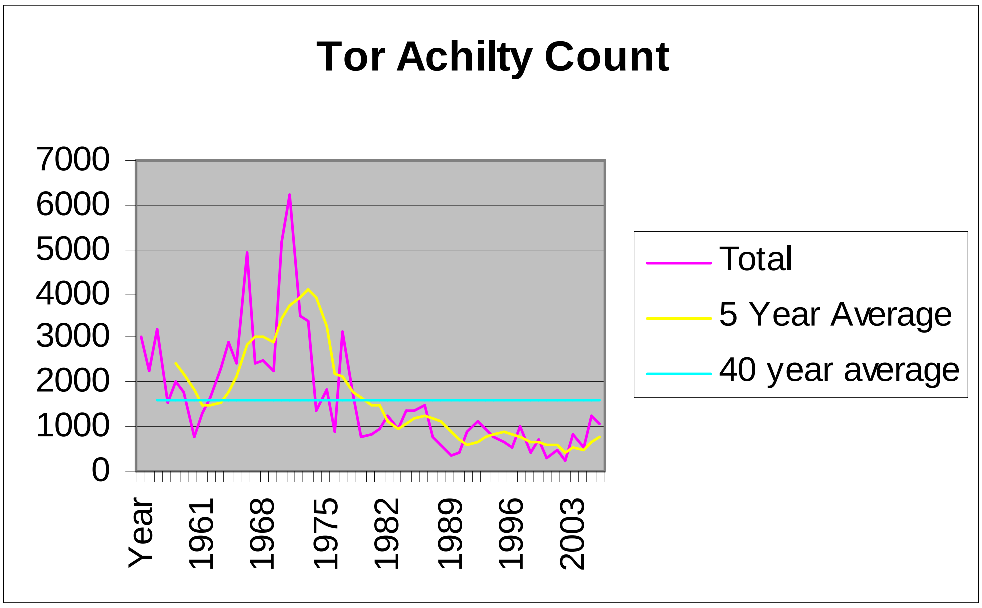
There are however some long term trends that can be discerned from the Conon rod catch. The grilse catch (yellow) shows relatively low numbers (less than 500 / yr) during the 1950s, a small increase in the 1960s and then a decline in the 1970s, following the outbreak of UDN. There was then an increase in grilse catches through the 1980s and early 1990s, when a number of strong grilse years coincided with an increase in angling effort, following the creation of the Brahan timeshare. There was a drop in grilse catches in 1999 which has since recovered to around 1,000 a year.

Looking at the combined salmon and grilse catch (pale blue) the Conon rod catch has been remarkably constant over the period since 1952 with catches at present similar to those at the start of the time series.

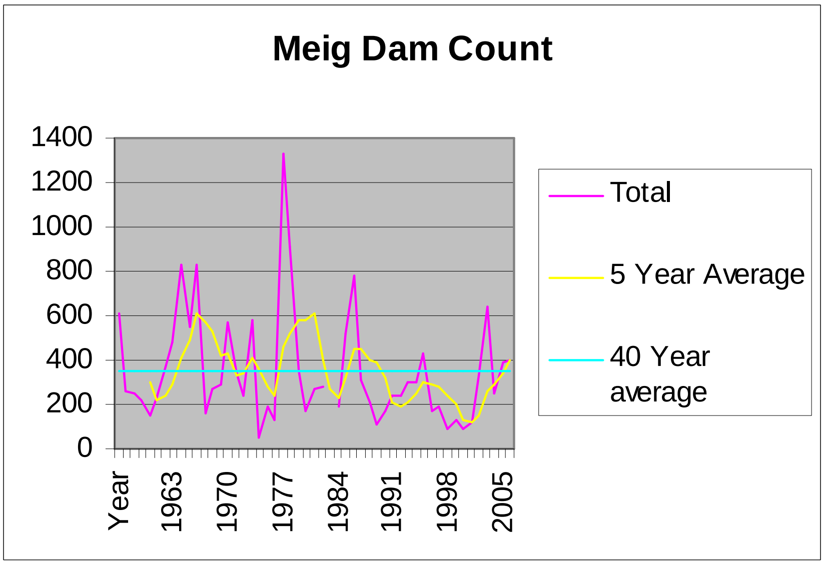


The spring salmon rod catch on the Conon declined during the 1950s and early 1960s following the construction of the Conon Basin Hydro Scheme, which reduced access to the headwaters of the catchment. Since then the spring salmon stock has persisted at a lower level, with a rod catch of under 100 a year since 1972. There have been signs of an upturn in spring catches since 2003.

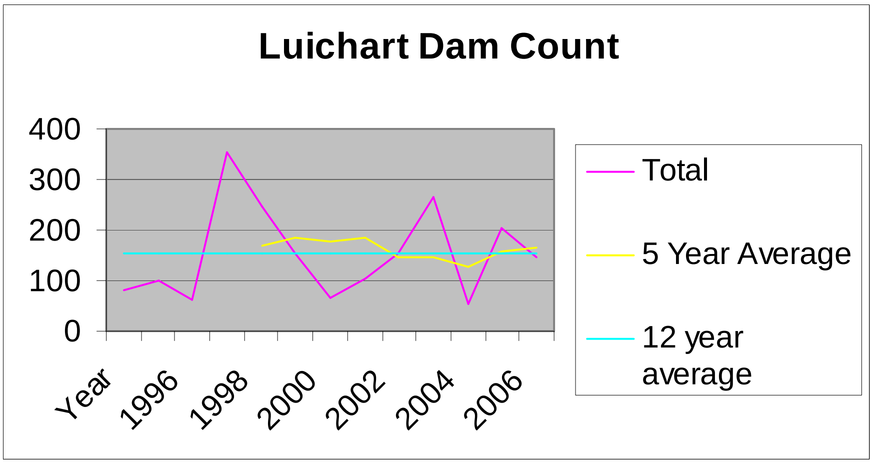
Although not without weaknesses, the Scottish and Southern Energy fish counts at Tor Achilty, Meig and Luichart dams provide a more reliable indicator of overall salmon stock than the rod catch.



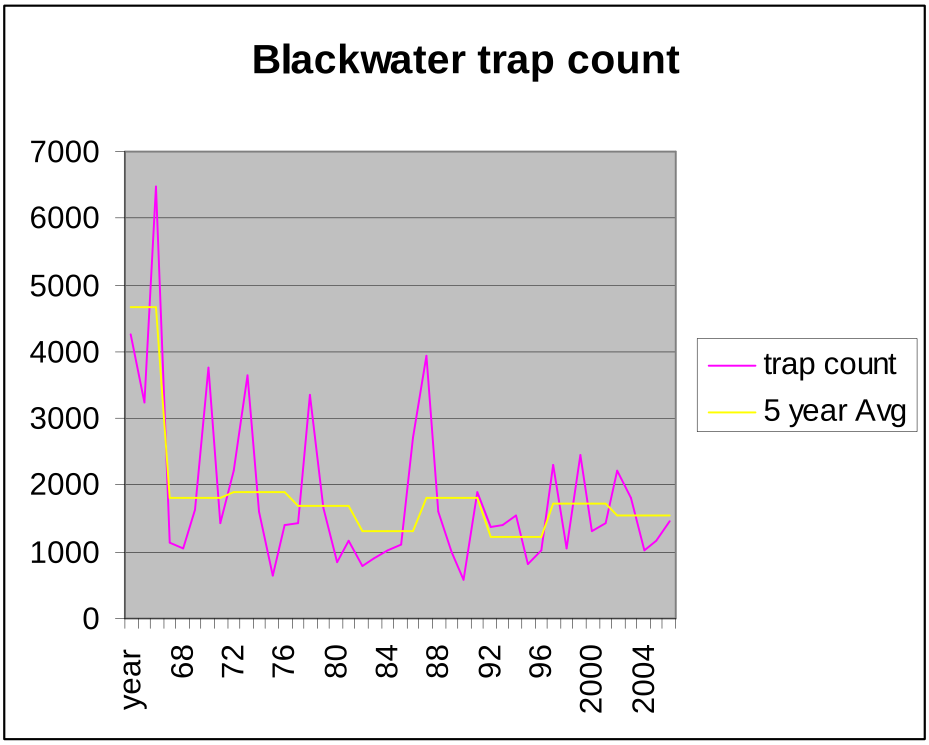
The Tor Achilty count is shown on the graph above, the early counts were manual and then a series of resistivity counters were used. The chart shows a period up to the mid 1970s when counts exceeded the 40 year average followed by a period since, when the 40 year average has not been reached. The counts in recent years have increased to over 1,000 a year. This may be due to an increase in the number of salmon returning or to the installation of an improved fish counter.



The Meig Dam fish counts do not show the same trend as the Tor Achilty count of a high abundance up to the mid 1970s and reduced numbers since. Instead the Meig count has fluctuated around the 40 year mean without a clear trend.

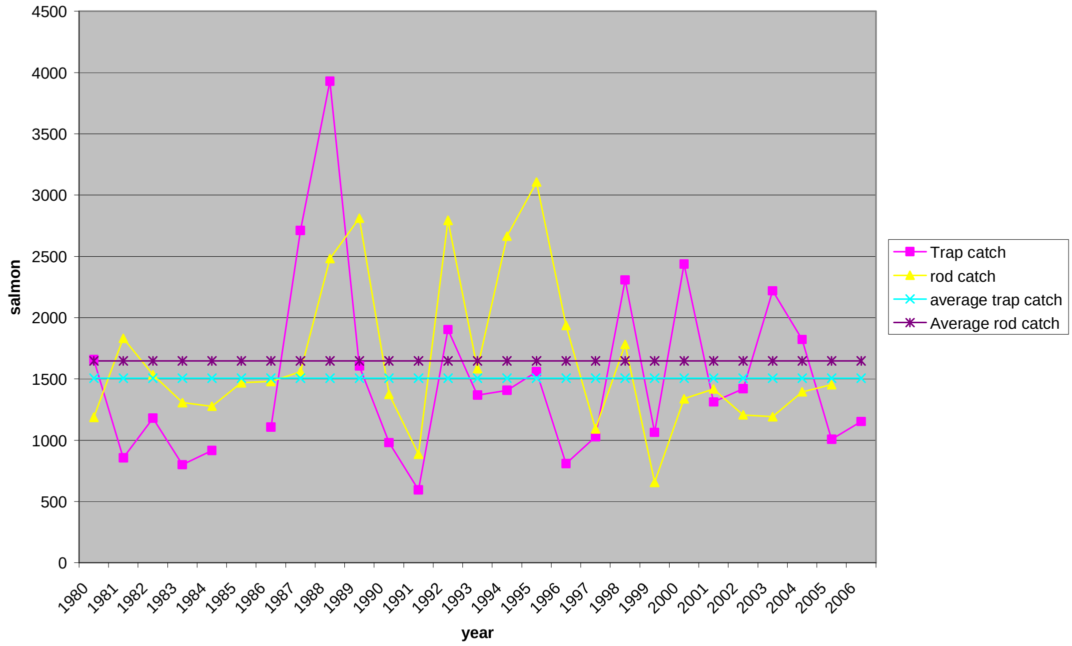


The Luichart Dam counts are shown on the chart above. The counts at Luichart are unreliable as there have been several periods when the counter has been out of operation. When it has been in operation there have been problems with wave action creating anomalous counts.



The trap catch at Loch na Croic on the Blackwater is show on the chart above. The Blackwater trap catches the entire upstream run of salmon returning to the Upper Blackwater and provides a more reliable indicator of stocks than either the rod catch or the fish pass counts. The Blackwater time series shows an initial decline after hydro construction and then variation around a mean without a clear trend either upwards or downwards.

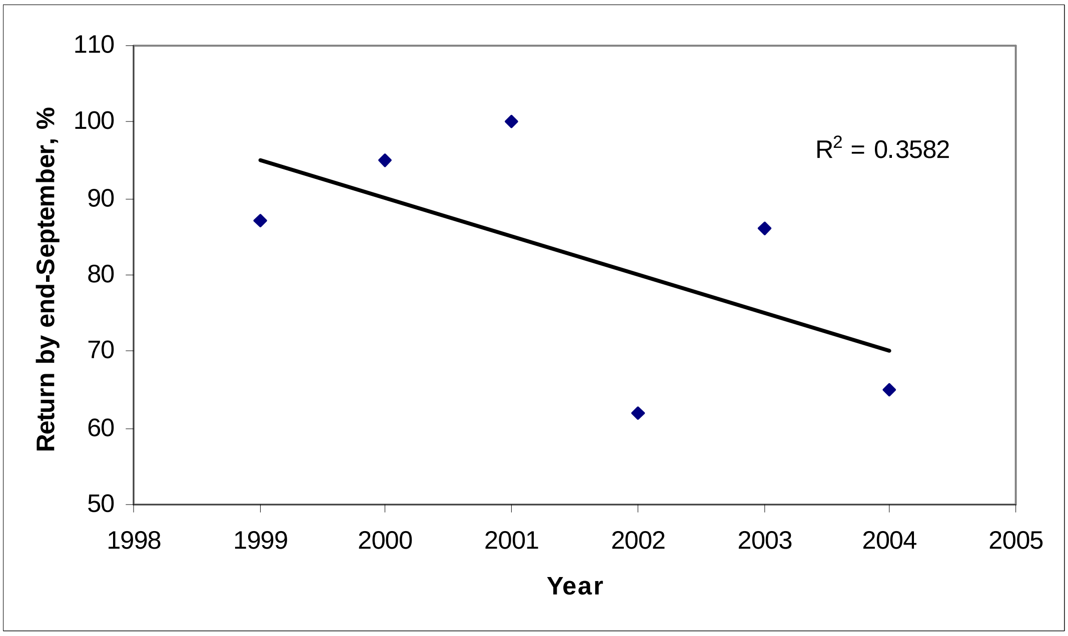
Conon Rod catch and Blackwater trap catch



When the Conon rod catch is plotted against the Blackwater trap catch, the extremes of abundance coincide. The very strong grilse runs of the late 1980s resulted in high rod and trap catches, whilst the very poor runs of 1991 and 1999 resulted in low rod and trap catches. However on years of more typical grilse abundance the relationship between rod catch and trap catch is probably more influenced by rainfall. This can be seen in the drought years of the mid 1990s, which showed a high rod catch and low trap catch. The wetter summers since 2002 resulted in a higher trap catch and reduced rod catch. The trap catches of 2005 and 2006 are anomalous because of a problem with the concrete base of the trap which allowed large numbers of fish to escape upstream of the trap.

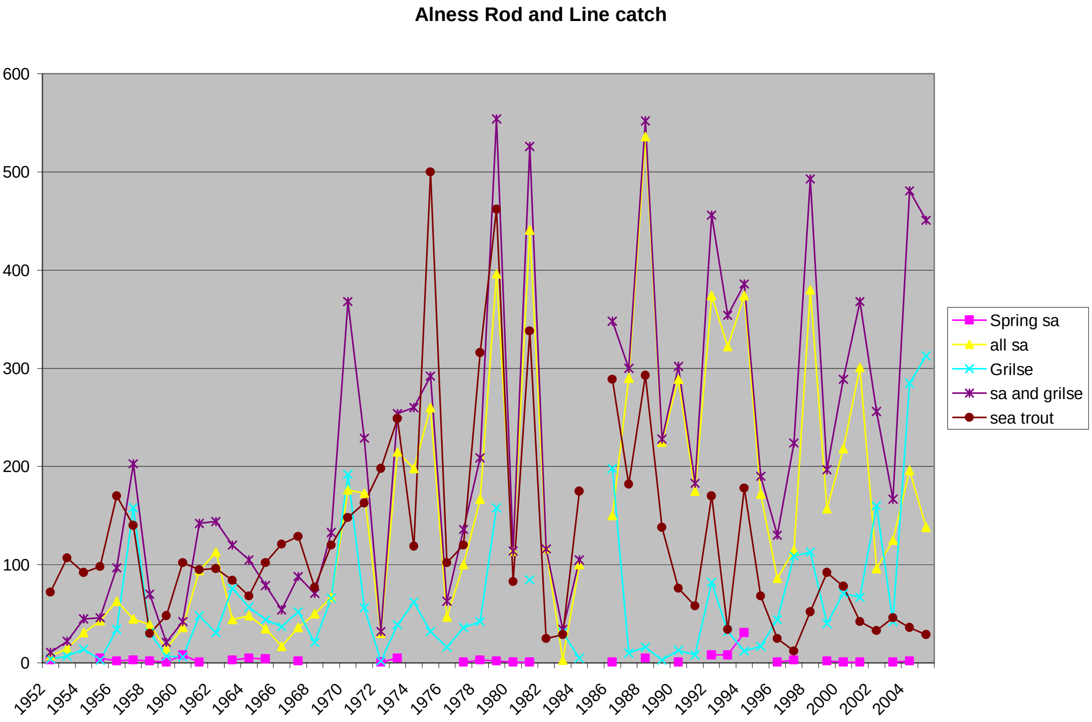
Although the overall rod catch on the Conon has remained relatively stable in recent years, the distribution of the rod catch by beat has changed. There has been a trend for grilse to lie in the lower reaches of the Conon, which has resulted in increased catches for lower beats, whilst fish have moved quickly through some middle beats which have shown a marked decline in catches. There has also been a reduced rod effort on some middle beats and an increased rod effort on lower beats.

There has also been a change in the timing of the Conon grilse run in recent years. The peak of the rod catch has moved from early July into August. This change in run timing has also been shown by the timing of passage of PIT tagged grilse through Tor Achilty Dam.

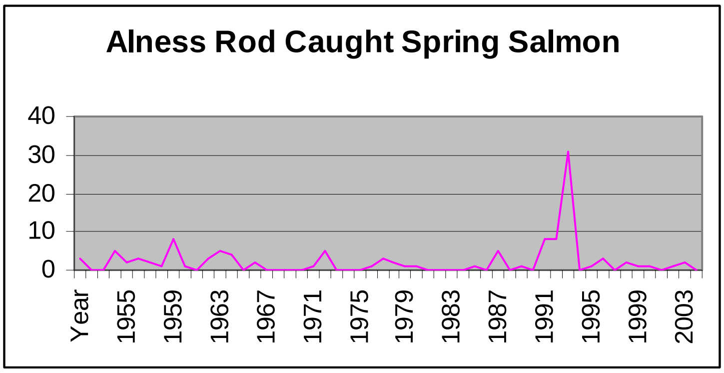


The graph above shows the percentage of PIT tagged grilse passing through Tor Achilty Dam before the end of the angling season. The graph shows a clear decrease in the percentage of tagged fish passing through the Dam within the angling season.

Alness Trends

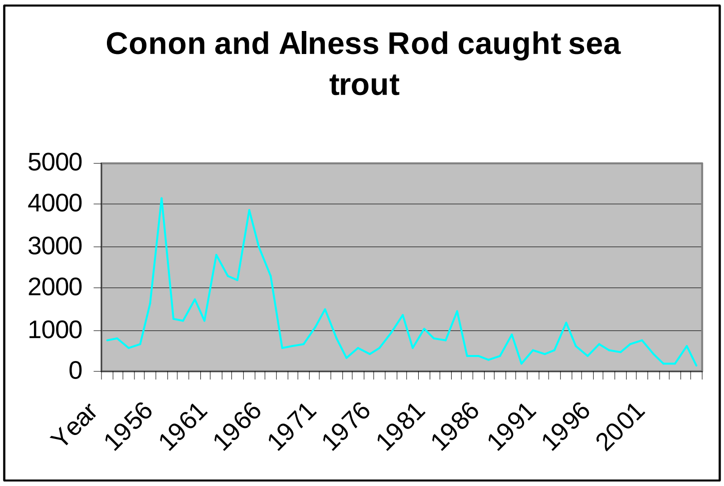


The graph above shows the Alness rod catch from 1952 to 2006. The Alness rod catch is even less reliable as an indicator of stock abundance than the Conon's. The Alness catch shows large variation and few clear trends because it is so dependant on rainfall creating favourable angling conditions. In recent years there has been an increase in catches resulting from a series of wet summers and increased angling effort, following improved marketing of the fishery.

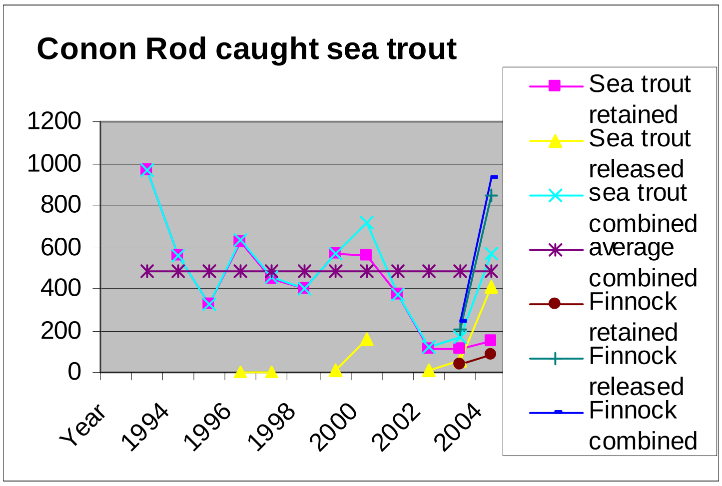


The Alness rod catch shows the presence of spring salmon in low numbers throughout the time series with no clear trend in abundance.

Sea Trout



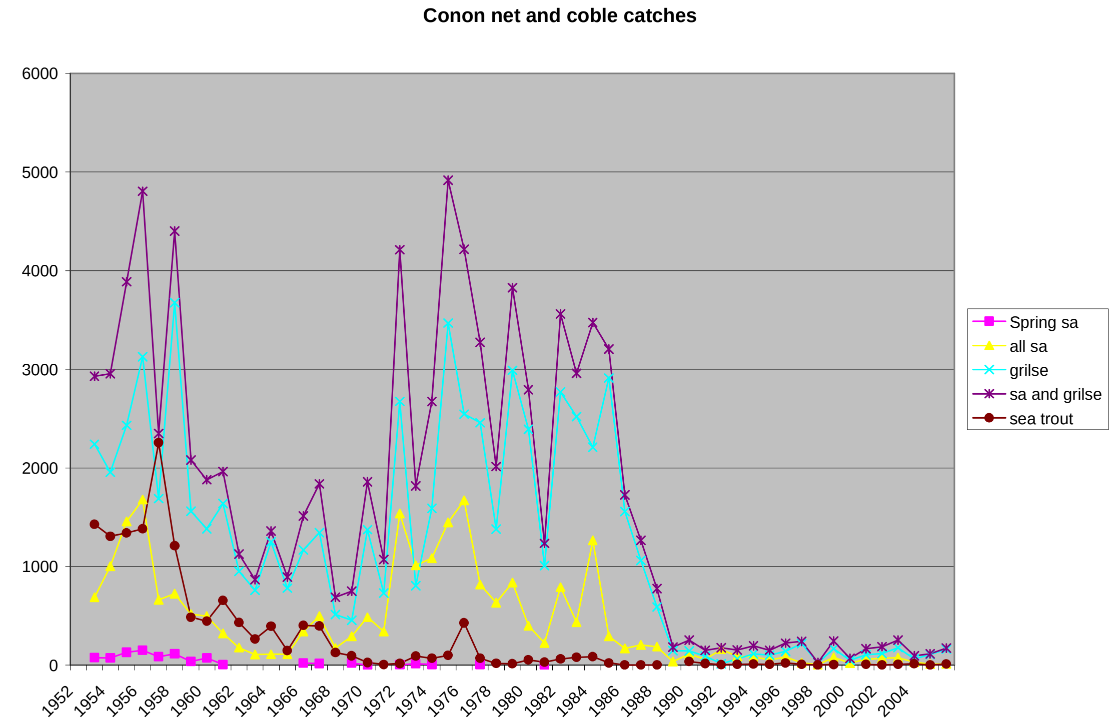
The combined Conon and Alness sea trout catch shows a period of relative abundance in the 1950s and 1960s and relative scarcity since 1970. This decline in numbers coincided with the occurrence of UDN in the 1970s and the Kessock herring fishery in the Moray Firth. However other factors such as the intensification of agriculture in lower catchments and the growth of commercial forestry may also be significant



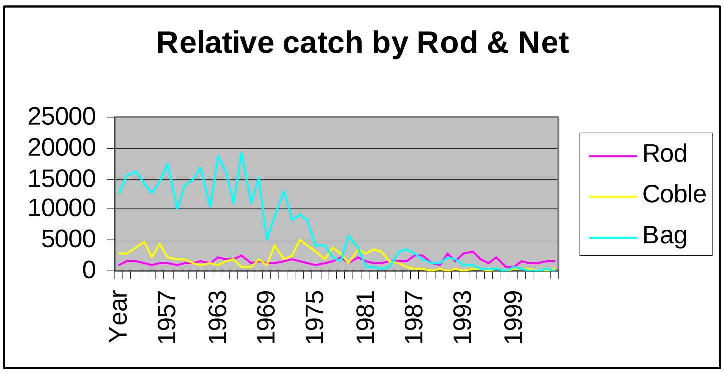
The sea trout catch of the Conon shows a fluctuation around a mean since the early 1990s, with a reduction in catches after 2000.

The effects of rainfall, flow and angling effort need to be corrected for before the sea trout rod catch can give a better indication of stock abundance. An angler log book system which records CPUE may be introduced as part of the Moray Firth Sea Trout project.

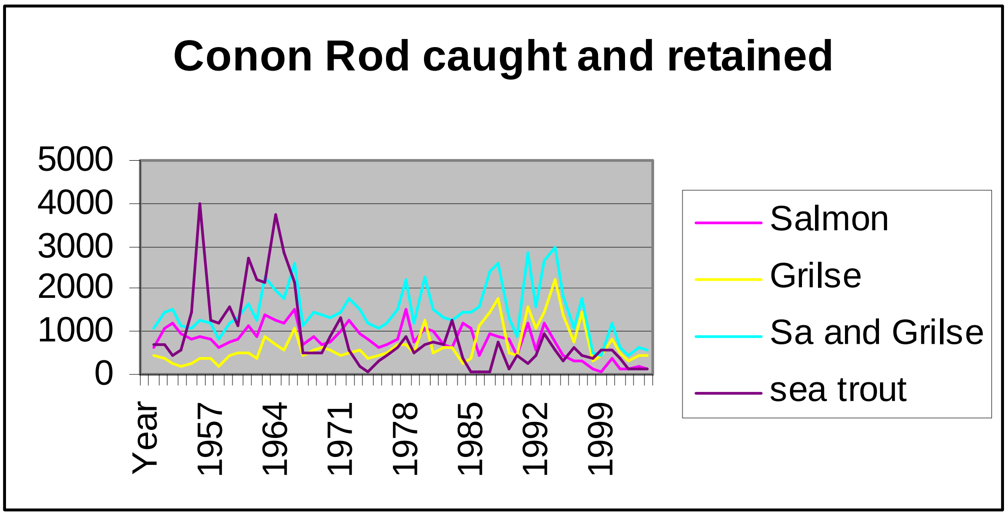
4.5 Exploitation of stocks.

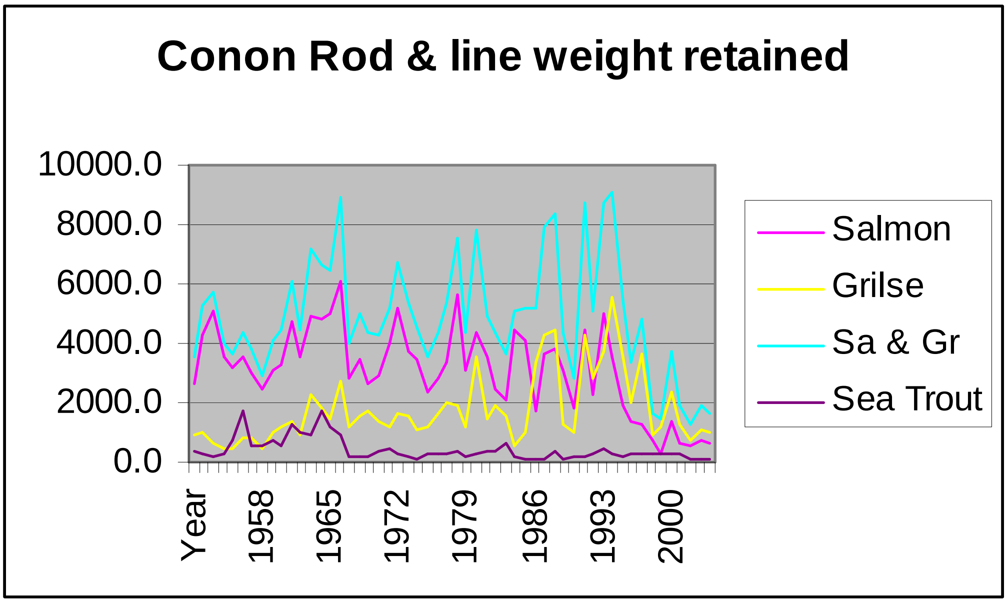


The Conon net and coble catch is shown on the chart above. The fixed engine catch also shows a similar pattern with a dramatic decline in fishing effort and exploitation since the late 1980s following the buy outs of netting stations by the Atlantic Salmon Conservation Trust, as described in Section 4.

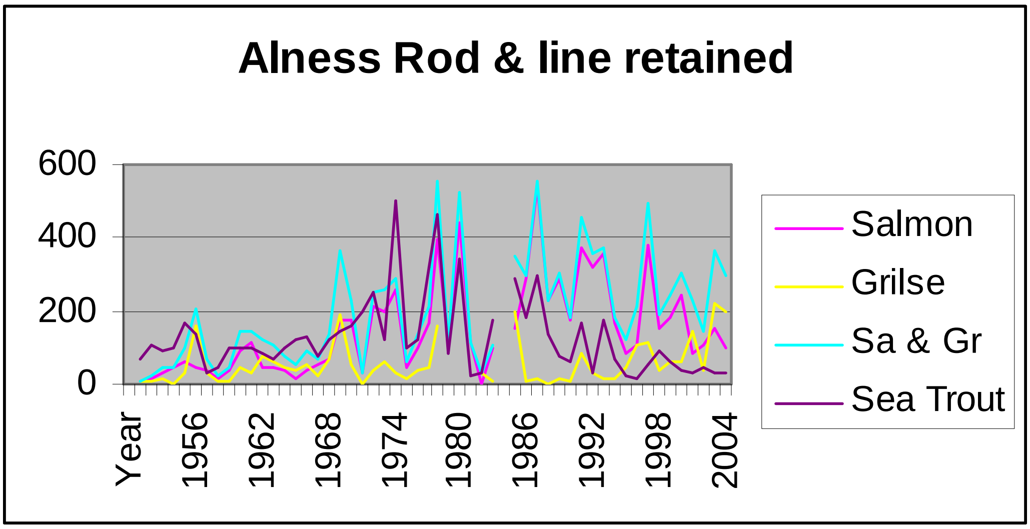


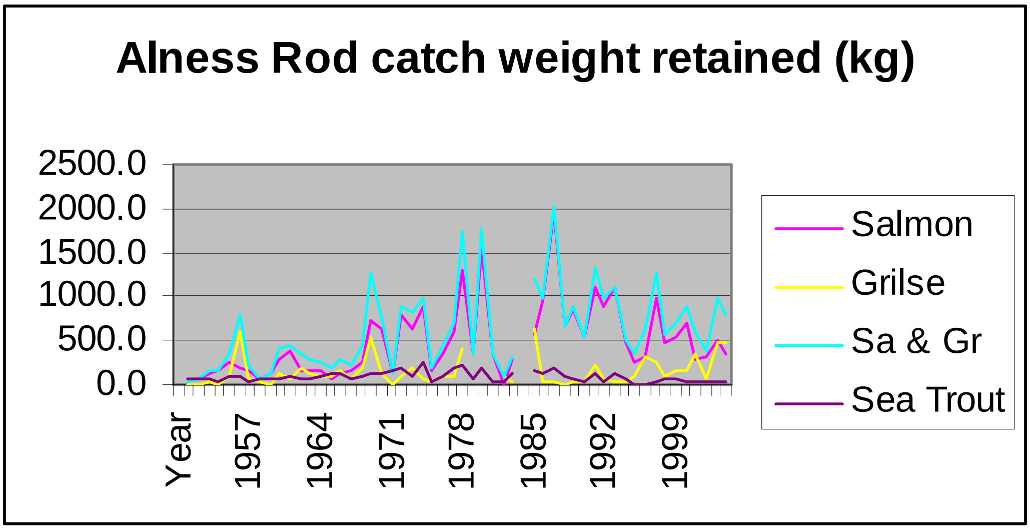
The chart above shows the relative catch by rod and line, bag net and net and coble fisheries. It can be seen that the rod and line catch has remained relatively constant whilst the net catch has reduced by a factor of fifty.





The numbers and weight of migratory fish caught and retained by rod and line in the Conon are shown on the charts above. It can be seen that since 2000 the numbers and weight of fish caught and retained has decreased. This decline in the number of fish retained is due to the response of anglers to the Board's conservation policy, which has resulted in more than 50% of the rod catch being returned in recent years.





The numbers of fish and weight of fish caught and retained by rod and line on the Alness are shown on the charts above. In recent years despite an increase in the proportion of fish returned the exploitation rate has remained static because more fish have been caught as a result of favourable conditions and improved marketing of the fishery.

Section 5. Present management activities

5.1 Predator control

Seal Management Plan

Since 2002 the Cromarty Firth Fishery Board with other Moray Firth DSFBs has collaborated with 11 statutory and non-governmental stakeholders to formulate a Seal Management Plan for the Moray Firth. It is designed to be a pilot project for the future management of seal-salmon interactions in Scotland, particularly in areas where SACs for both species exist, and where the economic importance of fisheries and wildlife tourism is significant. The Plan was introduced in April 2005, and has the following five aims:

- *Restore and maintain the favourable conservation status of harbour seals in the Dornoch Firth SAC, and salmon in the Spey, Moriston, Oykel, Cassley, Berriedale and Langwell SACs;*
- *Reduce the impact of shooting by salmon fisheries on the harbour seal population;*
- *Reduce the impact of harbour and grey seal predation on depleted adult spring salmon stocks;*
- *Monitor and research the status of harbour and grey seal populations, salmon stocks and interactions between them;*
- *Develop and implement non-lethal methods of reducing seal-salmon interactions.*

In order to meet these aims, stakeholders agreed the following framework:

Moray Firth Conservation Order 2004

While the Dornoch Firth SAC creates an obvious management area for harbour seals, individuals are known to move between haul-out sites throughout the Moray Firth (Thompson *et al.* 1996; SMRU unpublished data). Although information on the population structure of harbour seals in Scotland is not available, Moray Firth seals are geographically isolated from the nearest large concentrations in Orkney to the north and the Firth of Tay to the south (Anon., 2004). Therefore it was decided to manage harbour seals in the Moray Firth as one discreet population unit both in biological and administrative terms. Grey seals in the Moray Firth are regarded as part of the North Sea population. To create a legal framework the Scottish Executive introduced a Conservation Order for harbour and grey seals in the Moray Firth following the expiry of the PDV-related national Conservation Order in September 2004. Within the Order DSFBs apply jointly for a licence to shoot seals annually for the protection of salmon fisheries.

1. Within the Moray Firth, north-east Scotland, the Dornoch Firth has been designated a Special Area of Conservation (SAC) for harbour seals (*Phoca vitulina* L.) under the EU Habitats Directive. Six rivers have also been designated SACs for Atlantic salmon (*Salmo salar* L.).

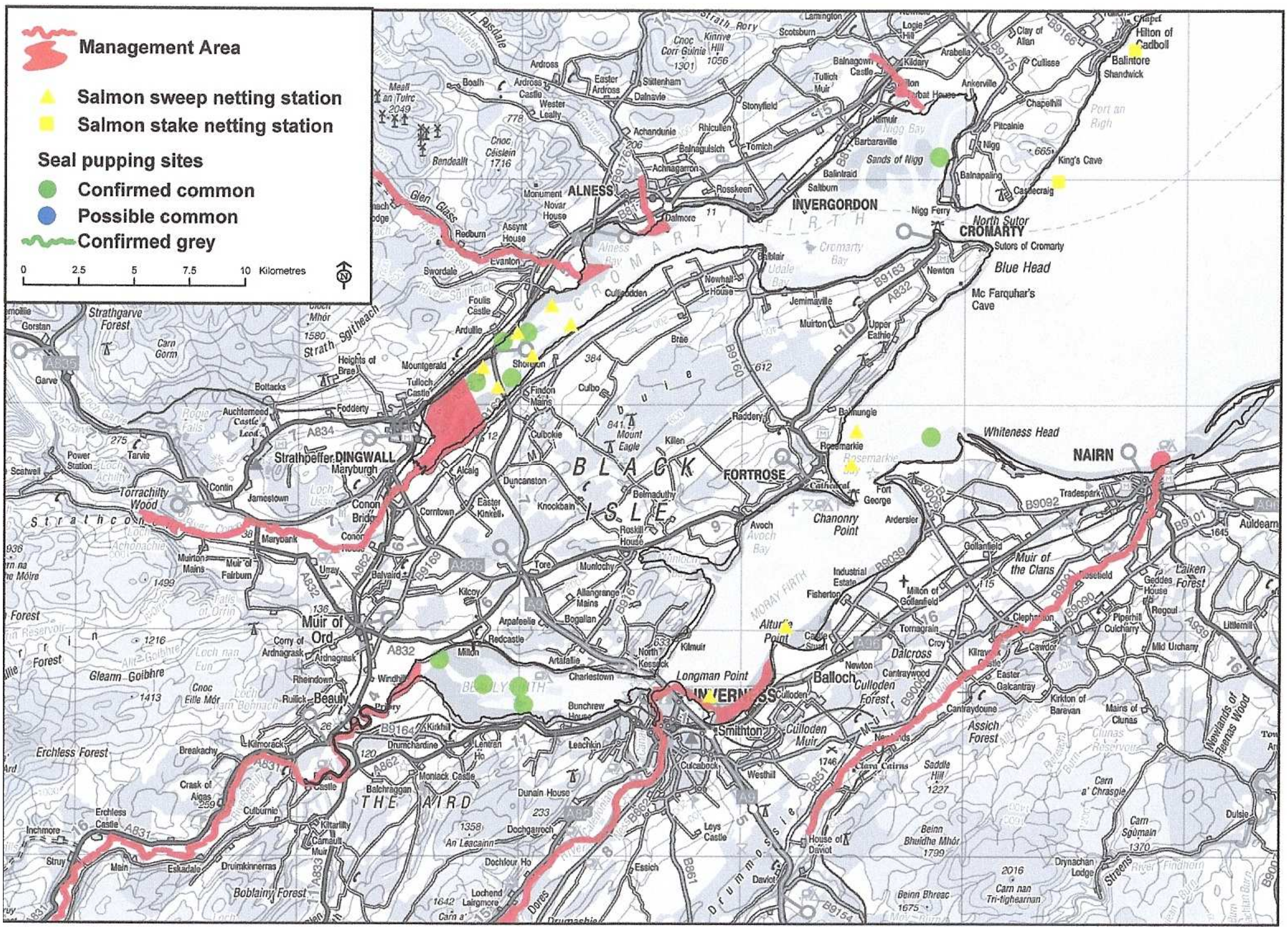
2. There is conflict between seals and salmon fisheries in the region because seals prey on salmon and attack netting stations. Under the UK's Conservation of Seals Act 1970 (CoSA) seals have been legally shot to protect fisheries and stocks. Conflict has increased due to declines in salmon abundance and spring stocks in particular.

3. During 1993-2004 the Moray Firth harbour seal population declined by 2-5% per annum, probably due to shooting. The Scottish Executive considered that the decline threatens the conservation status of the Dornoch Firth SAC. In 2002-2004 local District Salmon Fishery Boards negotiated with the Executive and 10 other statutory and non-government stakeholders to introduce a pilot Moray Firth Seal Management Plan, which aims to reconcile their conflicting obligations under EU and UK legislation to protect seals and salmon.

4. Key facets of the Plan include (a) the management of the Moray Firth region under a Conservation Order; (b) application of the Potential Biological Removal method to calculate a maximum limit of harbour seals to be killed; (c) Management Areas where removal of seals is targeted to protect salmon, but which avoid seal pupping sites; (d) a training and reporting system for Nominated Marksmen; (e) research on non-lethal, acoustic deterrent devices to remove seals from rivers, and (f) an adaptive management framework allowing an annual review of the Plan.

5. The Plan was launched in 2005. A maximum limit of 60 harbour and 70 grey (*Halichoerus grypus* Fabricius) seals was set. In April-December 2005 46 harbour (including 22 unidentified and two by-catch) and 33 greys (including one by-catch) were killed. The first year's operation highlighted the following issues: the inability to identify and control the numbers of seals killed at netting stations; peaks in shooting coinciding with harbour seal pupping in June and July, and the difficulty of detecting benefits for adult salmon spawning stocks. Despite these issues, the Plan provides a useful model for managing seal-fishery conflict in the UK, particularly where SACs for seals occur.

The map below shows the agreed management areas within the Cromarty Firth region.



Two marksmen have been nominated by the Cromarty Firth Board and have been trained and accredited as described in the Plan. Under the terms of the plan a quota of 9 common seals and 3 grey seals per year has been set for the Conon & Alness management area shown on the map above.

Since the introduction of the Plan the Cromarty Firth Board and Trust have actively supported research with St Andrews University and the Sea Mammal Research Unit. This research has involved photographic identification of individual animals and the capture and satellite tagging of seals in the mouth of the Conon. During this research work the Cromarty Firth Fishery Board agreed that seals would not be shot in the management area. In autumn 2007 the testing of an acoustic seal scaring device began in the Lower Conon, Board staff are supporting this research by charging and changing the batteries which operate the scarer.

Sawbilled duck management plan

In the same way that a seal management plan has been developed and implemented for the Moray Firth, a management plan for sawbilled ducks is under development.

From 1989 to 2003 the Scottish Executive issued licences to shoot predatory birds as an aid to scaring, in order to protect salmon stocks. However after a decline in the number of sawbilled ducks overwintering in the Cromarty Firth and Beauly Firth SPAs licences have not been issued for the rivers adjacent to these SPAs. The decline in numbers of sawbilled ducks overwintering in the firths has not been matched by a reduction in the number of birds feeding in rivers during the smolt run. A series of meetings have been held since November 2006 to bring together the Moray Firth DSFBs, SNH, SASA and the Scottish Government to develop a sawbilled duck management plan for the region. This plan is intended to protect migrating smolts from predatory birds without compromising the conservation status of the bird populations.

The plan will involve increased and more coordinated counting of birds using; canoes, coastal powerboats and observers on foot.

As with the Seal Management Plan there will be an emphasis on developing non lethal methods of scaring birds and using shooting as an aid to scaring in order to disrupt the birds feeding behaviour during the smolt run.

Pike

Pike have been introduced to several parts of the Conon catchment and are particularly abundant in the lochs on the Bran and Blackwater systems. Perch are also present in the Bran system. During the 1950's systematic netting of the Bran Lochs took place funded by the North of Scotland Hydro Electric Board. This is described by Mills 1963. It was found that this netting reduced the average size of pike in the lochs but not the overall biomass of pike. The effect was to increase the overall number of pike in the lochs which was counter productive in terms of protecting the smolt run.

Since 1994 the entire smolt run of the Bran has been trapped and transported past Lochs Luichart and Achonachie. This has removed the problem of pike predation on smolts in these lochs but not in the lochs further up the Bran.

Predation by pike, trout and also avian predators has been frequently observed above hydro dams where smolts congregate before finding fish pass entrances and below dams where smolts may be damaged or disorientated having passed through turbines.
Following balloon tagging experiments at Tor Achilty Dam the turbines are now maintained at above 2 megawatts during the smolt run. An increased flow over the top gate of the Orrin Dam Fish Pass also increases the flow in the Orrin and Lower Conon. The increased spring flow in the Conon which is intended to ease smolt passage at Tor Achilty and Orrin should also increase the speed of smolt passage in the main stem of the Conon and reduced their vulnerability to predation.

5.2 Habitat intervention

The Board and Trust have delivered fishery habitat improvements firstly by direct cooperation with landowners on individual projects and secondly by influencing policy through involvement with Local Biodiversity Action Planning, SEPA Area Advisory Group and liaison with the Forestry Commission Scotland on Forest Plans.

In Strathconon Estate several sections of riverbank have been fenced and replanted with native trees. The banks of Glen Meinnich a main tributary of the Meig have been cleared of non native conifers as part of forest restructuring on the Estate.


Strath Rannoch alders

On the Blackwater a joint project with the Forestry Commission Scotland has replanted the banks of Strath Rannoch with alder and willow.

Working with volunteers from the Dingwall Angling Association in 2006, forestry log jams on the Logie Burn were cleared to allow sea trout access and substrate restoration work was carried out on straightened and dredged sections.

An artificial sawmill lade on Fairburn Estate was cleared of debris and silt by bailiffs and clean spawning gravel introduced.

The largest individual project in recent years has been the reconstruction of a kilometre of river channel at Dunglass Island near Conon Bridge. This was done in two phases between 2003 and 2007. This project was intended to create new fishery habitat in the Lower Conon and to enhance the Conon Alder Woodland SAC. It has been successful in achieving these aims but has also acted as a demonstration project, showing the linkage of wild fishery and wider conservation interests.
This has been a partnership project involving the Fishery Board, Brahan Estates and the Conon Fishing Syndicate. Funding was provided by SNH, Highland Council, Ross & Cromarty Enterprise and Leader +.

Dunglass channel construction

Whilst these individual projects have all been successful on a local scale, wider habitat improvements need catchment scale changes in land use and management to restore upland riparian woodlands, address lowland agricultural siltation and the negative impacts of commercial forestry.

The Water Framework Directive is the most likely means of delivering this scale of habitat improvement and the continued involvement of the Board /Trust in the Area Advisory Group is essential.

5.3 Salmon Stocking Strategy for the Cromarty Firth Region

Contents

Introduction

1.1

This report makes use of data previously gathered by the Cromarty Firth Salmon Fishery Board.
Detailed habitat surveys of the Conon and Alness were conducted in 1995 and 2000 respectively. The Allt Graad was habitat surveyed in 2001. Results from electro-fishing surveys carried out from 1994- 2007 were also used.

The primary aim of the report is to identify areas for stocking which are likely to produce the most smolts per egg and also to have the least interaction with naturally spawned juvenile salmon. The numbers of eggs required for areas to be stocked are quantified and this is also used to calculate a recommended capacity for the hatchery at Novar, which is due for refurbishment.

The fieldwork for this report was funded by Ross and Cromarty Enterprise, Highland Regional Council and the former Conon Salmon Fishery Board. Scottish Natural Heritage supported the purchase of the software used for data analysis and mapping.

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1.2 Scottish Fishery Co ordination Centre

The Scottish Fishery Co-ordination Centre was formed in 1997. It was developed by collaboration between the SERAD Freshwater Fisheries Laboratory and biologists from most of the Fishery Trusts and larger Fishery Boards in Scotland.

The aim of the SFCC was to standardize and improve the way in which fishery data was collected in Scotland. The SFCC developed agreed protocols for habitat surveying and juvenile electro-fishing and has produced training manuals, courses and accreditation systems to ensure a high standard of data gathering.

The SFCC has supported these developments with the production of databases to store habitat and electro-fishing survey data. These databases are compatible with GIS (Geographical Information System) software, which can be used to analyse and map fishery data and also to combine SFCC collected data with other datasets.

1.3 Salmonid habitat requirements

The habitat requirements of salmon and trout are described briefly in the SFCC Habitat Training manual (Puhr C.B. 1998) and in more detail in (MAFF 1991).

The main habitat requirements for salmonids are related to; water quality, shelter and feeding territory, availability of food and availability of suitable spawning habitat.

Water quality

Salmonids need clean well-oxygenated water at all stages of their life history. Many factors can influence water quality. In particular point sources of pollution from industrial or sewage treatment operations may have significant effects on water quality. Other factors operating over larger areas may have important effects on water quality. Such factors include catchment land use, geology, altitude and flow type.

Shelter and feeding territory

Availability of shelter from predators and from unfavourable environmental conditions is of great importance to juvenile salmonids. Shelter may be provided by the stream substrate or aquatic vegetation. Close to the banks of the stream, bankside effects such as undercutting or the presence of exposed tree roots may provide valuable cover. Salmon parr are very territorial, so habitats with a high proportion of cobble and boulder, which give good cover, tend to support higher densities of salmon parr. At different times of year salmonids may use different habitat types, in winter salmon parr tend to make more use of pool habitat as well as the fast flowing riffles which they favour in the summer.

The physical nature of the stream is influenced by factors such as altitude, gradient and underlying geology.

The use of land draining into a watercourse may have significant impacts on its suitability to support salmonids. Overgrazing may lead to bankside erosion and collapse and a lack of shelter from bankside vegetation. Commercial forestry can also have serious effects on salmonid stocks (see Forestry and Water Guidelines [Forestry Commission Scotland 1992]).

Availability of food

Juvenile salmonids feed mainly on invertebrates, which may be of aquatic or terrestrial origin. A number of factors including water flow, water quality and substrate determine the abundance of aquatic invertebrates. The abundance of terrestrial invertebrates is largely determined by riparian vegetation. The presence of overhanging vegetation is of particular importance in the availability of terrestrial invertebrates to fish.

Availability of spawning habitat.

For migratory fish the access to suitable spawning habitat may be of great importance. The presence of obstacles to migration such as waterfalls, dams and road culverts may limit the distribution of salmon and reduce the potential smolt production. The basic requirements of trout and salmon for spawning are shown in the table below.

The table below from the SFCC Habitat Training Manual (Puhr C.B. 1998) summarises the habitats required for the different life stages of salmon and trout.

	Salmon	Trout
Eggs/ alevins	Golf ball to tennis ball sized substrate.	Dependent on fish size. As for salmon for large brown trout and sea trout. Pea to golf ball sized for smaller trout.
Fry (less than 1 yr old)	Golf ball to tennis ball sized substrate. Fast flowing shallow broken water.	Golf ball to tennis ball sized substrate, slow to medium flowing shallow water, often concentrated in stream margins.
Parr (more than 1yr old)	Tennis ball to football sized substrate, fast flowing broken water often slightly deeper than fry.	Variety of substrate, undercut banks, tree roots big rocks, deeper slower water.
Adults	Deep pools.	Deeper areas, sustained flow but not too fast, undercut banks, tree roots, good instream vegetation and large rocks.

Table 1 typical habitats for different life stages of salmon and trout

1.4 Conon Hatchery Facilities

The locations and ownership of the present hatchery facilities on the Conon are described in Section 1. of the Contract and the history of the stocking work is described in Section 4. of the Contract.
The main hatchery is based at Contin and is supplied with water from Loch Cran via a pipeline and filter station. Water is returned to the River Blackwater adjacent to the hatchery.

The Contin Hatchery contains 32 troughs each with three tiers and a separate water supply. There are also 8 2m tanks used for first feeding salmon fry. The total capacity of the Contin Hatchery is 4 million ova.

There is a small satellite hatchery at Strathconon estate which contains 7 2m tanks and 2 4m tanks. This hatchery has been used for first feeding fry for release into the Meig and Upper Orrin and also for experimental parr and smolt rearing as well as kelt reconditioning.

Broodstock collection for the Blackwater and Bran takes place at Loch na Croic on the Blackwater. A heck and trap were constructed by the North of Scotland Hydro Electric Board in the late 1950's as part of a compensation agreement.

Salmon congregate in Loch na Croic during the summer and autumn and are then trapped and stripped during November and December.

Fish are taken from the trap and held until ripe for stripping in a purpose built broodstock holding unit which was constructed by SSE in 2003.

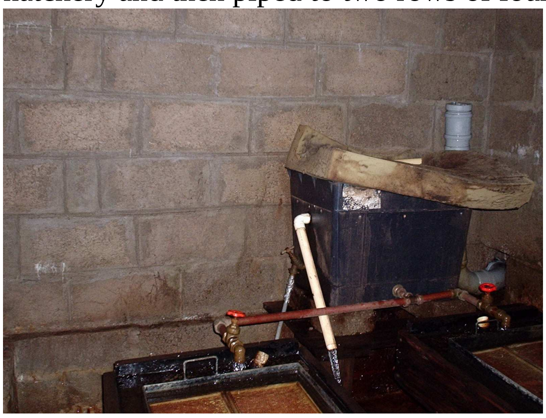
The broodstock unit is supplied with water by two submersible pumps from the Blackwater and contains 10 4m tanks with a capacity of 1,500 salmon.

There is a stripping room adjacent to the tank room. The current arrangement at Loch na Croic is a great improvement on the previous facilities (see Section 4 of Contract). The current facilities improve husbandry, reduce fish handling and improve health and safety for staff.

1.5 Alness Hatchery Facilities

The present hatchery facilities for the Alness are located in Novar Estate at 261175 /868050. The hatchery is supplied with water from Allt Duach.

The off take from Allt Dauch is above a low stone weir and the water undergoes primary filtration through a gravel matrix filter. Water is supplied to a header tank inside the hatchery and then piped to two rows of four wooden troughs.



Water is also supplied to a 2 metre square Swedish tank and a 1.5 metre round tank which have been used for fry rearing. The wooden troughs contain 32 plastic trays with a capacity of 160,000 ova.

Section 2 Methods

2.1 Habitat survey

Scottish Fishery Co-ordination Centre Habitat Survey

The SFCC habitat survey method was developed with specific reference to the habitat requirements of Atlantic salmon (Salmo salar. L) and brown/sea trout (Salmo trutta L.).

The SFCC Habitat Survey Protocol is described in detail in the current training manual Puhr C.B. 1998.

The possible applications of the method are listed in the training manual as:

(a) Evaluate quality of habitat for juvenile salmon and trout
(b) Identify location of suitable spawning gravels.
(c) Identify stream stretches that would benefit from habitat improvements.
(d) Target areas for stocking.
(e) Identify and classify point pollution sources
(f) Identify and grade obstacles to fish migration.
(g) Identify location and type of past channel / bank modification.

The SFCC conducts training courses and accredits surveyors to ensure a high standard of data gathering.

The method used is a 'sweep up' survey in which the surveyors walk a measured length between two points along a watercourse and record environmental parameters which are likely to impact on fish stocks. Some of the most significant habitat parameters recorded for each length of stream include; width, depths, flow types, streambed substrate types, bankside vegetation, shading and erosion. Combined with this sweep up data for each length of stream surveyed, point source data relating to obstacles, pollution sources, bankside modifications etc is also collected. A sample recording form is included in Appendix II.

The data from the recording sheets is accurately geo-referenced and then stored in a database which was developed for the SFCC.

2.2 Electro fishing surveys

Sites were sampled between August and October, towards the end of the growing season, when the fish were reaching their greatest length and before falling water temperatures reduced electro-fishing efficiency.

Backpack electro-fishing equipment (Electracatch WFC9) was used for this survey, running on 24-volt battery power. The operating output was 250-350 V smoothed D.C. Fish were stunned at the anode and drawn downstream into a banner net operated by a second worker. Study areas were fished for 5 minutes timed by stopwatch. Many of the sites selected were wide sections of main-stem river and shallow riffle habitat at the tails of pools were fished.

The fish were identified, counted and released without anaesthetic or measurement. The presence or absence of salmon and trout year classes and presence of other species were recorded. Scale readings were not taken and all fish were aged by eye. This data and other field notes were then entered into the SFCC database.

2.3 GIS analysis

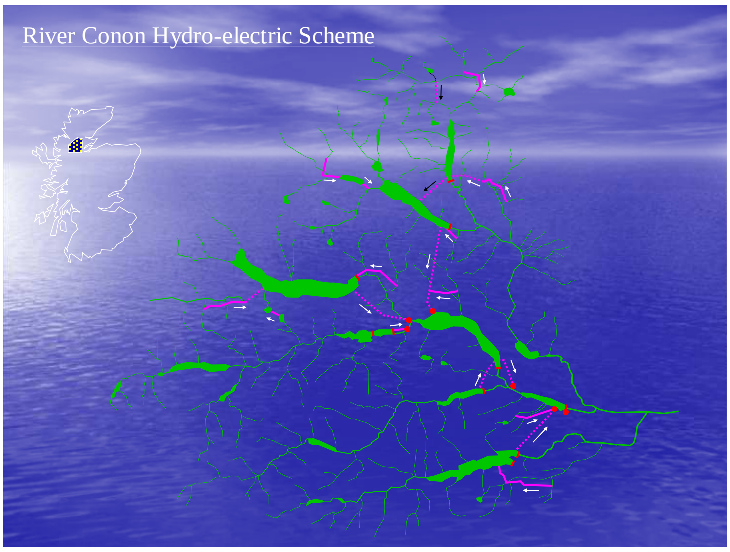
ArcView

The SFCC habitat database was designed to produce spreadsheet exports which are compatible with ArcView. ArcView is a Geographical Information System which can be used to analyse geographical data sets and can combine several different datasets together. It is an electronic mapping tool which allows map-based information to be layered and combined to form new maps.

Section 3. Analysis & Stocking strategy

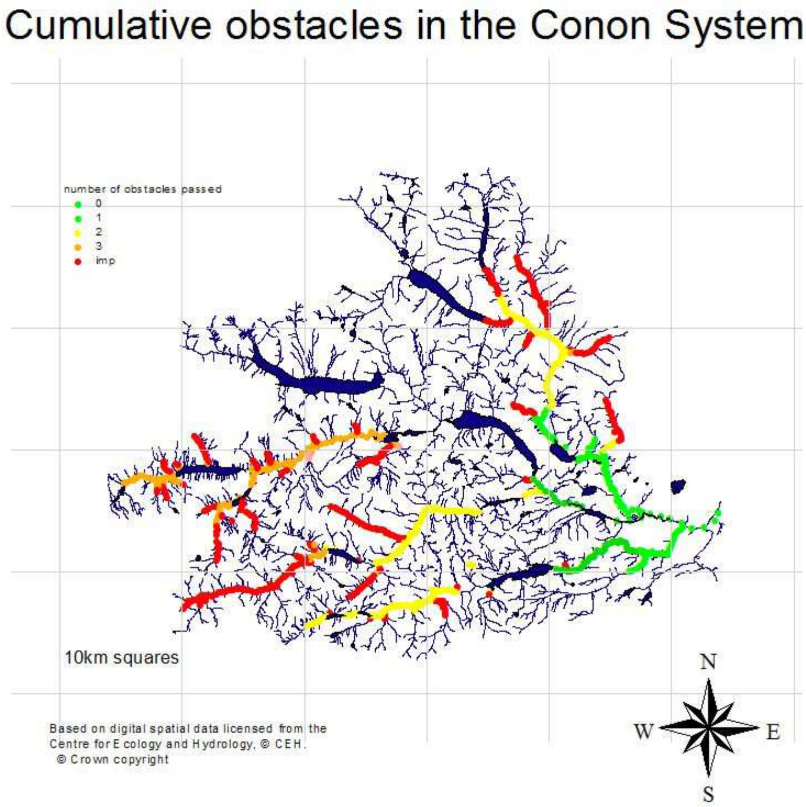
3.1 Conon Strategy

The present stocking strategy on the Conon is designed as a mitigation of the effects of hydro development and is largely funded by Scottish and Southern Energy. The stocking strategy has evolved as a result of a long term research and development commitment by the Cromarty Firth DSFB. This research has been based on initial habitat survey work which described the extent and suitability of habitat. This was then followed by electro-fishing studies which initially described the limits of migration but was then used to study the use of habitat by fish. This has given a range of densities of juvenile salmon in stocked and un-stocked parts of the catchment and has also been used to study the effectiveness of stocking at different life stages and densities. Further work with PIT tagging and smolt traps has been used to study smolt production from the tributaries of the Conon. The stocking programme on the Conon will continue to evolve as new research information becomes available, particularly as the genetics of the salmon's populations become better understood.



The map above shows the extent of hydro development in the Conon Basin with dams on all four tributaries and significant abstractions and transfers of water between tributaries. See Section 8 for more detailed description of hydro development and obstacles.

The potential of the Conon system to produce juvenile system is greatly influence by the effects of hydro development. The extent of natural obstacles to migration on the Conon tributaries gave an opportunity to mitigate for the areas lost because of hydro development.   The post hydro stocking programme on the Conon has been linked to the easing of these barriers to migration which took place as part of a compensation agreement during Scheme construction during the 1950's.



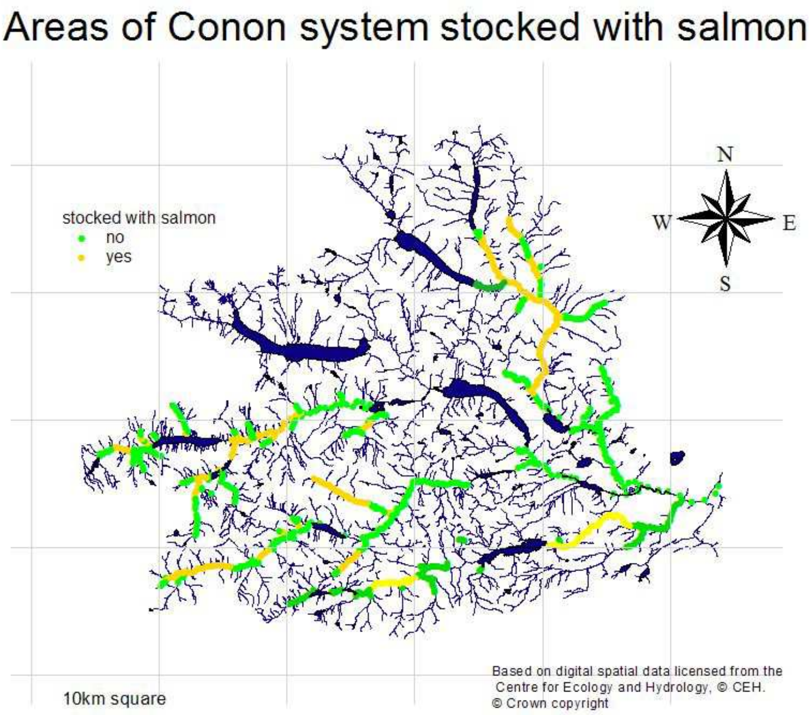
It can be seen from the map above that migratory fish have unhindered access to a relatively small part of the catchment and have to pass an increasing number of barriers to get to and from the nursery habitat of the tributaries. The cumulative losses during both upstream and downstream migration are partially offset by the hatchery operation.
As well as the issues of access created by hydro development there are also habitat modifications linked to dam construction which lead to a loss of spawning gravel downstream of dams. This can be partially offset by the introduction of fry but in the longer term habitat restoration and natural spawning would be preferable.

A variety of life stages have been used for stocking at different locations and altitudes. Electro-fishing has been used to monitor the effectiveness of stocking.

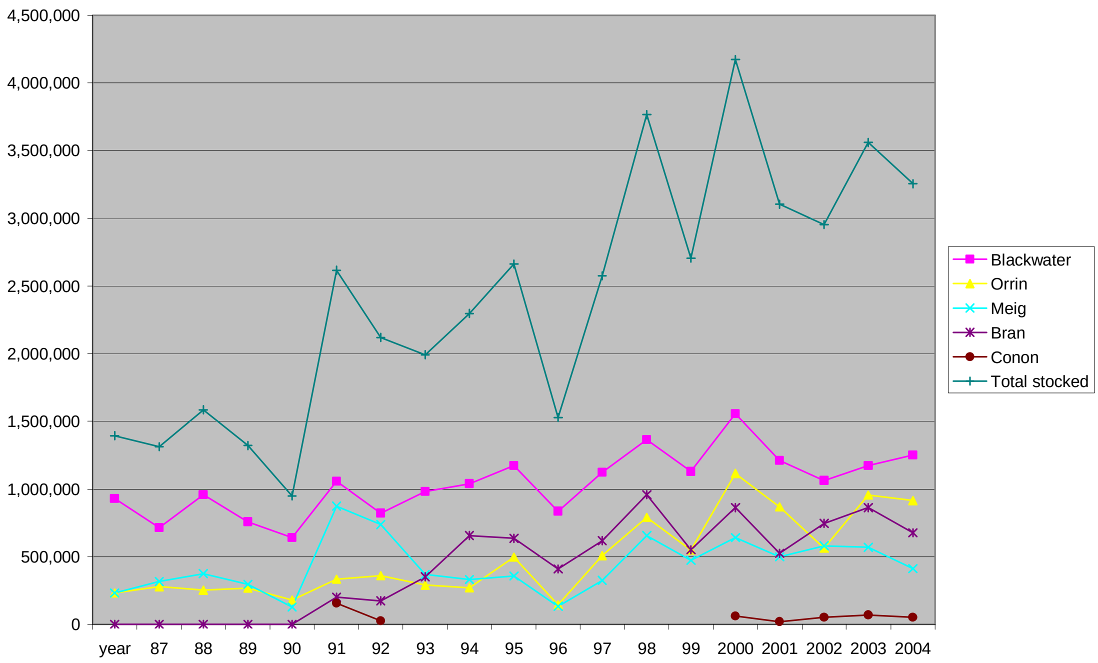
The hatchery operation on the Conon system has been operated in a biologically sustainable manner which has been in operation for more than fifty years.

The scale of the facilities available has permitted the collection of a large broodstock and the maintenance of genetic diversity. Stock has been distributed at the earliest life stages (eyed ova & unfed fry) in large enough numbers to mimic natural egg deposition. This has resulted in the production of smolts which have been exposed to natural selection for the maximum period of time. Best practice has been followed wherever possible to maximize the benefits of the hatchery operation whilst minimizing the risks (see FRS report No.65 2007).

The extent of stocking in the Conon system is shown on the map below.



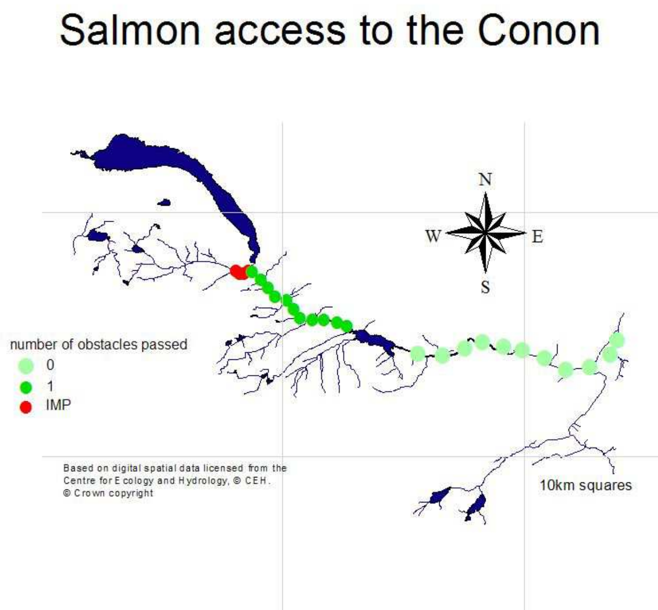
Conon stocking



The numbers of salmon stocked in recent years into the Conon system are shown in the chart above.

3.1.1 Main Conon

The map below shows that salmon have free access to the Lower Conon as far as Tor Achilty Dam and then access via a Borland Fish Lift to the Upper Conon. Water is diverted from Allt a Ghlinne via a dam and pipeline which prevents upstream access although this can be 'turned out' to allow downstream access.

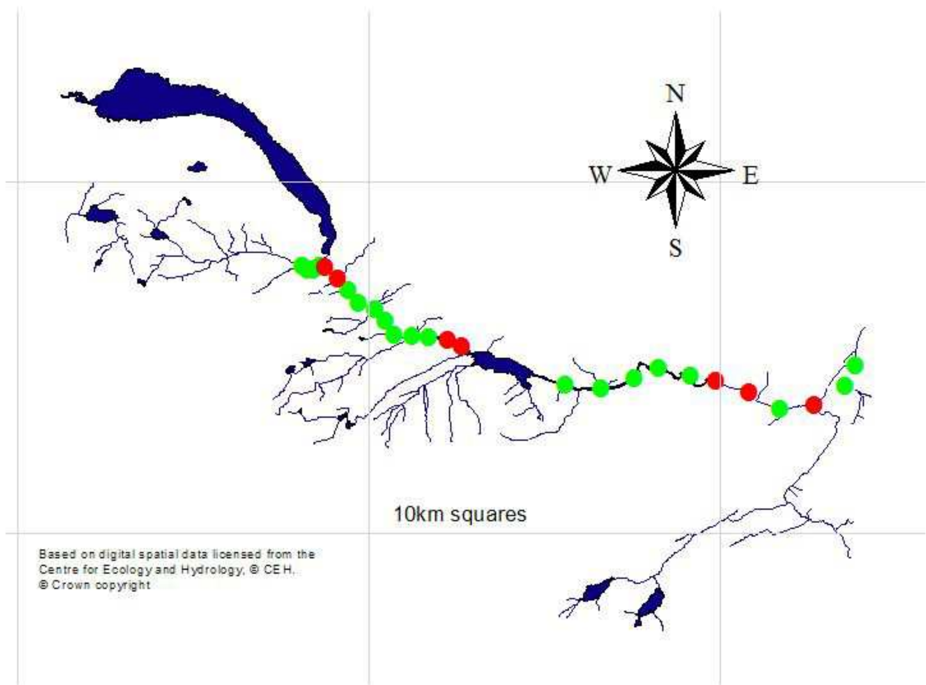


The map above shows the cumulative number of obstacles passed by returning salmon to reach any point. See Section 8 for a description of each obstacle.

Salmon production in both the Lower and Upper Conon is not limited by access for adult fish to spawning habitat. The production of juvenile salmon is more limited by the quality of nursery habitat available. The 1995 habitat survey of the Conon found large areas of both the Lower and Upper Conon to be suitable but sub-optimal as juvenile salmon habitat. Areas of shallow glide / riffle habitat and moderate substrate size have a patchy distribution whilst there is a much wider distribution of smaller substrate sizes and gravels suitable for spawning. It is therefore unlikely that the distribution of spawning habitat will limit salmon production. This is confirmed by timed electro-fishing surveys which consistently show high fry numbers in the main stem of the Conon in comparison with the tributaries.

River	Area of suitable habitat accessible to salmon m2	Suitable habitat above access m2	Stocking potential
Allt a Ghlinne	0	3,357	20,565
Lower Conon	390,000	0	0
Upper Conon	105,000	0	0
	495,000	3,357	20,565

Distribution of favourable and unfavourable habitat in the Conon

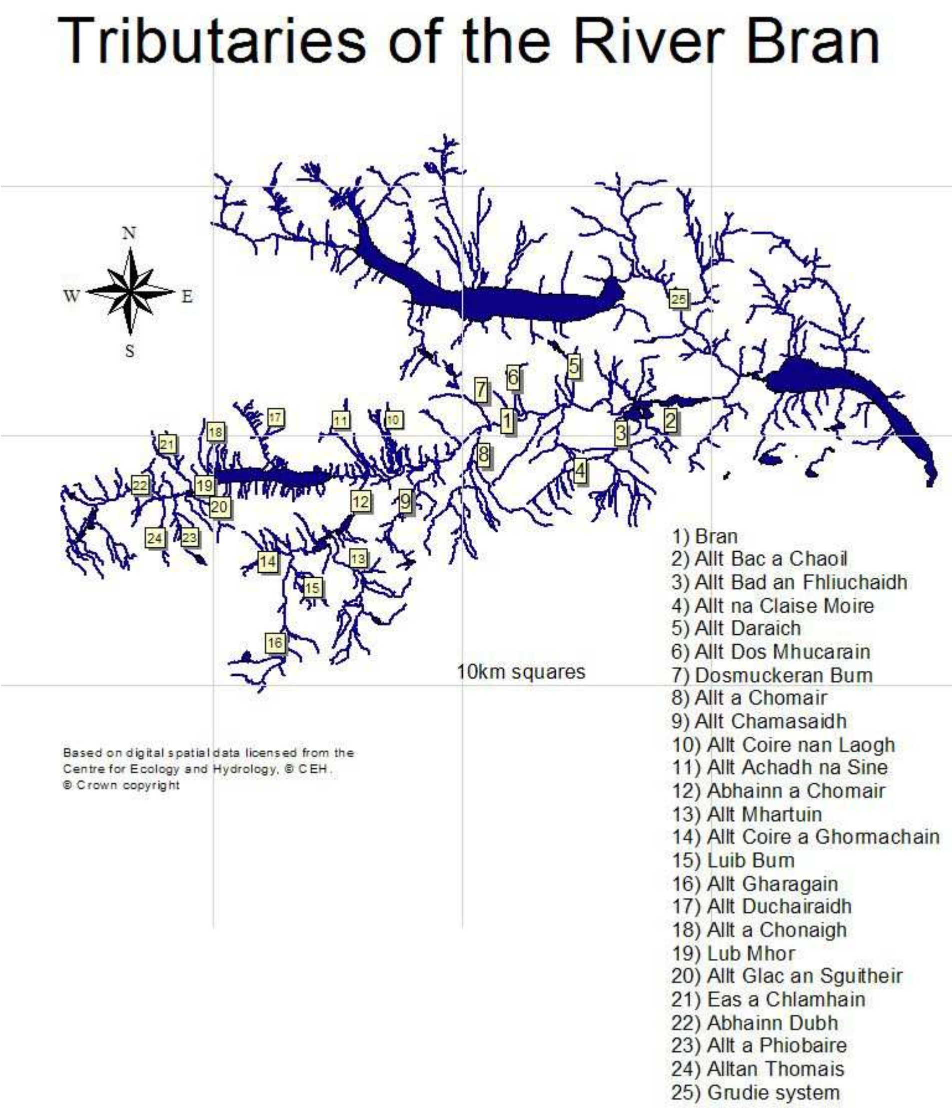


The table and map above show the extent and distribution of suitable nursery habitat in the Upper and Lower Conon with favourable habitat shown in green and unfavourable in red. A five year tagging experiment from 2002-2007 to assess the benefit of releasing reared parr into the Conon produced no benefit to the rod catch.

An agreement with SSE to allow Allt a Ghlinne to flow down its natural channel during the period of the smolt run has given an opportunity to stock this area and this would be the preferred location of any future stocking in the main Conon.

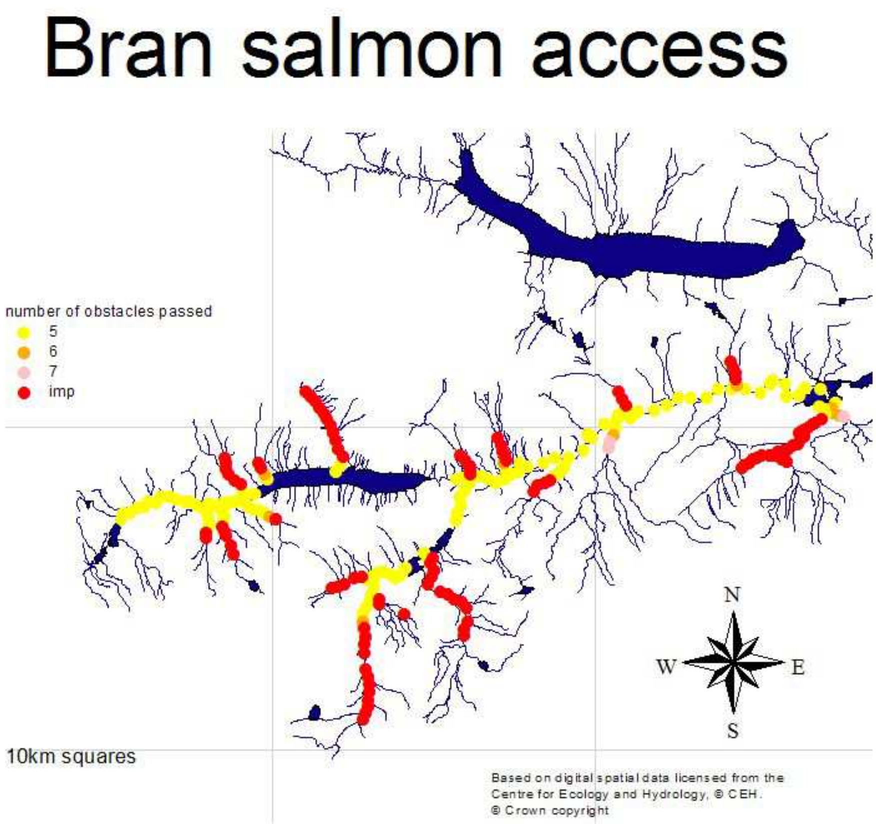
3.1.2 Bran

The map below shows the River Bran and its tributaries.



The River Bran was historically inaccessible to salmon but was opened up to salmon during the construction of the Conon Hydro-electric Scheme. Salmon accessing the Bran have to pass through Borland lifts at Tor Achilty Dam, Luichart Dam and Achanalt Barrage as well as fish ladders at Conon Falls and Achanalt. Smolts passing downstream are caught in a smolt trap at Achanalt Barrage and then trucked and released below Tor Achilty.

The number of obstacles passed through to reach the Bran and its tributaries are shown on the map below.



The map above shows the number of obstacles passed by returning salmon to reach any point on the Bran. See Section 8 for details of obstructions to migration in the Bran.

The present stocking regime on the Bran began in 1992 and produces between 5,000 and 12,000 smolts per year. Adult salmon have been returning to the Bran since 1995. There have been several radio-tracking studies on returning adults Gowans 1997 and Williams

2006. These studies have shown losses at each obstacle either from fish failing to pass upstream or being predated by otters. The cumulative effect of these losses means that some hatchery support is likely to be required to support natural spawning.

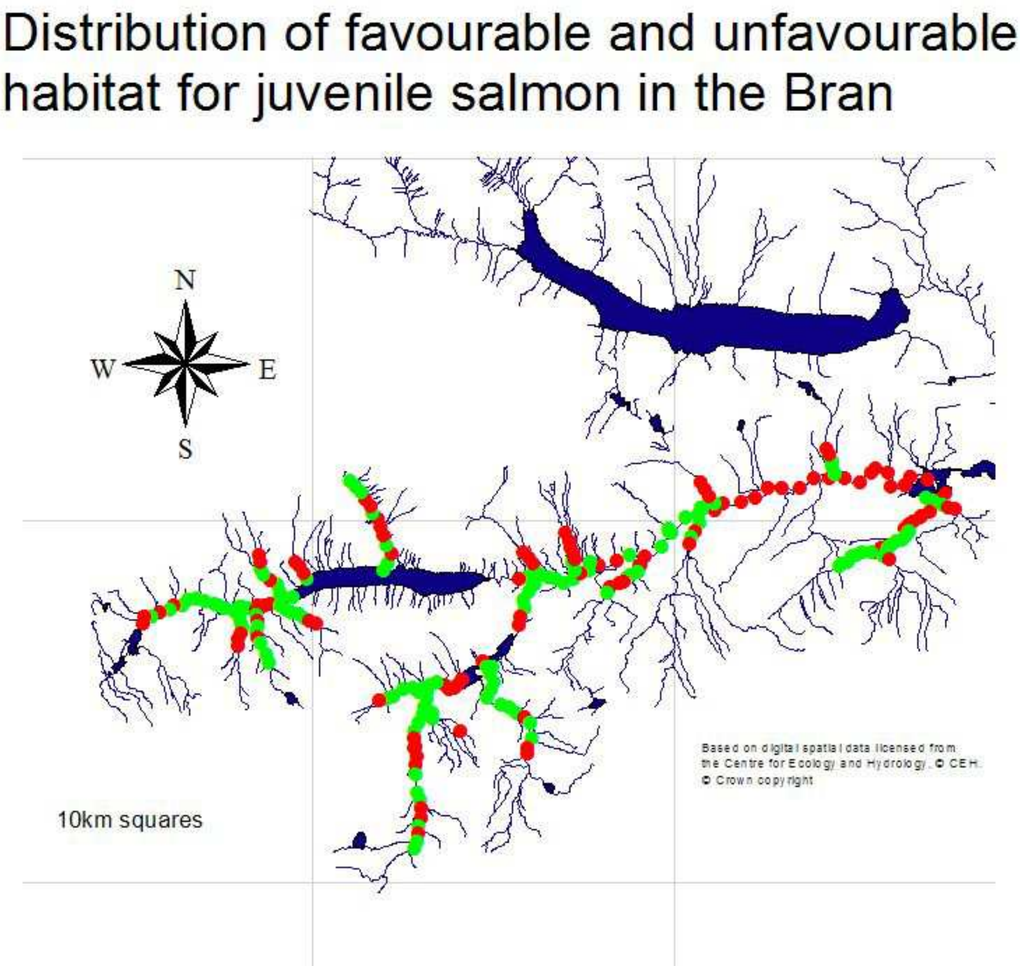
River	Area of suitable habitat accessible to salmon m2	Suitable habitat above access m2	Stocking potential
Bran	210,250	0	665,438
Allt Mhartuin	1,625	16,751	75,502
Allt Bac a Chaoil	3,814	0	1,750
Abhainn a Chomair	25,002	0	86,885
Allt a Chamasaidh	7,000	1,125	18,125
Eas a Chlamhain	3,125	2,188	25,565
Allt a Chonaigh	625	0	3,125
Allt a Chomair	8,046	0	26,973
Allt na Claise Moire	0	7,000	34,063
Allt Coire a Ghormachain	1,625	4,376	23,755
Allt Daraich	875	0	8,688
Dosmckeran Burn	1,000	1,875	5,000
Abhainn Dubh	21,564	0	111,976
Allt Ducharaidh	3,313	7,190	27,822
Allt Bad an Fhluichaidh	7,500	13,625	99,095
Allt Gharagain	19,626	9,313	116,193
Allt Coire nan Laogh	2,313	0	14,535
Luib Burn	1,000	5,750	21,563
Allt Dos Mucharain	1,125	0	5,625
Allt a Phiobaire	1,375	1,375	15,313
Allt Glac an Sguitheir	3,626	0	18,130
Allt Achadh na Sine	0	1,938	7,188
Altan Thomais	3,502	0	17,510
	327,931	72,506	1,429,819

The table above shows the extent of suitable habitat in the Bran system and the potential for stocking with eyed ova or unfed fry. PIT tagging research has shown significant losses of smolts passing through lochs on the Bran system due to predation.

For this reason ensuring the area below the lochs is adequately stocked is important in maximizing smolt production.

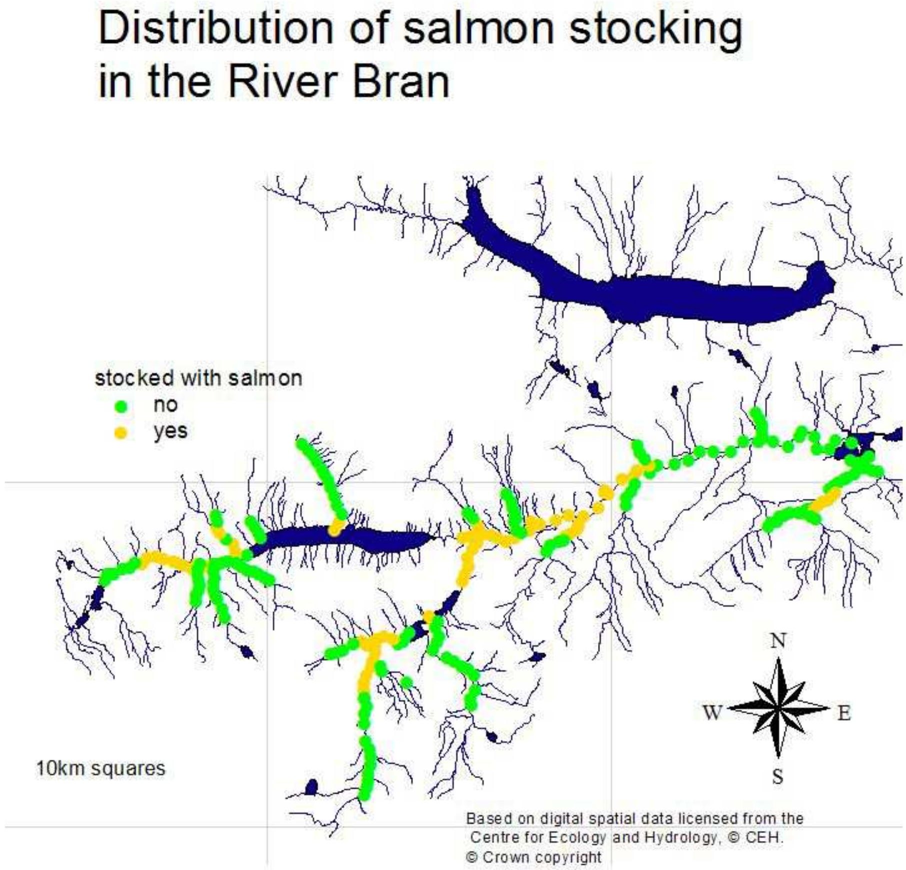
Broodstock for the Bran are collected from the trap at Loch na Croic on the Blackwater. The Blackwater is the neighbouring tributary to the Bran and has a similar topography, altitude, length and distribution of lochs.

The distribution of suitable salmon nursery habitat in the Bran system is shown below.



Favourable habitat is shown in green and unfavourable habitat is shown in red. The details of habitat assessment for each 250m section are recorded in the 1995 habitat survey.

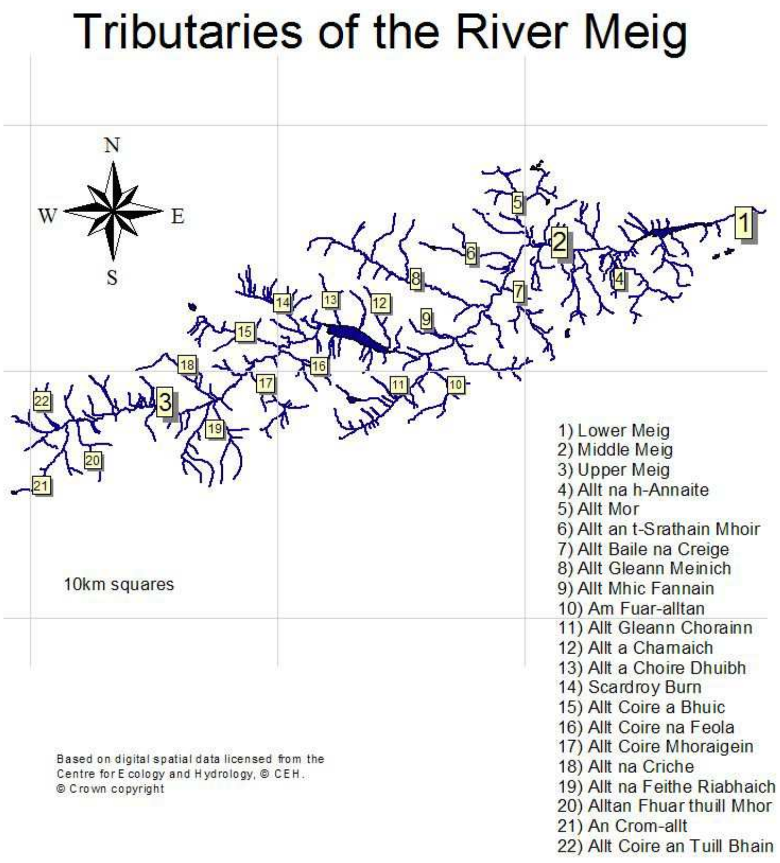
The areas of the Bran recently stocked with salmon are shown on the map below.



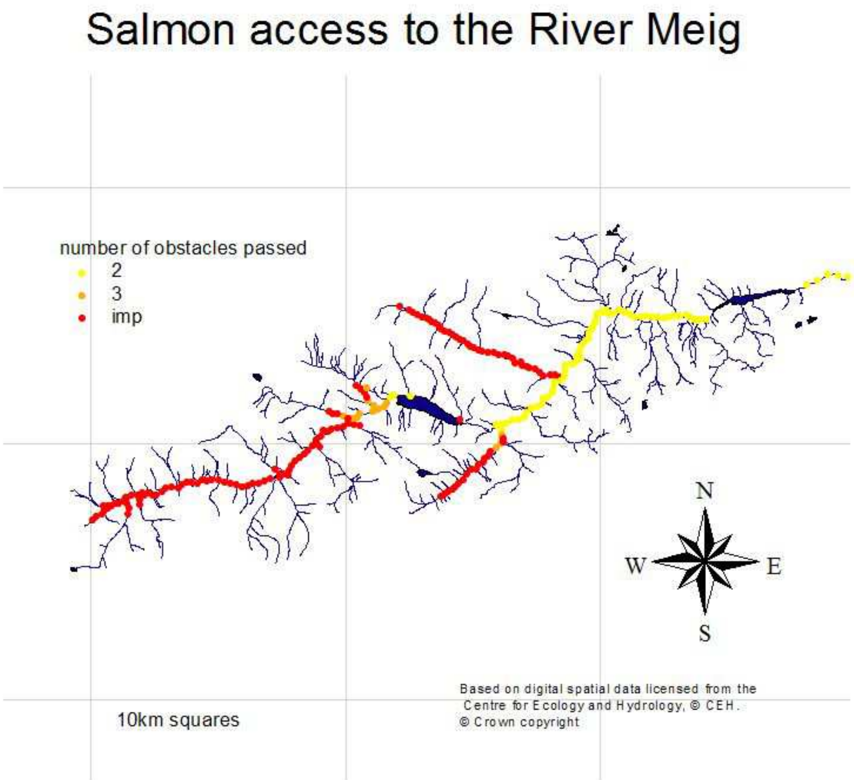
Because of the cumulative losses of adult fish as they pass obstacles to get to spawning areas in the Bran it is likely that the present level of stocking (c700,000) will be maintained in order to maximize smolt production. However if the counts of salmon returning through Luichart Dam increase then the stocking level could be reduced accordingly.

3.1.3 Meig

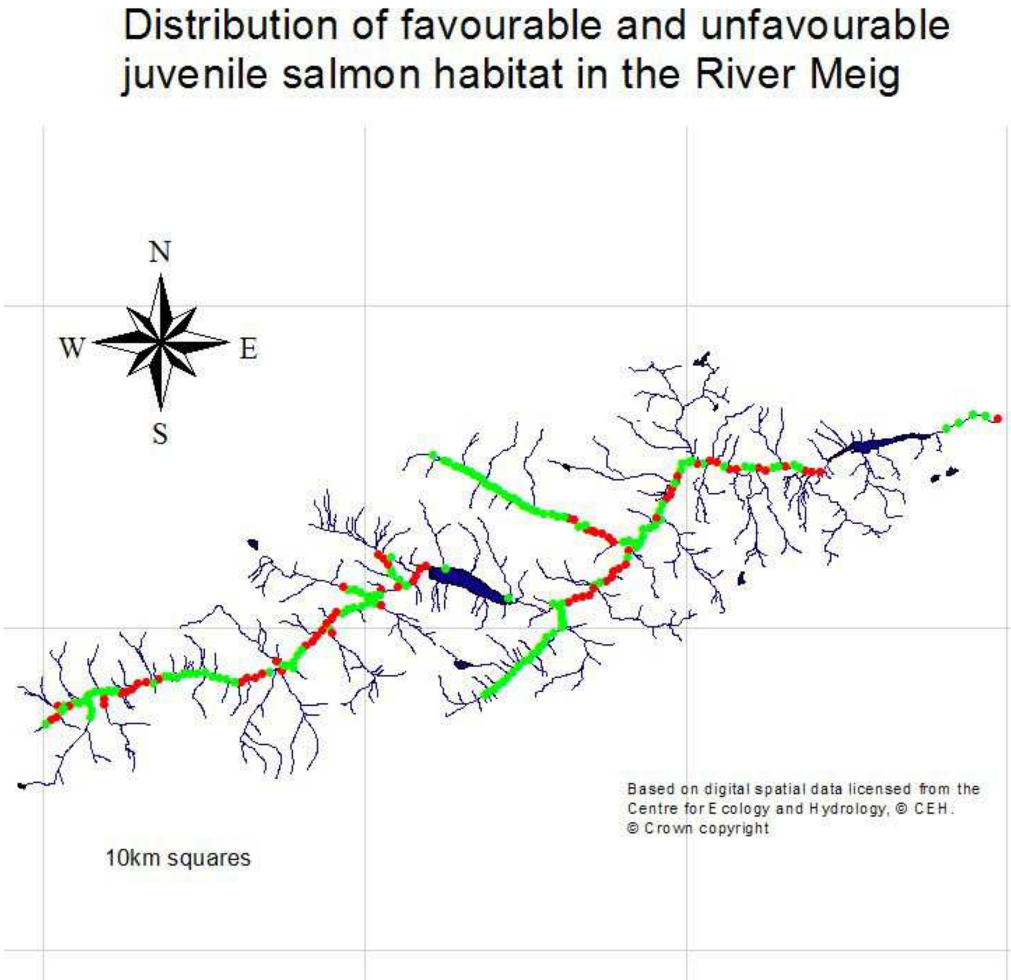
The location of the Lower, Middle and Upper Meig as well as their tributaries are shown on the map below.



The map below shows the number of obstacles migratory fish have to pass to reach the Meig and its tributaries. It can be seen that salmon have only to pass through two obstacles to reach the Lower Meig and three to reach the Middle Meig.   The steep sides of the Meig valley limit salmon migration into Glen Chorainn and Glen Meinnich. A fish pass using a natural channel provides limited access to the Upper Meig above the falls at Corriefeol. See Section 8 for details of obstructions to migration in the Meig.



The map below shows the distribution of suitable salmon nursery habitat in the Meig catchment. With a good distribution of spawning habitat there are wild spawned salmon populations in the Lower and Middle Meig. Favourable habitat is shown in green and unfavourable in red. Detailed habitat assessment of each 250 m section is included in the 1995 Conon Habitat Survey.

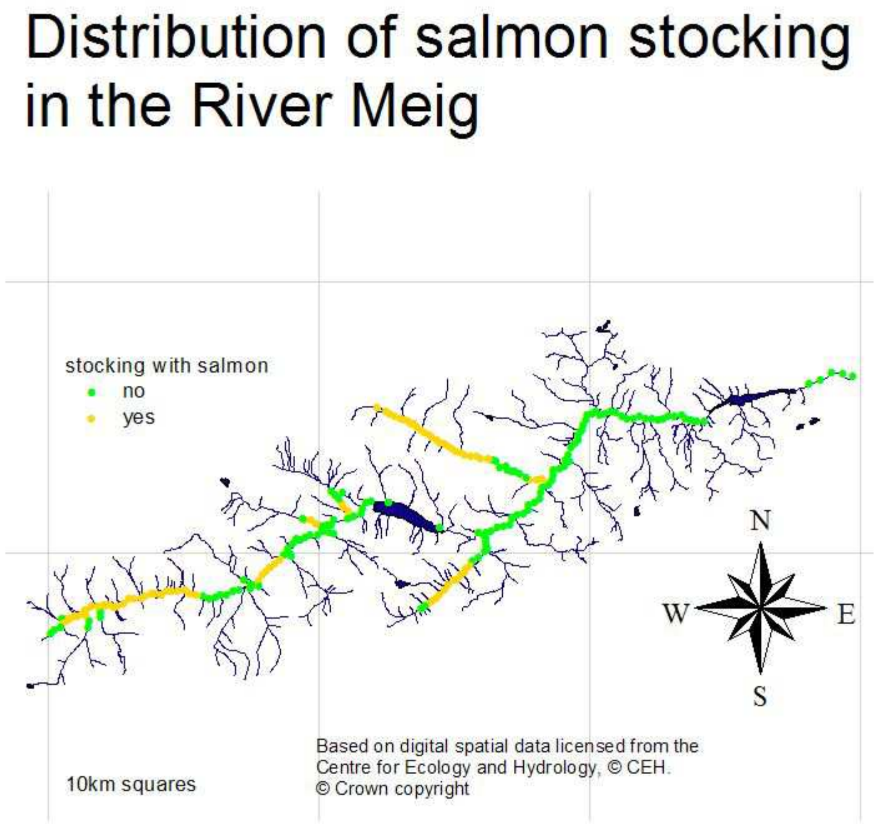


The table below shows the extent of available suitable salmon nursery habitat in the Meig and the potential for stocking with ova or unfed fry.

River	Area of suitable habitat accessible to salmon m2	Suitable habitat above access m2	stocking potential
Lower Meig	54,500	0	0
Middle Meig	113,625	0	0
Allt na h-annaite	1,000	0	0
Allt Baile na Creige	2,063	0	0
Allt Gleann Chorainn	5,939	13,822	65,858
Allt Coire a Bhic	1,063	1,001	5,005
Allt a Choire Dhuibh	750	0	0
Allt a Charnaich	0	750	3,750
Am Fuar-Alltan	375	1,625	5,938
Allt Coire na Feola	0	1,750	8,750
Glen Meinnich	1,625	36,475	182,375
Allt Mhic Fannain	0	313	1,563
Allt Mor	1,438	0	0
Scardroy Burn	1,688	500	2,500
	184,066	**56,236**	**275,739**
Upper Meig	30,250	108,300	541,500
An Crom-alt	0	6,313	24,126
Allt na Criche	0	750	2,250
Alltan Fhuar thuil Mhor	0	2,375	11,875
Allt Feith Riabhaich	0	1,000	5,000
Allt Coire Mhoraigain	0	1,875	9,375
Allt Coie an Thuill Bhan	0	750	3,750
	30,250	**121,363**	**597,876**

The Lower and Middle Meig are not stocked because they have wild spawning salmon populations and well distributed spawning and nursery habitat.

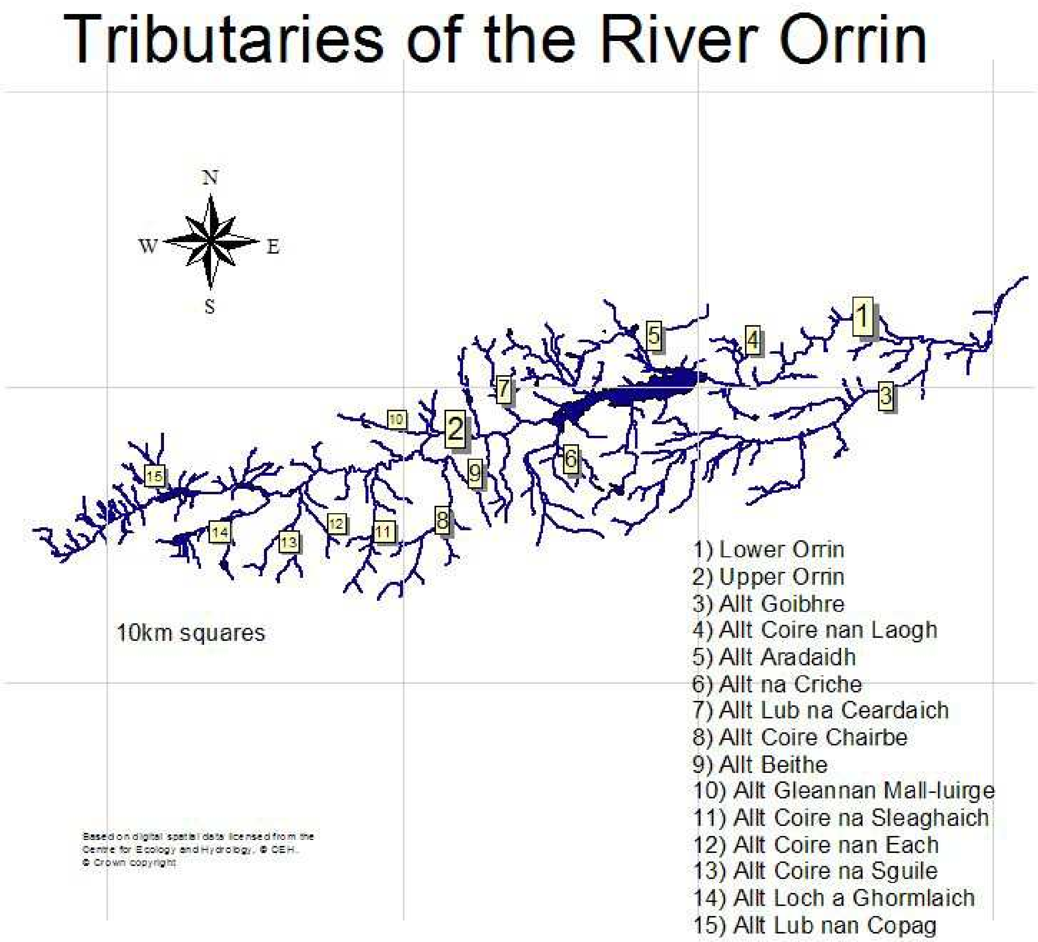
The map below shows the areas of the Meig which have been stocked with juvenile salmon from the hatchery at Strathconon.



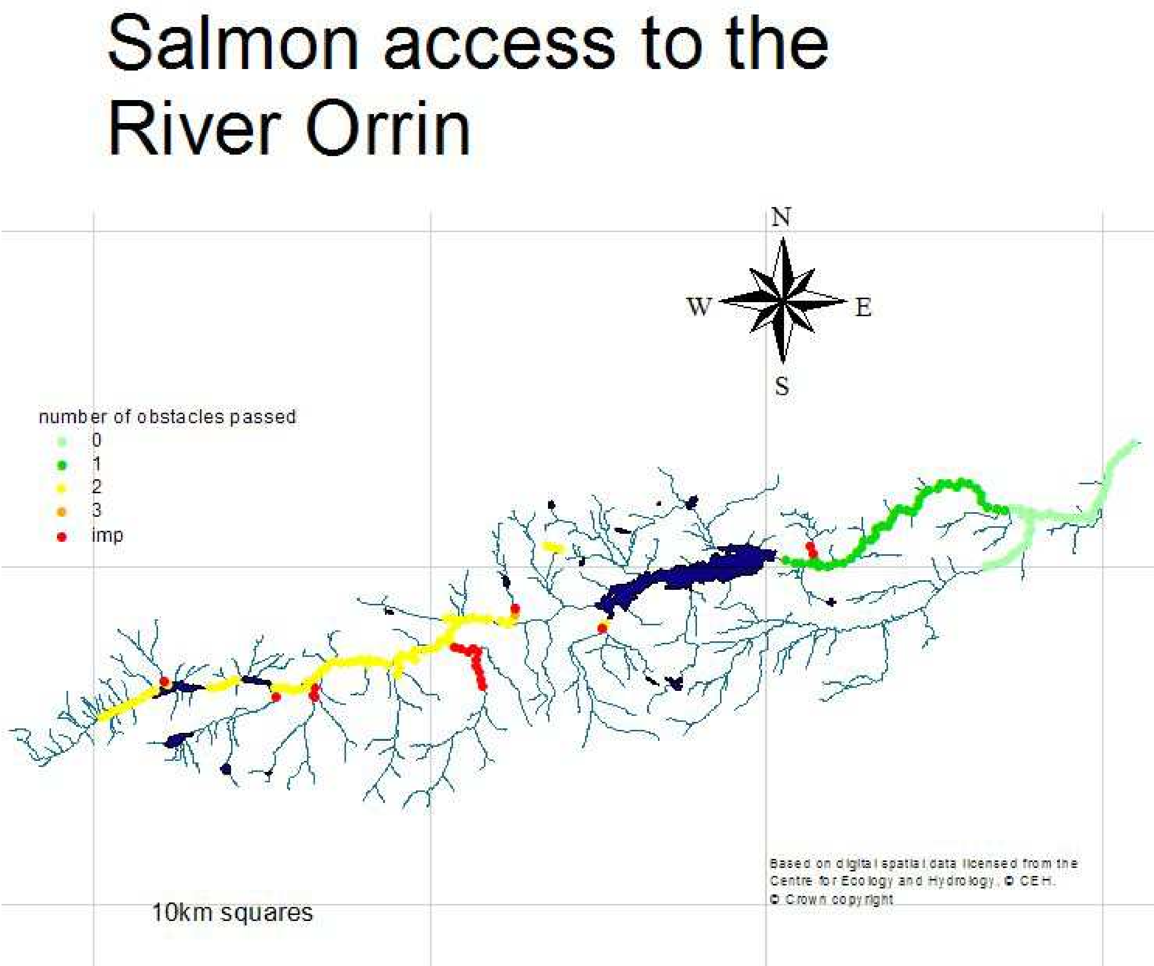
Glen Meinnich contains excellent juvenile habitat and is stocked with fry. There is a good access track which runs alongside the Glen Meinnich Burn which makes fry stocking possible. Glen Chorainn is less accessible by vehicle and is stocked using eyed ova in artificial redds. The Upper Meig above Corriefeol is stocked using eyed ova in its upper reaches and with fry in its lower reaches, large areas of the Upper Meig are not stocked. It is proposed to maintain the current policy of not stocking the Lower and Middle Meig because of their wild spawning populations. Stocking activity should be restricted to Glenn Meinnich (180,000), Glen Chorainn (65,000) and the Upper Meig (up to 600,000). Should the fish pass at Corriefeol be improved sufficiently then the stocking of the Upper Meig should be reduced and replaced by wild spawning. The area upstream of Corriefeol is above 200m in altitude and would be best stocked with salmon of early running MSW origin.

3.1.4 Orrin

The River Orrin and its tributaries are shown on the map below.

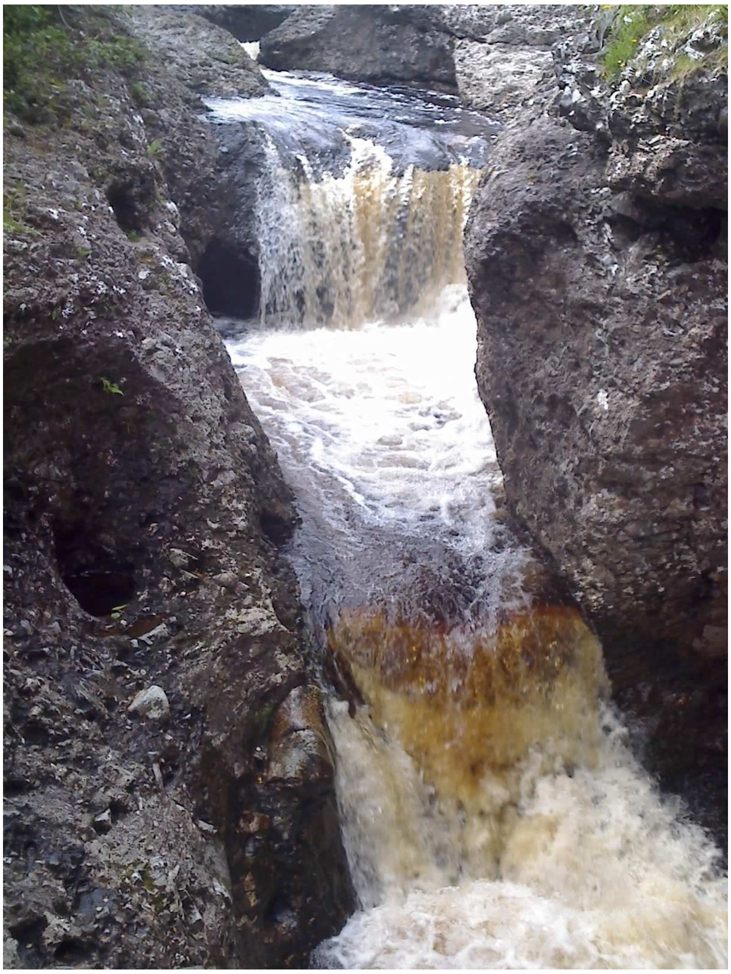


The number of obstacles returning salmon have to pass to reach any point on the Orrin are shown on the map below. See Section 6 for a detailed description of obstacles to migration in the Orrin.



As with the other Conon tributaries obstacles and access are important in limiting salmon production. The Lower Orrin has only one obstacle but this is Orrin falls which almost 12 feet in height. The falls were partially eased in the 1950's by the installation of a stop log step. The Orrin falls however remain a significant obstacle particularly as there is a private hydro plant upstream of the falls with a further fish pass.

The picture below shows Orrin Falls with the stop log step in place.



Orrin Dam was constructed in the late 1950’s and contained 4 separate Borland lifts to accommodate the rise and fall of the reservoir level. It was found that smolts were unable to find the top gates of the fish pass and the Upper Orrin lost its run of salmon.

In recent years the Cromarty Firth DSFB and Scottish and Southern Energy have worked to restore salmon to the Upper Orrin. Since 1998 the Board has stocked the Upper Orrin with around 200,000 ova each year to provide an experimental smolt run. An adult trap was constructed below Orrin Dam to allow adult salmon to be trapped and transported by truck over the Dam. The top gates of two of the fish passes were repaired. A variety of turbine operation schemes, fish pass openings and netting leaders in the reservoir have been tried to attract smolts into the fish pass with limited success. However in 2007 more than 50 adult salmon returned to the foot of Orrin Dam suggesting that the combination of turbine and fish pass flow settings used in 2006 had been successful in allowing downstream smolt passage.

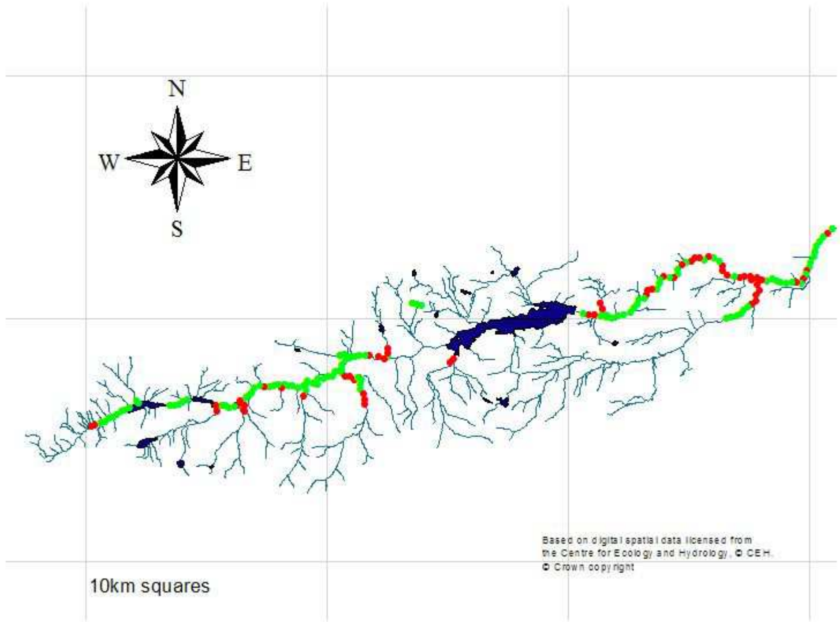
The distribution of suitable salmon nursery habitat in the Orrin and potential for stocking is shown in the table below.

River	Area of suitable habitat accessible to salmon m2	Suitable habitat above access m2	Stocking potential
Allt Aradaidh *	2,251	0	11,255
Allt Beith *	0	0	0
Allt Lub na Ceardaich *	875	0	4,375
Allt Coire Chairbe *	3,000	7,500	67,700
Allt Lub nan Copag *	813	938	3,752
Allt na Criche *	1,500	0	7,500
Allt Coire nan Each *	0	0	0
Allt Loch a Ghormlaich *	1,500	0	7,500
Ally Coire nan Laogh	1,075	0	0
Allt Ghoibhre	24,000	40,563	203,565
Orrin below falls	80,500	0	0
Orrin above falls	140,500	0	702,500
Allt Gleannan Mall-luirge *	2,063	0	10,315
Allt Coire na Sguile *	2,750	0	13,750
Allt Coire na Sleaghaich *	2,875	0	14,375
Upper Orrin *	132,625	0	663,125
	367,952	49,001	1,567,837

- above dam

The map below shows the distribution of suitable salmon nursery habitat in the Orrin but not the distribution of spawning gravel. Favorable nursery habitat is shown in green and unfavourable in red. See the 1995 Conon Habitat Survey for detailed habitat assessment of each 250 m reach of the Orrin and its tributaries.

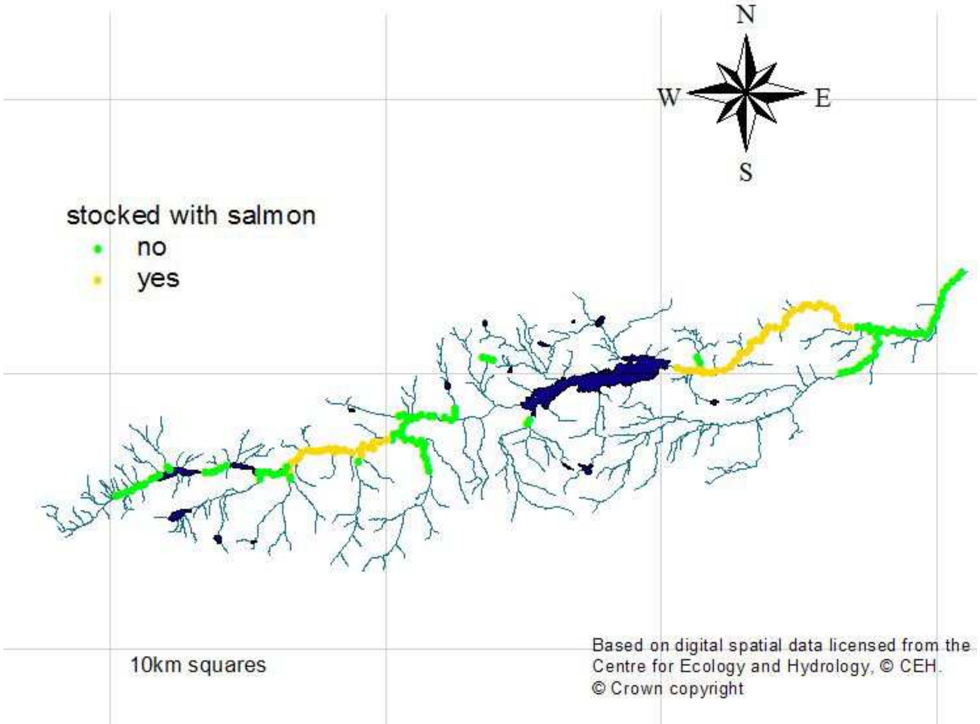
Distribution of favourable and unfavourable juvenile salmon habitat in the River Orrin



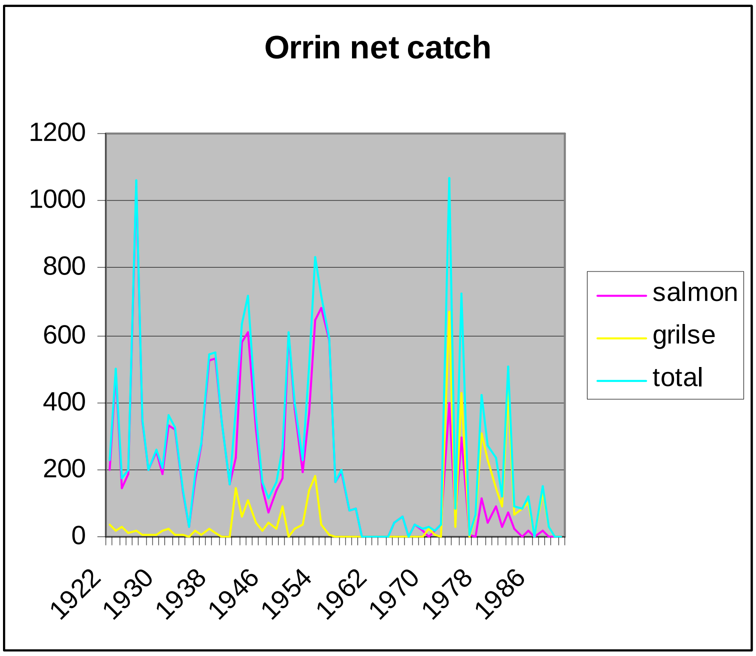
Lower Orrin habitat

One effect of Orrin Dam has been to halt the downstream movement of sediment. The steep gradient of the Orrin from the Dam to Orrin Falls has resulted in the loss of much of the spawning gravel during floods which has not been replaced.
The limited wild spawned stock in the Orrin has been supported by hatchery stocking with fry since the 1970's. The areas stocked are shown on the map below.

Distribution of salmon stocking in the River Orrin



The chart above shows the net catch by Fairburn Estate below Orrin Falls.



The chart shows the collapse in stock following dam construction and recovery following restocking with Blackwater stock in the 1970's until the net fishery was phased out in the 1980's. The chart shows the replacement of a multi–sea winter spring salmon stock which spawned in the excellent habitat of the Upper Orrin prior to impoundment with a grilse stock produced from below the Dam after impoundment.

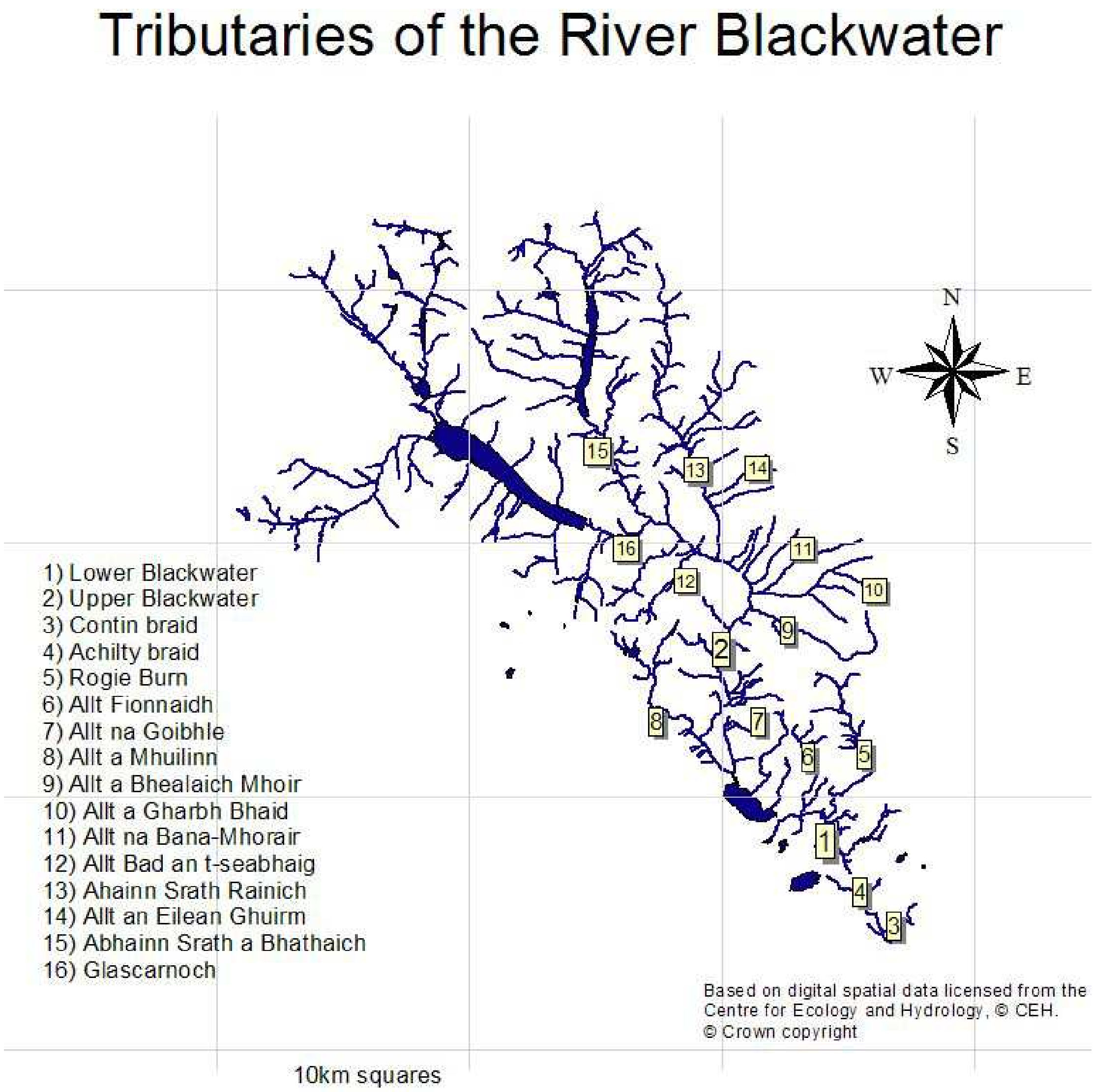
The area downstream of Orrin Falls has an adequate supply of gravel much of which is produced by the Aultgowrie Burn.

It is proposed to maintain the present policy of not stocking below Orrin Falls because of the natural spawning which takes place and restricting stocking to the area between the Falls and Orrin Dam (up to 700,000 fry) and the area upstream of Orrin Dam. In recent years an experimental stocking of 200,000 ova has been stocked above the Dam. If the recent success in providing smolt access can be maintained then this stocking should be significantly increased (up to 800,000) until sufficient returning adults are produced to stock the Upper Orrin naturally at which time stocking should be phased out. The area upstream of Orrin Dam historically produced early running multi sea winter salmon and this should be considered in the selection of broodstock for this area.

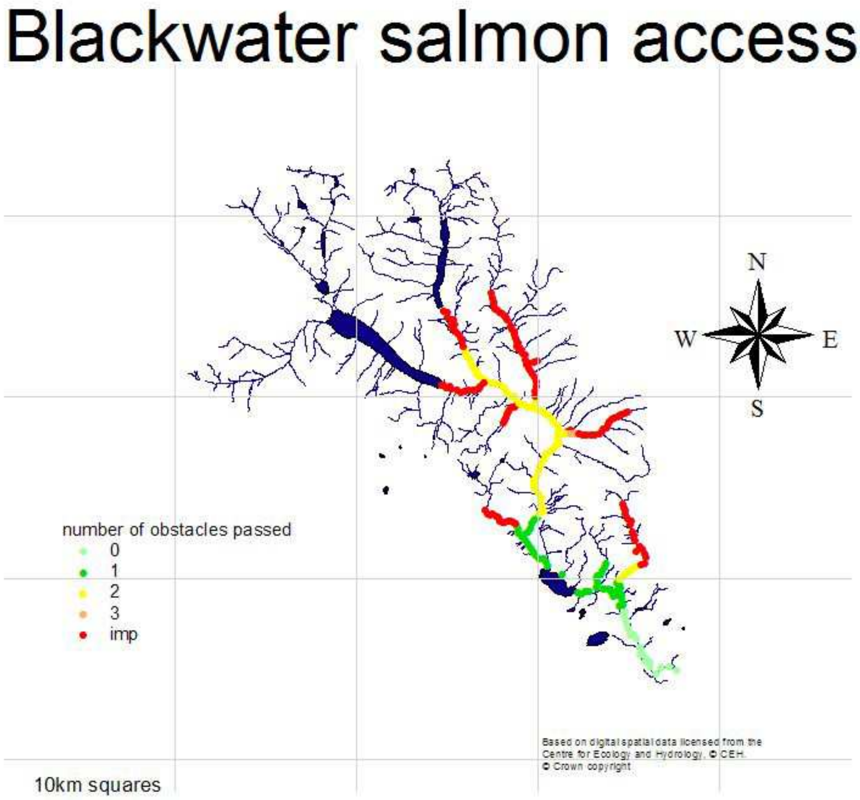
The area between Orrin Dam and Orrin Falls is at present stocked because of the lack of spawning habitat linked to the gradient and effect of impoundment on sediment transfer. If remedial works were to take place to restore gravels to this area then a reduction of stocking and replacement with wild spawning would be desirable.

3.1.5 Blackwater

The Blackwater and its tributaries are shown on the map below.



The Lower Blackwater flows from Loch Garve down to the confluence with the Conon near Contin. The Upper Blackwater flows from Lochs Glascarnoch and Vaich down to Garve.



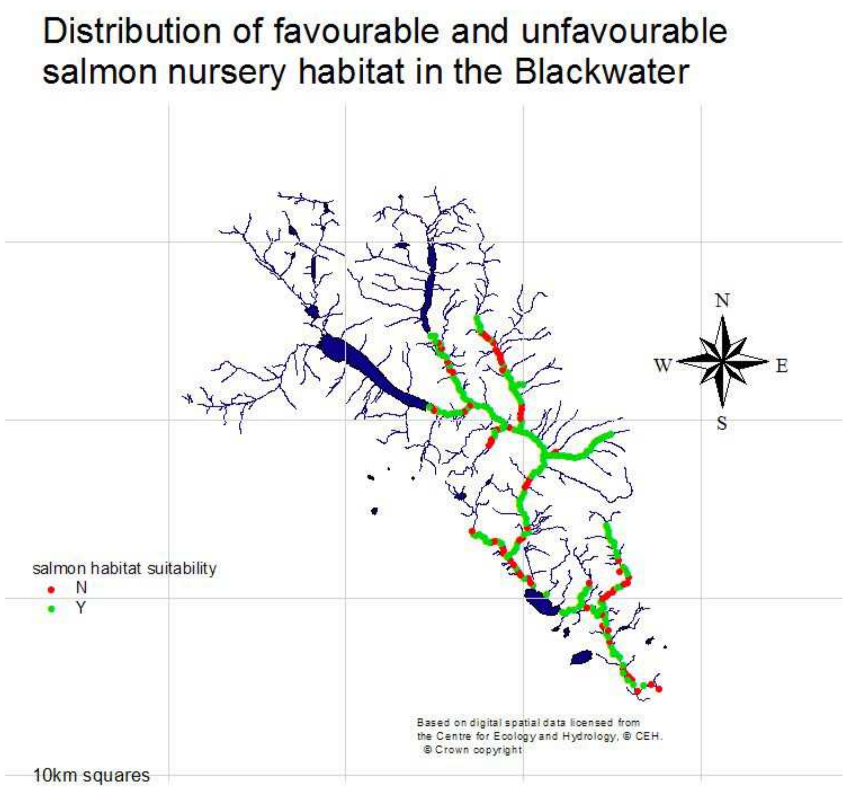
The map above shows salmon access to the Blackwater and its tributaries. See Section 6 for a detailed description of obstacles to migration in the Blackwater. There is unhindered access to the Lower Blackwater as far as Rogie Falls. Rogie used to be a significant obstacle with few salmon passing above it. Rogie Falls was made passable by the construction of a pool & overfall fish pass in the 1950's as part of the Conon Hydro Scheme which improved an earlier pass.

There is no provision for salmon passage at Glascarnoch and Vaich. There are similar issues to the Orrin with a limited and patchy distribution of spawning habitat in the Upper Blackwater but a large area of excellent parr habitat.

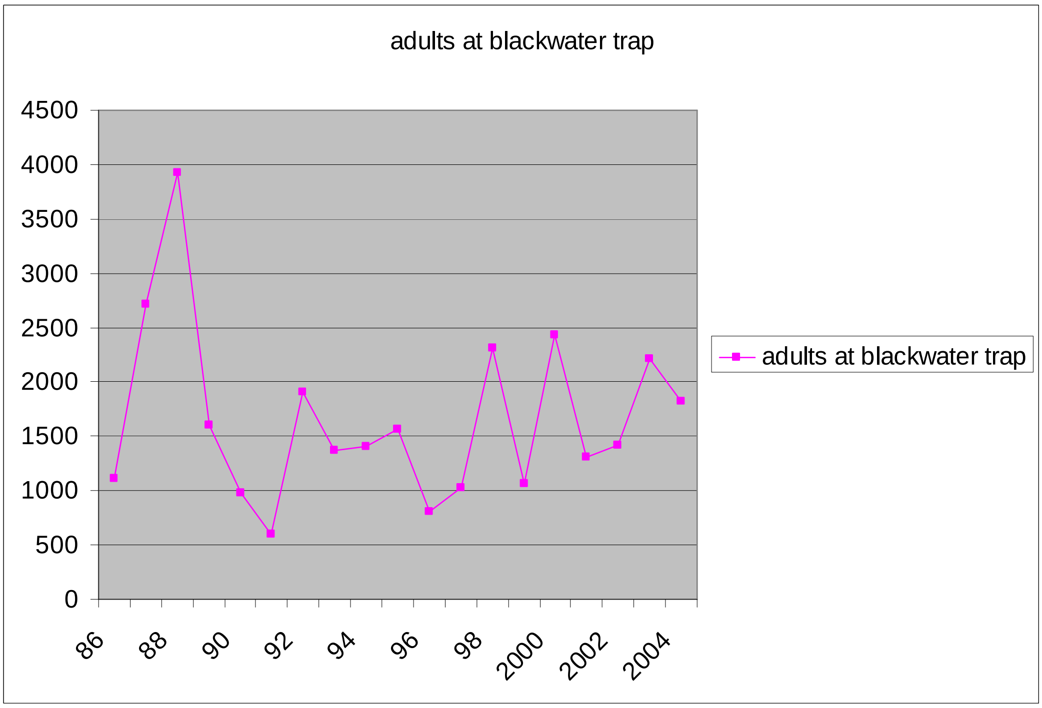
As part of the mitigation scheme during hydro construction a fish trap was constructed at Loch na Croic and a hatchery at Contin to allow the collection of broodstock and stocking with unfed fry.

River	Area of suitable habitat accessible to salmon m2	Suitable habitat above access m2	Stocking potential
Lower Blackwater	252,500	0	0
Achilty backwater	875	0	0
Contin backwater	8,050	0	0
Rogie Burn	13,250	10,875	48,625
Allt Fionnaidh	5,188	0	0
Upper Blackwater	0	280,750	1,318,125
Allt na Bana Mhorair	0	813	1,625
Allt an Eilean Ghuinn	0	2,563	10,180
Allt Gharbh Bhaidh	0	21,818	103,933
Allt na Goibhle	0	875	4,375
Allt a Mhuillin	0	7,129	33,020
Abhainn Srath Rainnich	0	46,375	239,000
Allt bad an t-seabhaig	0	5,725	28,756
Abhainn Srath a Bhaich	0	68,125	327,194
	279,863	445,048	2,114,833

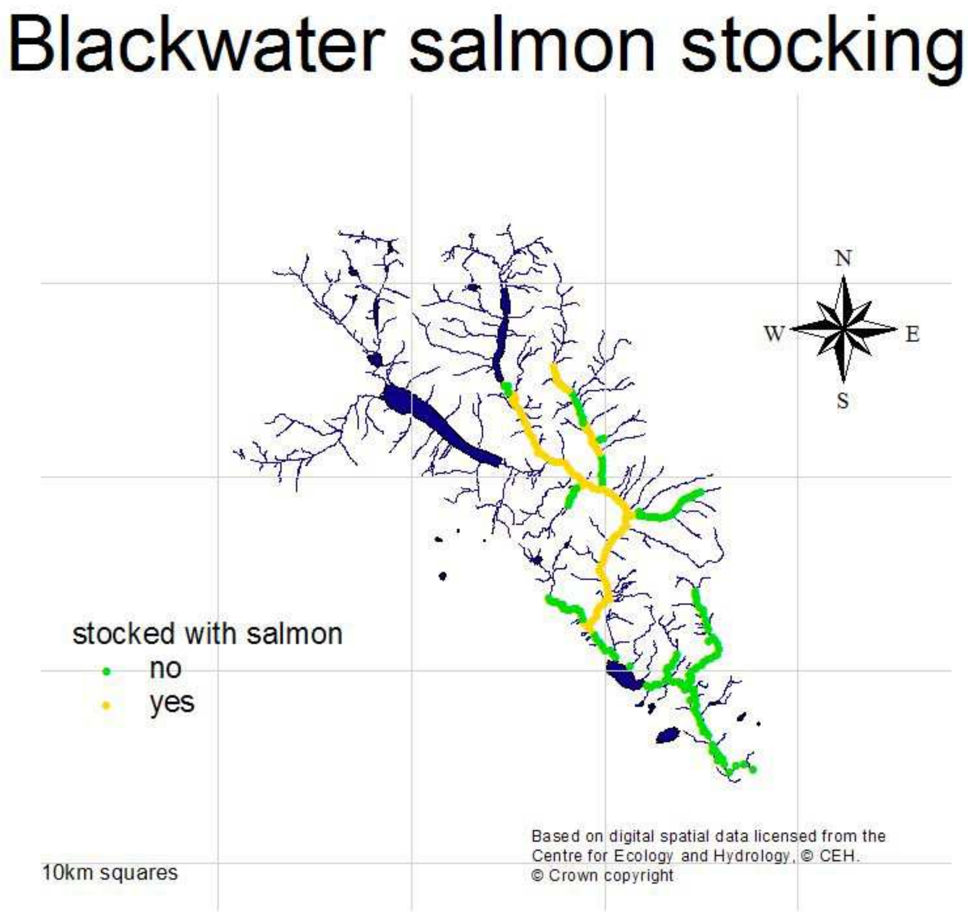
The table above shows the extent of suitable habitat in the Blackwater system and the potential for stocking with unfed fry. The map below shows the distribution of suitable habitat in the Black water. Favourable habitat is shown in green and unfavourable in red. See the 1995 Conon Habitat Survey for detailed habitat assessments of each 250m section of the Blackwater and tributaries.



The area downstream of Loch na Croic has a combination of suitable nursery habitat and areas of suitable spawning habitat and is stocked by natural spawning. It is not recommended to introduce hatchery fry in this area. The area upstream of Loch Garve contains large areas of suitable nursery habitat and has been stocked for the last 50 years. This stocking has maintained the salmon fishery downstream and has produced an average of 1,900 returning adults per year to the Loch na Croic trap.

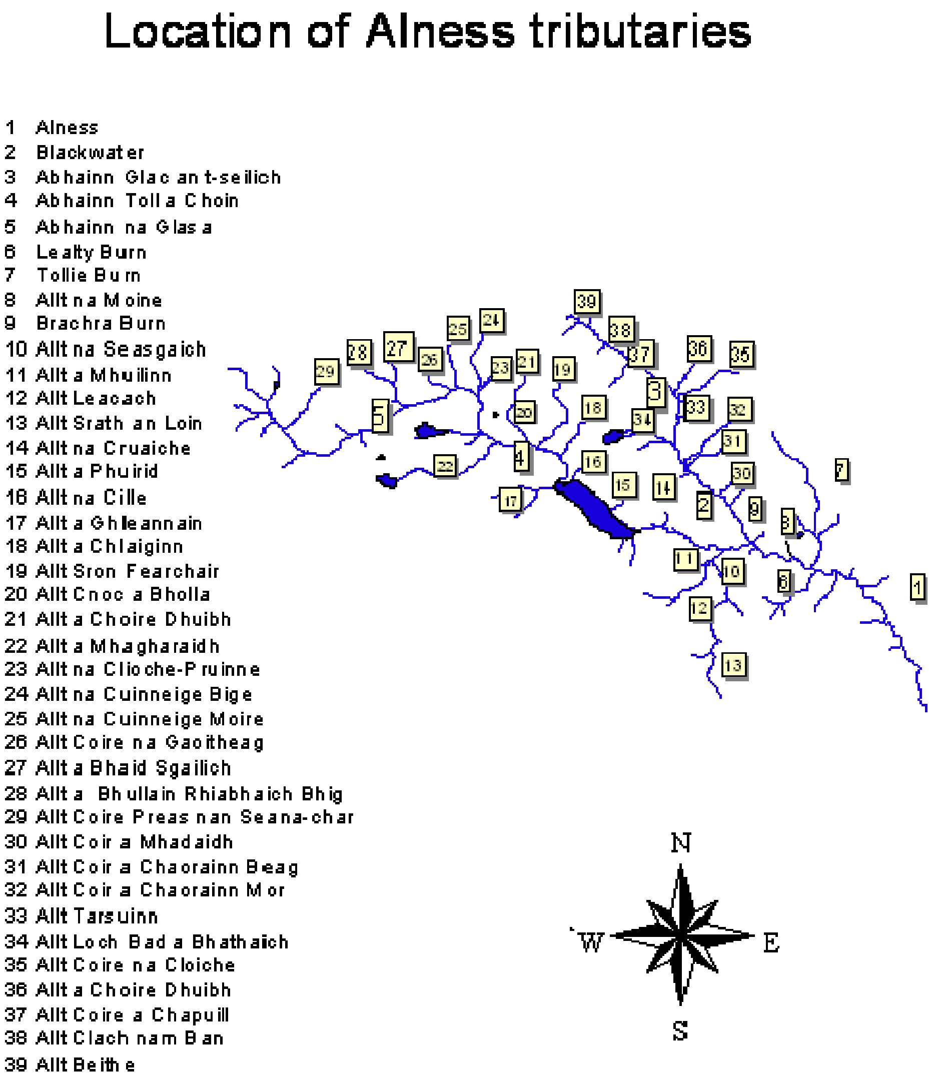


This area remains a priority for stocking, whilst it would be difficult to stock the remoter sections of all the tributaries a stocking of c 1,500,000 should be maintained unless habitat and flow restoration could be achieved to allow a similar level of wild spawning. The map below shows the areas of the Blackwater presently stocked.



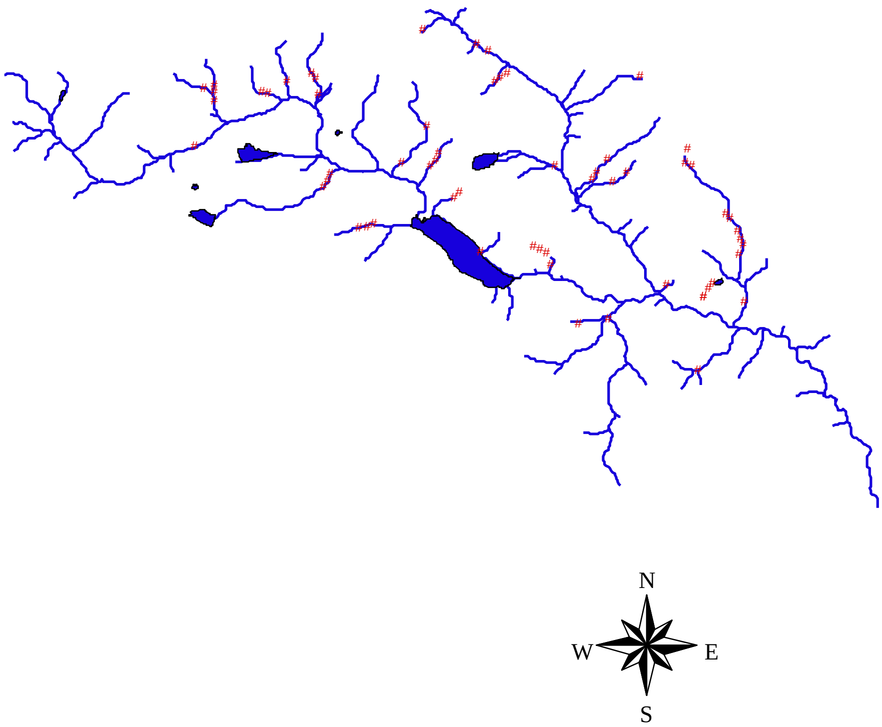
3.2 Alness

The Alness and its tributaries are shown on the map below.



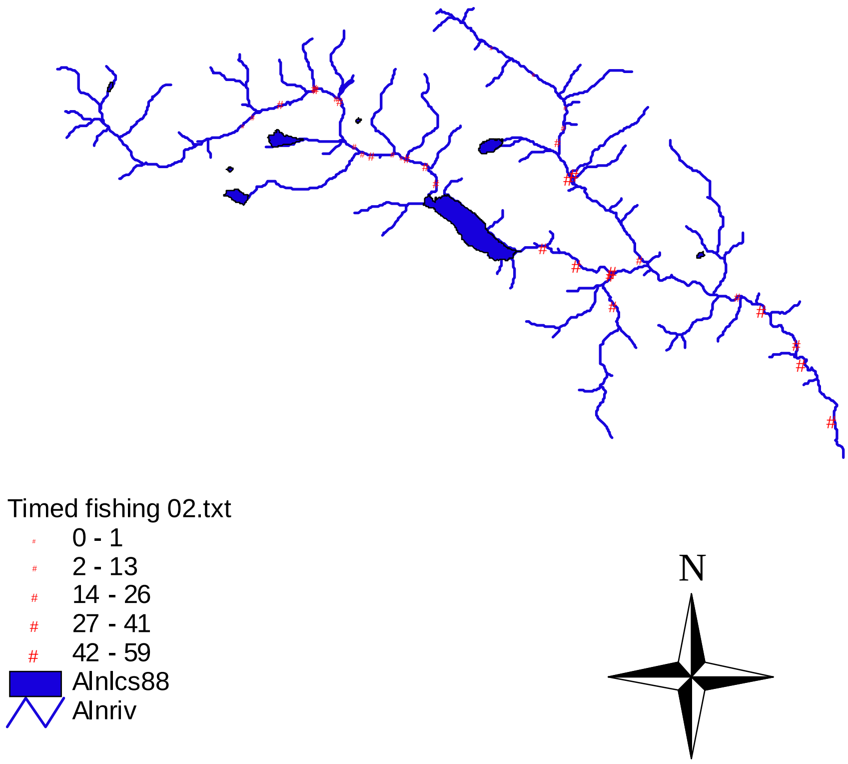
The location of obstacles to migration which were likely to be impassable are shown on the map below

Location of impassable obstructions to upstream migration

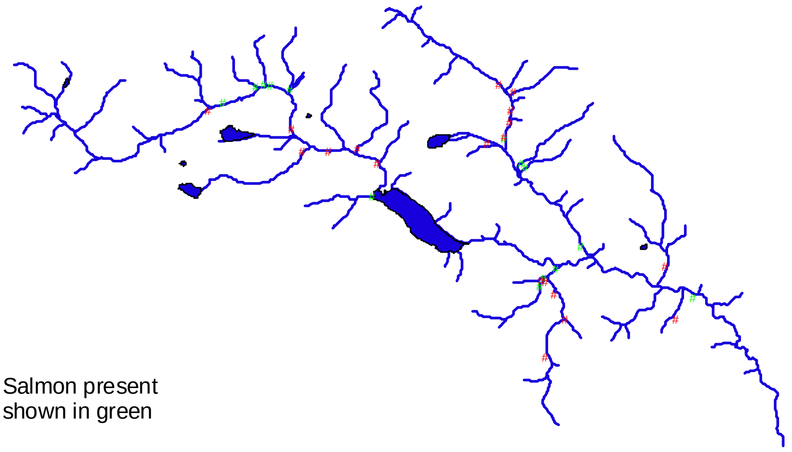


The distribution of juvenile salmon recorded during the 2002 electro-fishing survey is shown on the map below.

Distribution of salmon at 2002 electro-fishing sites

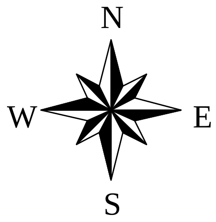


Presence /absence of salmon from 1998 survey

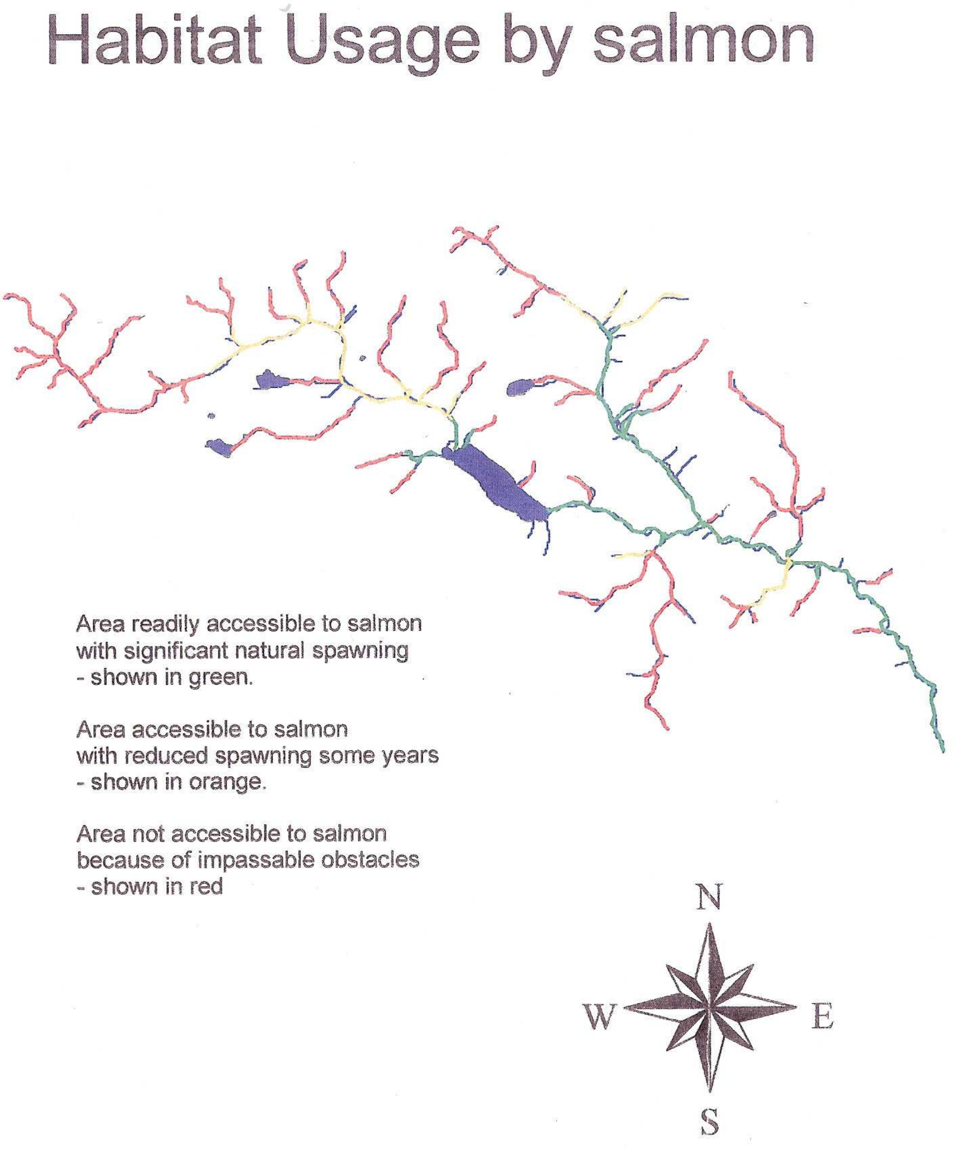


Salmon present
shown in green

Salmon absent
shown in red



The usage by salmon of the catchment is shown below.

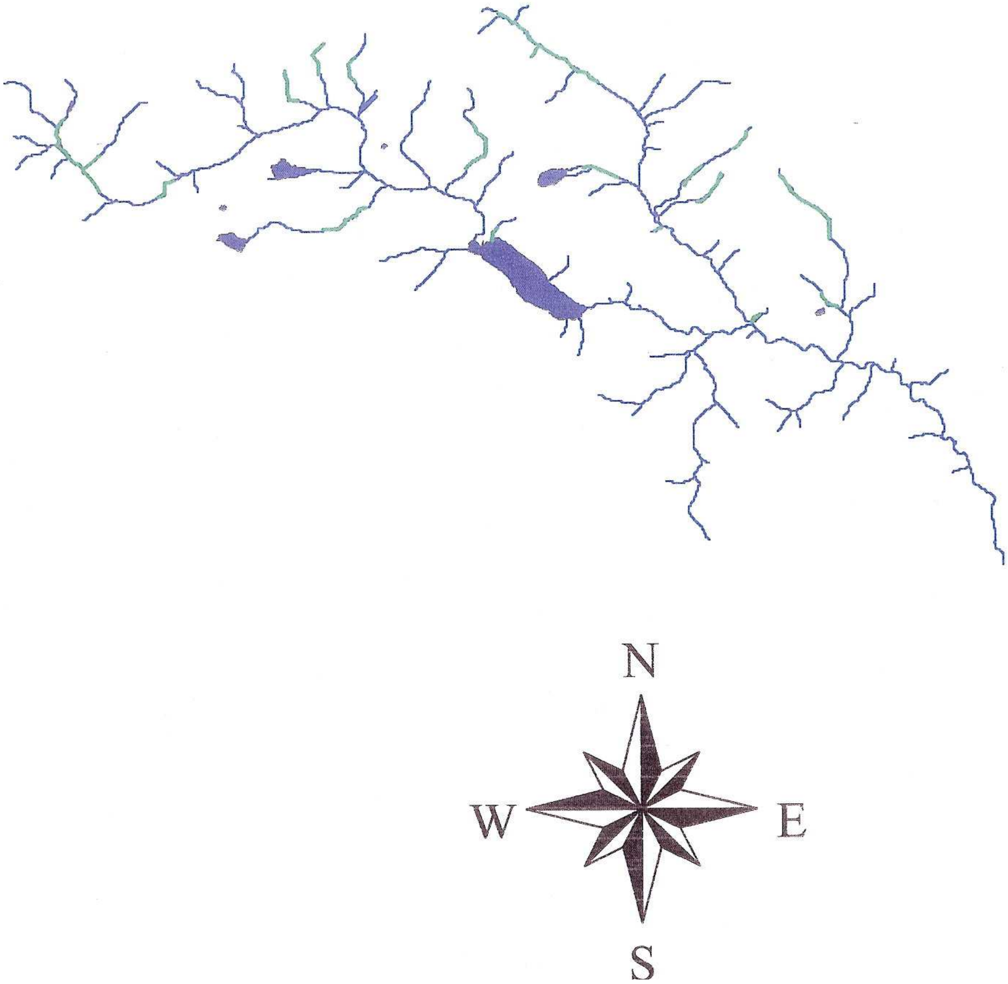


Alness stocking requirements

Data from the 2000 habitat survey which recorded the location of obstacles to migration was combined with juvenile salmon electro-fishing data from 1998 and 2002. The resulting habitat usage is shown on the map above. Prior to the 1998 survey a series of drier summers limited upstream migration, whilst the 2002 survey took place after two wet summers and good conditions for migratory fish to penetrate further inland. The areas which were unavailable to natural spawning in either survey are shown in red on the map. The areas which were well used in both are shown in green and the areas which were partially used after a dry year are shown in orange.

The greatest number of smolts produced per egg are likely to occur in areas with no natural spawning and therefore no competition from wild fish. In addition stocking these areas is less likely to have a detrimental effect on wild spawned stocks. There may be some effect on wild trout populations but the habitat will become partitioned so that salmon will dominate in shallower faster flowing areas and trout in deeper slower sections. The areas most suitable for stocking are shown on the map below.

Areas recommended for stocking



Water course	Priority	Max Capacity	Recommended stocking area	Recommended stocking number	Notes
Abhainn Glac an t-seilich	H	86,000	Above T14	50,000	mainly B&C habitat
Abhainn na Glasa	H	175,000	T38-40	42,000	patchy above falls
			T48-57	74,500	best habitat
Tollie Burn	H	65,000	T19-27	22,500	best above falls
Allt na Moine	M/L	5,750	T1	5,000	best at bottom
Brachra Burn	M/L	2,500	T1	1,250	mainly C
Allt na Cruaich	M/L	750	T1	750	too steep above T1
Allt na Cille	M/L	2,375	T1-2	2,000	best at bottom
Allt na Ghleannain	L	10,625		0	good density below falls
Allt a Chlaiginn	L	8,000		0	steep patch habitat
Allt Sron Fearchair	M/H	23,877	T3-6	17,000	mainly A & B
Allt a Mhagaraidh	M/H	32,000	T5-9	17,000	mainly B patchy above
Allt a Cuinneige Bige	M/L	19,626	T5-8	6,000	high altitude
Allt a Cuinneige Moire	M/L	15,813	T 4-7	8,500	patchy above falls
Allt Coire na Gaoithaig	M/L	8,188	T4-7	6,000	T4-7 best
Allt a Bhaid Sgailich	L	5,313		0	remote, patchy habitat
Allt a Bhllain Rhiabhaich	L	13,750		0	remote, patchy habitat
Allt Coire Preas nan Seana-Char	M/L	8,282	T1-3	5,500	
Allt Coir a Chaorainn Beag	M/L	5,033	T4-7	4,500	
Allt Coir a Chaorainn Mor	M/L	27,000	T5-7	12,500	steep patchy habitat
			T9-10	5,000	mainly C
Allt Loch Bad a Bhathaich	L	10,878	T3-5	6,000	mainly C
Allt Coire a Chapuill	L	1,735		0	v.steep
Allt Clach nan Ban	M/L	1,250	T1	1,250	mainly b
Allt Beith	L	3,719		0	v.steep

The total capacity of the habitat above the lowest impassable obstacle on each watercourse is shown in the table above. The habitat survey habitat quality gradings were used to assess the stocking priority for each watercourse. Sites having a higher proportion of A & B grade habitat were ranked above those with a greater proportion of C & D grade habitat. Other factors such as excessive gradient, habitat fragmentation and remoteness were also taken into consideration.

Within each tributary the location of the best habitat for stocking and a recommended number of ova or fry required is shown. This gives a hatchery requirement to stock the areas of high and medium/ high priority of 188,500 and 64,250 to stock the areas of medium and low priority.

After one or more dry seasons it may be desirable to partially stock the habitat shown in orange on the map above. Some of the ova from the lower priority areas on the table above may be better stocked into the best of these areas, especially Abhainn Glac an t-seilich T9-14 and Abhainn na Glasa.

It would be difficult to collect sufficient suitable broodstock to stock all of these areas and beyond the capacity to which the present hatchery could easily be expanded. The numbers of eggs required could be significantly reduced by habitat improvements, which would in the long term be more sustainable and cost effective.

In particular the problem of the Allt na Seasgaich road crossing should be resolved. This would save 30-40,000 fry per year which are presently stocked into this area as mitigation for this obstruction. See Section 8 for description of obstacles in the Alness system.

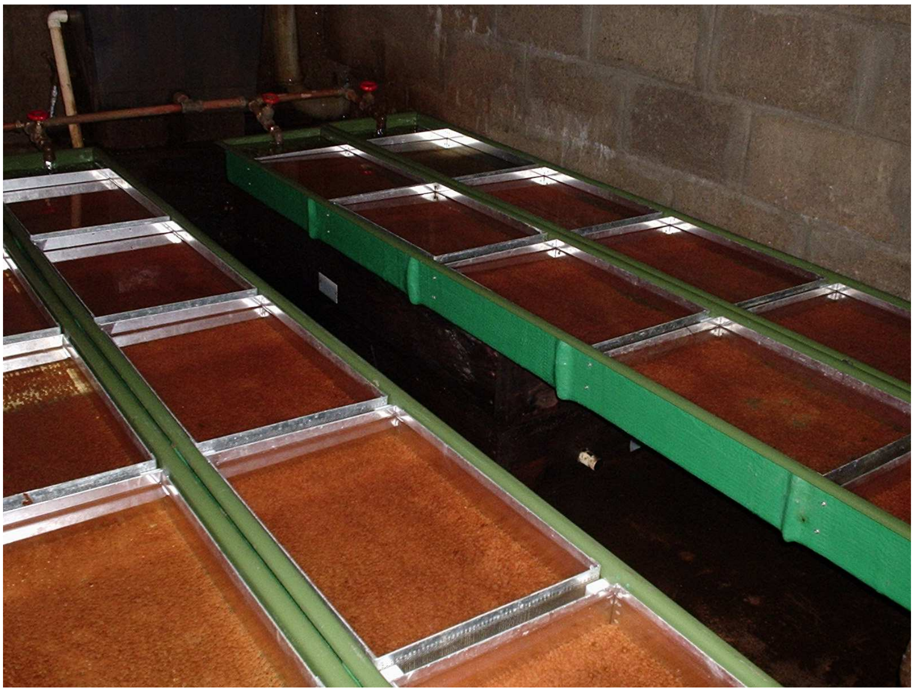
The very large area of suitable parr habitat in Abhainn na Glasa, which is partially used, could be more productive. A small number of holding pools would allow fish to penetrate further upstream, especially in dry years. The creation of off stream spawning channels would help to balance the egg deposition with the large area of parr habitat available.

Genetic analysis of the salmon stocks of the Alness system should be undertaken and the results used to guide stocking strategy. It is recommended to collect broodstock from the areas below the Blackwater junction and Allt na Seasgaich by rod and line or electro-fishing and to tag and strip them separately.

Hatchery requirements

The fabric of the Alness hatchery building is sound. The water supply and filtration system are proven and have withstood both summer droughts and winter freezing. Security is also good with the hatchery located adjacent to a Novar owned house.

Most of the areas identified as of greatest importance for stocking would be best stocked with eyed ova in artificial redds.
The ova incubation facilities in the hatchery have recently been refurbished. The previous wooden troughs were not entirely watertight and would drain down if the flow were interrupted. Replacement with modern fibreglass troughs has overcome this and also allows better sterilisation against viral, bacterial and parasitic infections.



Upgraded hatchery troughs

Without malachite green to control *Saprolegnia* fungal infection, it has become very difficult to hold broodstock for more than a few weeks. The previous Alness broodstock holding tank was of a D shaped design, which has a low water exchange rate and is particularly susceptible to fungal infection and transmission between fish this has been replaced with a more efficient circular 4m tank. The collection of broodstock should be delayed until as close as possible to spawning to reduce pre-spawning mortality.

7.1.3 Allt Graad

Black Rock gorge

The biology of the migratory fish stocks of the Allt Graad is dominated by the presence of the Black Rock Gorge, without which the Allt Graad would be a significant salmon river. The area below the gorge to which migratory fish have access limits the smolt production of the river. The area of available habitat below the gorge is just under 35,000 square meters. Above the gorge there is a further 54,000 square meters of habitat in the main stem of the Allt Graad alone. This area has an estimated fry capacity of 250,000 fry. The potential exists, should sufficient Allt Graad broodstock be available and given suitable hatchery facilities, to more than double the smolt production of the river.

A further consequence of the limited area available to salmon and sea trout below the gorge is the vulnerability of these populations to extinction. There are serious threats to the migratory fish stocks of the Allt Graad. Poaching poses an ongoing threat and in particular the practice of deliberately poisoning the holding pools below the gorge. This not only kills adult salmon, preventing them from spawning but also kills several year classes of juveniles, so that the effects of such a poisoning can have long-term impacts. There is also a risk of accidental poisoning of the river from the Assynt Water Treatment Works and discharges of suspended solids have been reported from the works on several occasions. The Lower Allt Graad is vulnerable to damaging floods and redd washout which has been exacerbated by forestry practices and drainage in the middle catchment.

Given these pressures a limited stocking operation above the Black Rock Gorge, using stock of Allt Graad origin, would act as a gene bank and reduce the risk of extinction of lower river stocks. In order to achieve this; broodstock collection, broodstock holding and hatchery facilities would be required. The optimum solution would be to recondition Allt Graad kelts or to rear captive broodstock from parr so as to minimise the risk of removing too many spawning fish from the lower river. However these options are beyond the hatchery resources presently available.

The current stocking strategy for the Allt Graad is to capture a small number of salmon on rod and line which are then held in the Alness broodstock unit until ready for stripping. The eggs are incubated in the Alness hatchery and the unfed fry (approx 20,000 are stocked upstream of the Black Rock Gorge. This level of stocking is not intended to greatly enhance the run of adult salmon to the Allt Graad but rather to act as a gene bank should a major poisoning event take place downstream of the gorge.

Upstream of the Gorge further obstacles to migration exist which may have significant impacts on local trout populations. In particular culverts on Allt Gharbaidh, the Glen Burn, the Loch Burn and Allt Cailice are impassable and isolate the trout populations above them.

Allt nan Caorach and its tributaries have potential for smolt production but are steeper, have more waterfalls and contain poorer habitat than the main stem of the Allt Graad. They are also more difficult to access than the Allt Graad.

Appendix I

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Maff Publications PB 0535

FRS 2007
Hatchery Work in Support of Salmon Fisheries
Scottish Fisheries Research Report No. 65
ISSN: 0308 8022

Conon DSFB 1995
Conon Habitat Survey

Conon DSFB 2000
Alness Habitat Survey

Conon DSFB 2001
Allt Graad Habitat Survey

5.4 Exploitation control

Catch and release policy

The current Cromarty Firth Conservation Policy is shown below;

Cromarty Firth Fisheries

Conservation Policy 2008

MULTI-SEA WINTER SALMON

UP TO 30TH JUNE

As in previous years anglers are requested to release, if possible, the **FIRST** spring salmon they catch. They may, if they wish, kill the second, but thereafter all salmon caught should be released.

AFTER 30TH JUNE

All salmon over 30" / 75cm long (about 10 lbs) should be released.

GRILSE

The Board is recommending that only two grilse per angler per week may be killed. All other fish should be returned to the river.

SEA TROUT

Sea Trout of over 1 1/2lbs are particularly valuable and no more than two / angler / week should be retained.

GENERAL

- All coloured fish should be released
- Please use barbless hooks
- When releasing fish, try to keep the fish in the water at all times and use knotless mesh landing nets

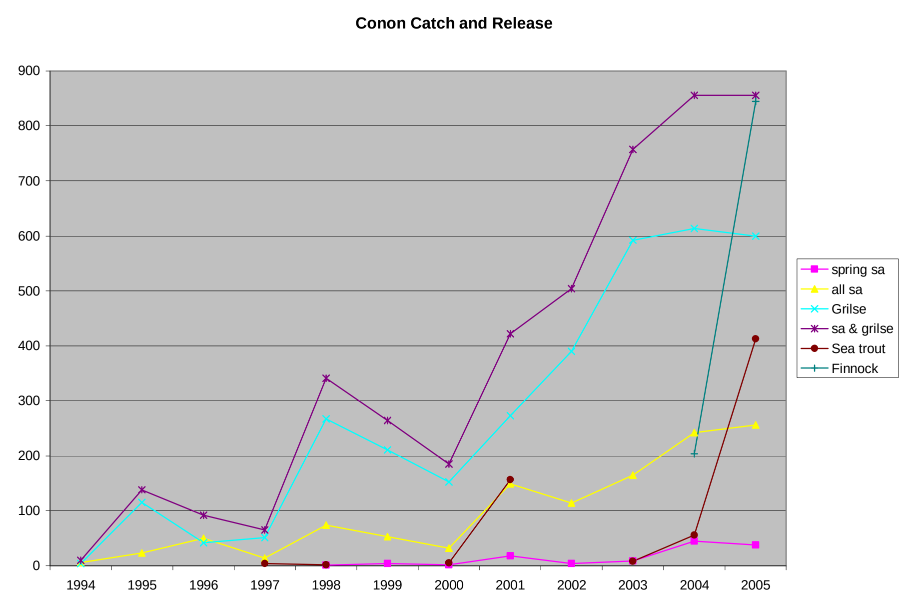
FIN CLIPPED FISH

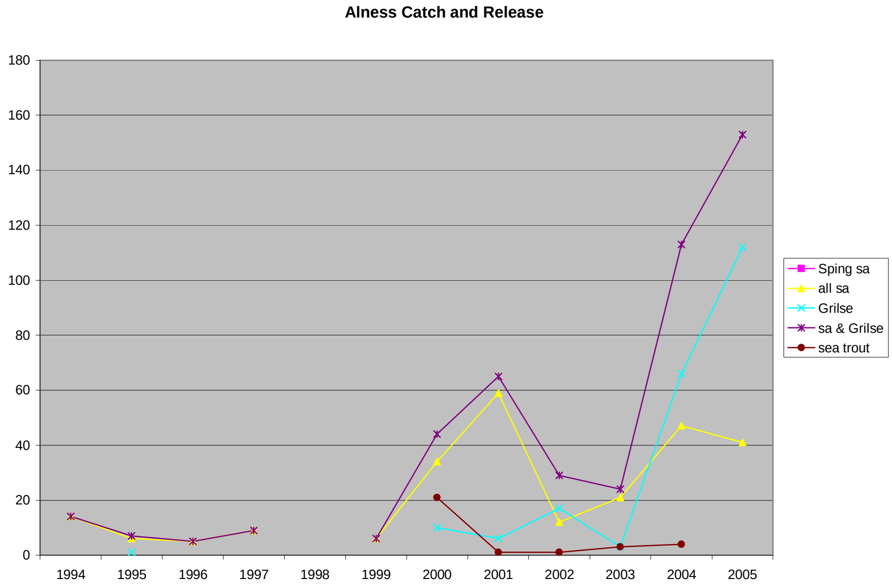
If an angler catches a fish that has had the adipose fin removed, please retain it and inform Simon McKelvey (01997 433405 or 07887 845648). These fish will have been either micro-tagged or PIT tagged and the information contained in these tags is important to the operation of our stocking programme. The angler keeps the fish, will be given a £5 reward and, in due course, the life history of the fish.

GYRODACTYLUS

Proprietors or their appointed nominees are being urged to ensure that anglers fishing their waters have completed and signed a declaration regarding sterilizing fishing equipment.

The Cromarty Firth Conservation Policy contains recommendations to encourage anglers to return a proportion of the fish caught. The Policy is voluntary rather than mandatory and the effects can be seen in the charts below showing the numbers of fish released by anglers on the Conon and the Alness in recent years, with up to 70% of rod caught fish being released. The success of the Policy has been largely due to the cooperation and enthusiasm of ghillies in promoting catch and release. The Policy has also been supported by radio-tracking work (Willams 2004) which showed a very low recapture rate and high spawning survival of rod caught spring salmon.



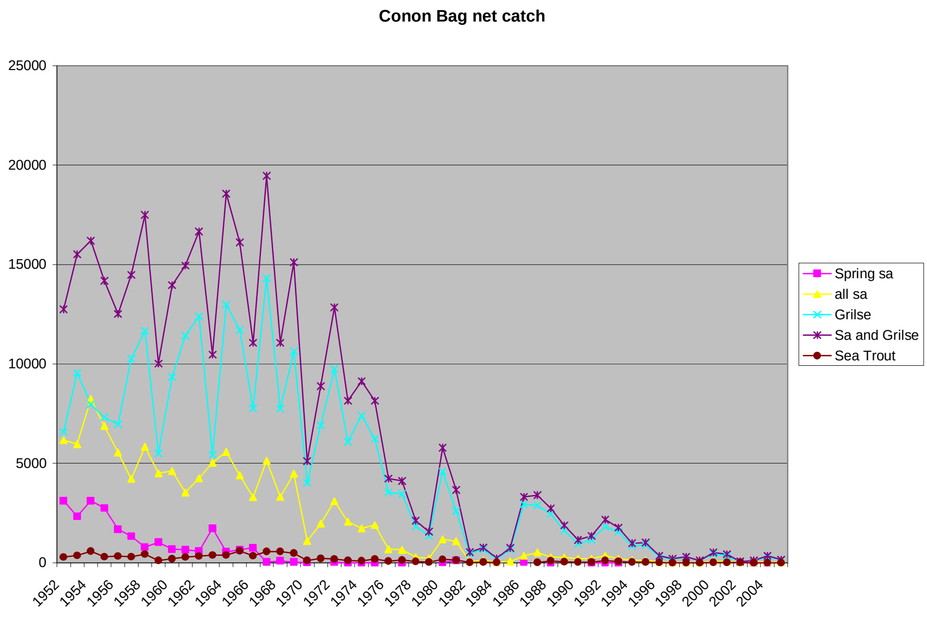


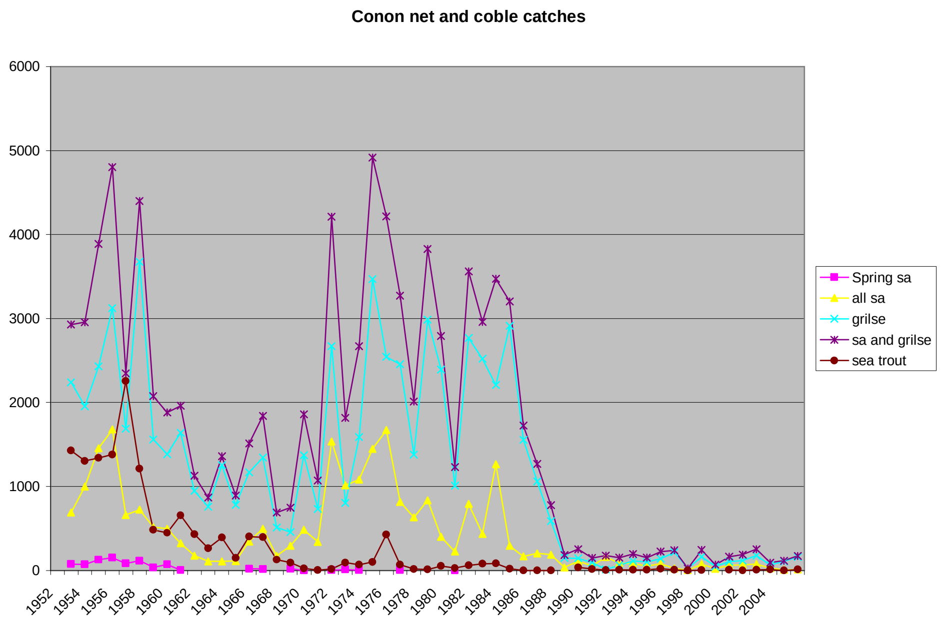
Netting exploitation

The previously high level of netting exploitation has been reduced by a number of mostly economic factors. As the value of rod and line fishing increased in the last quarter of the 20th century, the value of net caught salmon decreased with the rapid expansion of aquaculture. The combination of these factors along with declining marine survival led to a reduction of netting effort. This was accelerated with net buy-outs in the 1980's & 1990's by the Atlantic Salmon Conservation Trust and District Salmon Fishery Boards.

The Conon DSFB further reduced net exploitation particularly on vulnerable spring salmon stocks by offering netsmen in the region a 90% reduction in assessment if they agreed to limit netting effort to six week period in the summer.

The effects of these measures can be seen in the charts of net catches for the region shown below.





5.5 Migration obstructions

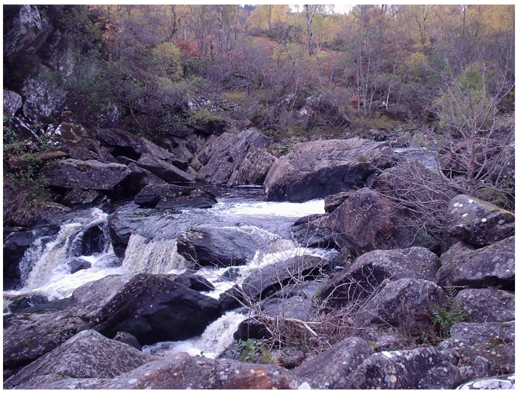
It was recognised as early as 1837 that the salmon production of the Conon system was limited by the access salmon had to the four tributaries. Stoddart in his ‘Angling Reminiscences’ recommended the easing of the falls below Luichart to open up the River Bran to salmon. The issue of access to the Conon tributaries was repeatedly discussed in DAFS ‘Salmon Fisheries of Scotland’ reports. In 1882 the easing of Conon Falls was recommended. In 1887 there was a recommendation to ease falls at Conon Falls, Orrin and Grudie. In 1890 it was recommended to ease the falls at Conon Falls, Orrin Falls and Rogie Falls on the Blackwater. In 1921 there was the first suggestion of linking hydro development to the easing of Conon Falls.

Hydro development.

It was during the development of the Conon Basin Hydro Scheme during the 1950’s that barriers to migration at Conon Falls and Achanalt were eased by the construction of new fish passes. Borland fish lifts at Luichart Dam and Achanalt Barrage combined with the fish ladders to give access to the River Bran for the first time. This arrangement was not without cost, as part of the scheme agreement access was to be lost to the spawning grounds on the Blackwater above Glascarnoch and Vaich.

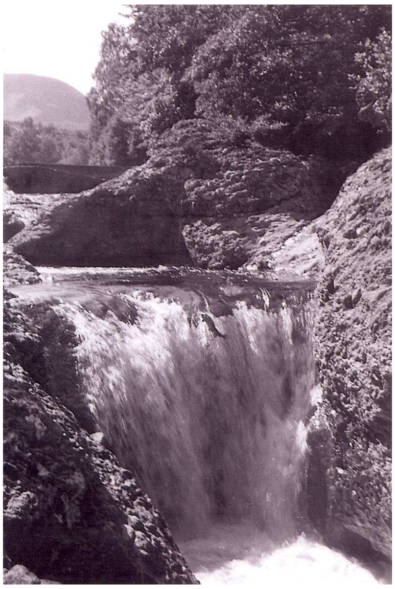
Although most of the Borland lifts in the Conon Scheme worked for upstream passage of adult fish some were not so effective for downstream passage of smolts. This problem of downstream passage meant that the Upper Orrin ceased to be a salmon river and lost its valuable run of spring salmon. The Bran scheme also failed because of downstream passage at Luichart Dam. The Bran has eventually been restored as a salmon river but requires a smolt trapping and transport operation and a continuing hatchery input to maintain a run of salmon. This hatchery and smolt transfer operation is carried out by the Cromarty Firth Fishery Board and is funded by Scottish and Southern Energy. The extent of management and the confined apertures through which fish must pass to enter or leave the Bran system has provided a valuable research facility which has been used by FRS in recent years.

Radio tracking work in the 1990’s found several problems for fish passage in the Bran system. These were resolved by engineering a new section of the Achanalt ladder and setting up a freshet regime below Luichart Dam which gives a variation of flow required for salmon to get to the Conon Falls ladder and then to negotiate it.



Section below Luichart Fish Ladder

Orrin Falls



Orrin Falls at almost 12 feet in height is reputed to be the highest falls negotiated by salmon in Scotland. In 1921 a wooden structure was installed below Orrin Falls to reduce the height of the jump this was not sufficiently well engineered and soon washed out. In 1951 it was suggested that a timber stop log structure could be installed between the falls and the pool below. This was constructed with steel channels fixed to the rock of the gorge below the falls in 1953. With the construction of Orrin Dam in 1959 and the loss of the spring salmon run the stop logs below the falls became essential to allow access to the Orrin for the grilse which replaced the lost Orrin spring salmon.

Photo courtesy Dr. D. Mills

Just above Orrin Falls there is a weir and lade which supplies a private hydro scheme at Fairburn House. The weir is made passable by a diagonal dished channel fish pass.

The mouth of the Orrin has periodically blocked with gravel and has been disturbed by commercial gravel workings. Board minutes record a history from 1950 onwards of channel clearance at the mouth of the Orrin to allow salmon access.

Rogie Falls


Photo courtesy Dr D. Mills

Rogie Falls would have been a significant barrier to salmon with only occasional fish succeeding in swimming up a diagonal cleft in the face of the falls. In 1911 Rogie Falls and the falls at Silver Bridge near Garve were blasted to improve salmon access. In 1955 as part of the Hydro construction an improved fish ladder was constructed in the bypass channel blasted alongside Rogie Falls. This pass which is a mixture of pool and overfall and roughened channel has been effective in maintaining the run of salmon to the Blackwater. The flow in the Rogie fish pass can be controlled by adding or removing stop logs in the top pool of the channel.

In 2006 a bypass culvert was installed at the Glascarnoch heck to allow smolts to exit the Glascarnoch River for the first time since scheme construction in 1955.

Corriefeol Falls

Photo courtesy Dr. D. Mills

In 1957 Dr Mills proposed the easing of Corriefeol Falls at Scardroy to open up a large expanse of excellent nursery habitat upstream. In 1959 the natural bypass channel was identified as being the most effective way of providing fish passage. This channel had a flow of water in flood conditions and in the past may well have given salmon access to the Upper Meig. The 1995 Conon DSFB habitat survey of the Conon system showed the potential of the area upstream of Corriefeol as nursery habitat and in 1998 a digger was used to reconnect the bypass-channel so that some fish could ascend but only under ideal flow conditions.

Corriefeol bypass

In 1921 falls on the Lower Meig were blasted to improve fish passage. A weekly freshet regime has been established from Meig Dam fish lift which has eased passage through the gorge below the Dam and helped fish find the entrance to the lift

Other works

Some dams on the Balnagown were eased by blasting in 1902. The 2001 habitat survey identified further works which would improve passage at weirs and culverts.

In 1966 dams at Neil's Pool and at Swordale on the Sgitheach were blasted this now gives salmon access as far as the natural falls upstream of Swordale.

A fish pass was constructed in 2003 on a distillery weir at the confluence of the Contulich and Culcraggie burns.

Contulich Fish Pass

Alness

Loch Morie Fish pass

The weirs at Loch Morie and Dalmore Distillery are both provided with fish passes which appear to be effective for both upstream and downstream passage. A poorly designed fish pass and culvert on a main tributary at Boath should be dealt with under CAR regulation.

5.6 Fishery Protection

Poaching has long been seen as a significant impact on the stocks of migratory fish in the Cromarty Firth region.
In 1895 the DAFS 'Salmon Fisheries of Scotland' Report states that because of the extent of illegal netting by Cromarty fishermen 'I Fear that the Alness will by-and-by cease to be a sea trout river.'
In 1977 George Macintosh's Superintendent's report to the Conon Board states 'This has been a very poor year for salmon, in fact they appear to be getting less every year. Everyone who owns a boat is after them. I don't think the day is far distant when the only salmon to be found will be on fish farms.'

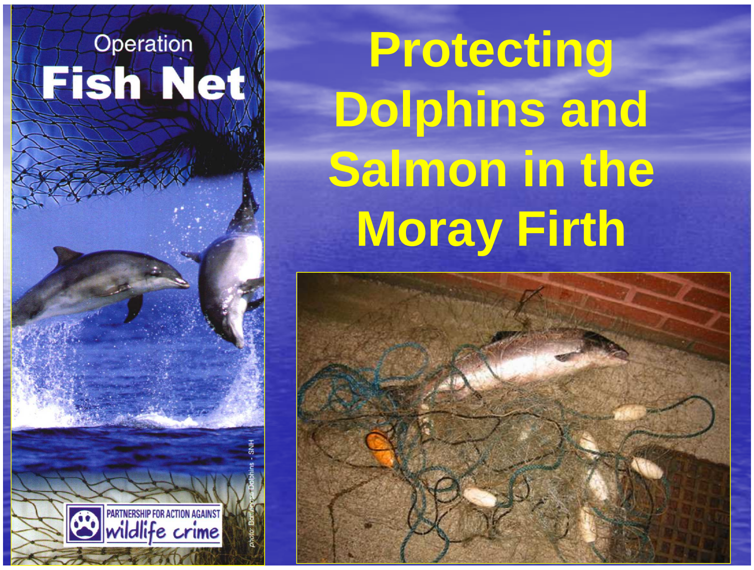
Controlling the level of illegal exploitation has been a core function of the District Salmon Fishery Board and this can be seen from the history of the Conon DSFB described in Section 4. Illegal coastal netting became an even more serious threat with the development of mono-filament gill nets which could be easily concealed and also catch large numbers of salmon. Section 4 gives a history of the war of attrition which the Conon Bailiffs have waged against costal gill netting; it sets out numbers of nets seized and prosecutions executed. It documents the level of intimidation, violence and vandalism associated with fishery protection work but not the unseen courage and determination of the Bailiffs involved.

As well as gill netting there has been a history of illegal operation of net and coble at netting stations in the Moray Firth. The DAFS 'Salmon Fisheries of Scotland' report for 1904 describes three methods in which sweep nets were being operated in the Cromarty Firth to illegally increase their efficiency by turning them into fixed engines.

This problem still exists and in recent years the Board has sent copies of current legislation, which very clearly defines the legal method of net and coble operation, to all netting proprietors. This has been backed up with warnings given to netsmen and by several successful prosecutions both in the Cromarty Firth and in joint operations with the Ness DSFB in the neighbouring firth.

During the 1990's a concerted effort was made to combat illegal gill netting. Coastal patrols were increased in frequency, collaboration and information sharing with neighbouring Boards was developed and helicopter patrols funded by the Scottish Fishery Protection Agency were used. This resulted in increased net seizures for several years and a period of confrontation with poachers. There were a number of assaults on bailiffs, damage to property and vehicles, threats of violence involving firearms and threatened poisoning of rivers.

A significant turning point in the campaign against gill netting came from the designation of the Inner Moray Firth as an SAC for bottle nosed dolphins. Entanglement in illegal gill nets was identified as a significant preventable cause of dolphin mortality. A campaign called 'Operation Fishnet' was launched to raise public awareness of the environmental damage caused by gill netting. It also gave a 'hot line' to report illegal netting. The effect of this has been to turn public opinion against illegal netting and encourage the courts to deal with poachers more rigorously treating salmon poaching as wildlife crime.



The combination of maintaining a high level of bailiffing activity on the coast in close cooperation with neighbouring Boards and maintaining a publicity campaign through Operation Fishnet has significantly reduced illegal coastal gill netting in the Cromarty Firth in recent years. This change in public attitude has been reflected in harsher sentences handed out by Sheriff Courts for poaching offences.

Training of Bailiffs has been essential to the delivery of effective fishery protection. All Bailiffs must achieve the Institute of Fisheries Management Scottish Law and Bailiffing qualification before being issued with a warrant card. Boat crew are all qualified to Royal Yachting Association Level III Inshore Powerboat standard and hold a Marine VHF Radio Operators Licence. Bailiffs also hold British Canoe Association qualifications for Kayak and Open Canoe.

Institute of Fishery Management protocols are followed to plan and execute anti-poaching patrols to maximise their effectiveness and make it difficult for criminals to predict future activity. Communications and night vision technology are routinely used.

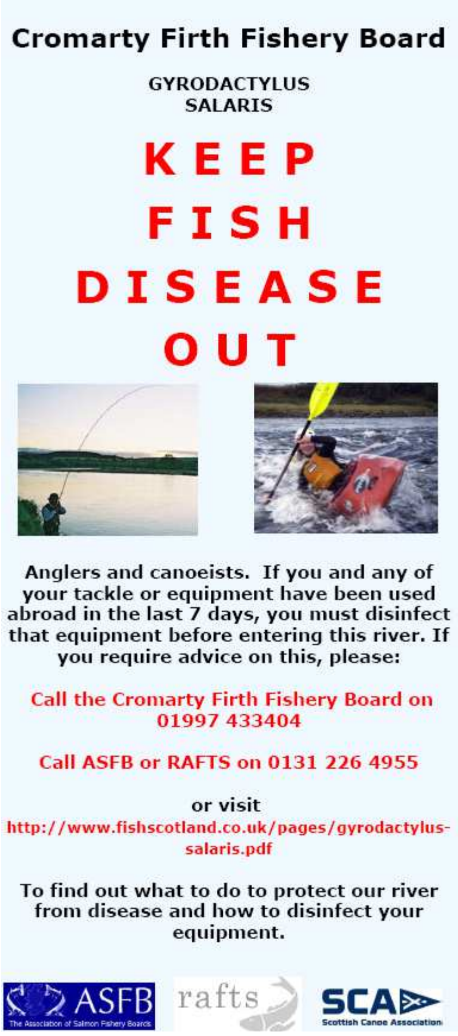
Fishery protection work is targeted at activities which present the greatest threat to fish stocks these include; poisoning and netting of rivers, illegal gill netting either from boats or shore and the illegal operation of netting stations. Rod and line offences are normally dealt with by issuing warnings in the first instance to casual offenders with the sanction of arrest and prosecution of more serious or persistent offenders.

A combination of high profile patrols and covert surveillance operations are used to deter illegal fishing and to arrest and prosecute persistent criminals. Close cooperation with neighbouring Boards and the Police is essential to effective fishery protection.

5.7 Biosecurity

As part of a national campaign to protect against the introduction and spread of *Gyrodactylus salaris* the Cromarty Firth Fishery Board has instigated a number of measures.

A publicity campaign to raise awareness is ongoing. Interviews have been given to local television, radio and press. Leaflets and posters have been distributed to angling and canoeing outlets. Information posters have been laminated and installed at access points to rivers and lochs.



In addition to the publicity campaign, anglers fishing in the area have been asked to sign a declaration form before fishing to ensure that their equipment is not infected with *Gyrodactylus salaris*.

DECLARATION BY ANGLER

A: I declare that none of my fishing equipment has been outside the United Kingdom in the prior three months to the commencement of my fishing within the Conon District Salmon Fishery Board catchment area on ____________________ (*insert date*).

Signed: .... Print Name: ....
Fishing Owner or Fishing Tenant

B: I declare that my fishing equipment **has** been used outside the United Kingdom in the three months prior to the commencement of my fishing within the Conon District Salmon Fishery Board catchment area on ____________________ (*insert date*) and that is has been property sterilised adopting one of the following methods (*please tick one of the following*):

	Please Tick
Method A: Drying to a minimum of 20°C for at least two days	
Method B: Heating to above 60°C for at least one hour	
Method C: Deep freezing for at least one day	
Method D: Immersion of materials in a solution of, or addition of one of the following chemicals to water to the concentration indicated for a **minimum** of 10 minutes:	
VIlkon 1%	
Wescodyne 1%	
Sodium Chloride (common salt) 3%	
Sodum Hydroxide O.2%	

NB: The chemicals above may be available from agricultural chemical suppliers. The use of trade names is for illustrative purposes only and does not imply endorsement of any particular product. Users should check that their use does not damage their equipment.

Signed: .... Print Name: ....
Fishing Owner or Fishing Tenant

C: I declare that my fishing equipment has been used outside the United Kingdom in the three months prior to the commencement of my fishing within the Conon District Salmon Fishery Board catchment area on ____________________ (*insert date*), and has NOT been sterilised.

I agree that it will be sterilised by the fishery proprietors before I commence fishing and I understand that this may result in a delay in the start of my fishing.

Signed: .... Print Name: ....
Fishing Owner or Fishing Tenant

Fishery Board staff are routinely disinfecting equipment when electro-fishing between catchments.

Section 6. Assessment of issues and impacts

Issues and impacts on fish stocks and management of stocks ranked by frequency

Issue				Management units									no. units
	1.1	1.2	1.3	1.4	1.5	2	3	4	5	6	7	8	
Obstructions	*	*	*	*	*	*	*	*	*	*	*	*	12
status of non salmonid fish species	*	*	*	*	*	*	*	*	*	*	*	*	12
Climate change	*	*	*	*	*	*	*	*	*	*	*	*	12
Biosecurity	*	*	*	*	*	*	*	*	*	*	*	*	12
unknown genetic status of stocks	*	*	*	*	*	*	*	*	*	*	*	*	12
Channel modification	*		*	*	*	*	*	*	*	*	*	*	11
Alien plant species	*			*	*	*	*	*	*	*	*	*	10
Exploitation (illegal)	*			*	*	*	*	*	*	*	*	*	10
commercial forestry			*	*	*	*	*	*	*	*	*		9
Riparian overgrazing /erosion		*	*	*	*	*	*	*	*		*		9
Unknown status of sea trout	*				*	*	*	*	*	*	*	*	9
Info on still waters/hill lochs		*	*	*	*	*	*	*	*				8
Predation	*	*	*	*	*	*				*			7
Exploitation (legal)	*				*	*	*	*	*				6
Flow regulation	*	*	*	*	*	*							6
Monitoring Lge water bodies	*	*	*	*	*	*							6
agricultural run off / sedimentation							*		*	*	*	*	5
Cultural oligotrophication		*	*	*	*	*							5
Water quality	*						*		*	*		*	5
Abstraction				*		*	*					*	4
Alien animal species	*			*	*					*		*	4
mixing of flows		*	*	*	*								4
Sediment transfer	*		*	*	*								4
Unknown adult salmon abundance						*	*	*	*				4
Smolt loss	*	*				*							3
Aquaculture	*			*									2
other recreational use	*					*							2
Trout stocking			*	*									2

More details of each pressure and impact are listed below by management unit.

6.1 General non-site specific issues

6.1.1 Climate change.

A Scotland and Northern Ireland Forum for Environmental Research (SNIFFER) 2006 publication 'A Handbook of Climate Trends across Scotland' examined climate trends in the last century which are described in Section 5 of this plan.

These trends predict impacts on the freshwater environment which are summarised in the SNIFFER report and are shown below.

Climate Change in Scotland - Predicted Impacts and their relevance to water

.1 Temperatures in Scotland may rise by up to 4°C by the end of the century, with consequences including milder and wetter winters, hotter and drier summers, more extreme weather events and rising sea levels.

.2 *Climate Change Scenarios for the United Kingdom: The UKCIP02 Scientific Report* presents four climate change scenarios. UKCIP02 predicts a number of impacts that may occur in the UK by 2080. The key findings of this work suggest:

- 1.5 to 2°C warmer in winter; up to 3.5°C warmer in summer; and possibly 4°C warmer in autumn. Summers will suffer some significant heat waves.
- Milder temperatures in winter will result in wetter conditions, with extremes of rainfall leading to serious flooding events.
- Precipitation will increase by over 30% in the east of the country and up to 20% in the west during the winter season. Conversely, summer rainfall will be around 40% less, particularly in the south and east of Scotland.
- Daily winter rainfall will increase by at least 20% for storms that normally occur only once every two years.
- Summer cloud cover will decrease by 10%, with a slight increase in winter cloud cover.
- Daily average wind speed is not likely to change significantly, although it could be up to 3% higher, particularly in the north west of Scotland. Meanwhile, the two year daily mean average wind speed could be up to 4% higher. If this increase applies to storm gusts, considerably more damage to infrastructure will be inevitable.
- Snowfall across much of Scotland will decrease by over 90%.

- Sea level will rise by approximately 60cm around Scotland's coastline and storm surges could be up to 0.7m higher, resulting in higher risks of coastal flooding.
- Sea surface temperature will be $1^{\circ}C$ to $2.5^{\circ}C$ warmer; the greatest increase being off South East Scotland.
- The frequency of high impact weather events will increase with rising average global temperature.

7.2.3 Flooding - It is likely that with increased average rainfall, increased rainfall intensity and prolonged periods of rain, more frequent and more severe river flooding will occur. It is estimated that this may affect more than 70,000 properties, many of which are concentrated within particular areas of risk. In addition, with higher sea levels and increased wave height, it is predicted that coastal flooding in Scotland will become both more frequent and more severe. It is predicted that a further 30,000 properties could be at risk from this source of flooding. Flooding can have very significant effects on property, businesses and agriculture and can be a risk to life.

7.2.4 Droughts – Long term predictions are for an increased likelihood of summer droughts. While the observed impacts in Scotland have not borne this prediction out, if realised, this could result in river water quality problems (caused by lack of flow), limitations on abstraction of water (particularly for agricultural use) and even possible problems with water supply.

7.2.5 Water quality – Increased flood events and the potential for summer time droughts may result in water quality issues that need to be addressed. For example, reduced river flows during drought periods will provide less dilution for aquatic discharges which may increase pollution risk. Reduced river flows may also affect abstraction for drinking water or for commercial use. Conversely, increased flooding may increase run off of pollutants, for example from agricultural land, into waterbodies and which may affect their status – eg agricultural run off impacting on bathing water quality.

7.2.6 The marine environment – It is predicted that sea levels will rise, that there may be increased wave heights (particularly during storms) and that sea temperatures around Scotland will rise. While the consequences of these are difficult to predict, it is possible that greater coastal erosion will result from higher sea levels and wave heights. This in turn may lead to habitat loss on land. In the marine environment, increased sea temperature may result in changes to the distribution and abundance of marine biodiversity. This may result in the increase of some species and the decrease or even loss of others (with warmer water species replacing colder water species). This may in turn affect other species – e.g. the recent poor breeding of Scottish Island seabirds. Changes in marine species may also affect economic activities such as commercial fisheries.

7.2.7 Aquatic Biodiversity - Climate change predictions for the UK suggest that as the environment changes, biodiversity will be significantly affected. It is still not exactly clear how biodiversity in Scotland will be affected or how species will adapt to climate change, but it is suggested that there will be the potential for:

- Changes in the abundance and distribution of species;
- Changes in the length of growing and breeding seasons;
- Higher temperatures to be less favourable for native species, while new species may appear. New species may compete with native species for food and habitat;
- High intensity rainfall and flooding to cause destruction to river habitat
- Increased erosion resulting in loss of habitat
- Disruption to food chain with potential catastrophic loss of species (e.g. island breeding sea bird populations)

These predicted changes would inevitably have consequences for freshwater fisheries.
There is likely to be more variation in marine survival, run timing and condition of salmon / sea trout.
There are likely to be more frequent and damaging extremes of flow and temperature.
There may be accelerated freshwater growth and changes in carrying capacity.
Changing conditions may favour some non salmonid species.

These factors all increase the importance of monitoring to inform management, this is much more important in a changing environment than a stable one.

The safe and stable hatchery incubation environment will give some mitigation for winter flooding and redd washout in the areas dependent on stocking.

6.1.2 Biosecurity

There is a need to develop a biosecurity policy for the region and to coordinate with national policy and initiatives.

There is a particular risk of the introduction of Gyrodactylus salaris which has destroyed salmon stocks in more than 20 Norwegian rivers. There are national and European measures in place to prevent the introduction of GS. These measures need to be reinforced by local actions which will not only help prevent introduction but reduce the risk of spread, should GS be introduced to the UK. A series of measures were agreed by RAFTS and ASFB in 2007 and have been acted upon locally. The list of agreed actions is shown below.

Recommendation	Action	Review	Timetable
Awareness Raising			
Posters/leaflets - Highly visible literature (posters/leaflets etc) should be provided at points of entry to the river requesting that all angling equipment be disinfected or evidence provided that it has been.	**ASFB** to circulate new leaflets to all Boards/Trusts. These should then be circulated locally by **Boards/Trusts.**	Annual	Material to be disseminated **by end April 2007**
Signage at rivers – Generic signage will be developed by ASFB and made available to all Boards and trusts. These should be placed at logical access points on each river. These should be relevant to other water users as well as anglers.	**ASFB to co-ordinate the design and circulation of relevant notices, and circulate these to all Boards/Trusts.**	End 2007	Aim to have these designed and circulated by **Summer 2007.**
Local Seminars – FRS have indicated that staff would be available to make presentations to rivers on a regional basis to provide more detailed information on Gs. This has already been conducted on the Dee and it is proposed to roll these out across the country. These should be planned around existing river 'events', so if you have an AGM or other event planned, these could built around these dates. Possible regions could be: **Tweed/Forth** (co-operate closely with RTC/Tweed Foundation) **Tay/Esks** (Tay/Esk DSFB involvement) **Dee** - already done in 2007 **Moray Firth** **Caithness and North Coast** rivers **North West Coast** including the Isles **Lochaber & Argyll** **Clyde & Ayrshire** **Dumfries & Galloway** **These are not definitive and the groupings**	**All Boards/Trusts** to consider now dates and venues for coordinated seminar/presentation. Boards/Trusts to flag up key events/meetings during 2007 at which such a presentation could be made – **dates to be passed to ASFB** who will liaise with FRS and assist Boards/Trusts in each area.	Annual	Events to be organised **during 2007**

could reflect local circumstances			
Preventative measures			
Declaration forms – A short clear generic declaration/information form is developed for universal use throughout Scotland. It should contain a few clear statements, concise information about GS and information about disinfection procedures and facilities. A proforma form is attached for this purpose – this could be adapted to suit local needs. We do appreciate that most declaration systems rely on there being a member of staff at the fishery (usually a ghillie) to ensure the form has been signed. Given the inability to legally enforce a declaration process and given the complexity of arrangements for access to fisheries around Scotland, the intention of this recommendation is to establish a formal, widely understood generic procedure that, though voluntary, would become an accepted part of taking fishing in Scotland. We acknowledge that such procedures would not be foolproof or easily enforceable. They could be circumnavigated and may, in some circumstances, be logistically difficult to apply but it is clear that an organised and effective attempt could be made to implementing such procedures.	**Boards to circulate forms** to all proprietors and tenants and ask them to ensure anglers complete and sign the appropriate declaration form before fishing.	Annual	Forms to be circulated to all proprietors/tenants **by end April**
Treatment facilities – as above, we appreciate that there will be logistical issues in many areas associated with providing a facility for disinfection, drying or other treating of clothing and tackle should an angler fall into a 'risk' category. The facility need not be complex or costly, however, and the requisite fluids could be placed at manned sites on those rivers that use ghillies, boatmen or guides, or Association and syndicate waters that have access to a hut.	**All Boards/Trusts** to consider promoting the use of treatment/drying facilities within their district. All proprietors and tenants should be contacted about the viability of this.	Annual	**During 2007**
Biologists & researchers – due to the roving nature of biologists across different catchments (often within the same district), it is essential that appropriate measures are taken to ensure equipment such as clothing, electro-fishing kit, nets etc poses no risk in use. All equipment should be treated as per the guidelines after use.	**All Boards & Trusts to provide clear advice to research staff regarding drying/treatment of equipment.**	Annual	**By end April**
General			
Audit of effectiveness – The ASFB & RAFTS will establish a review process at the end of each year to establish how effectively the above measures have been considered and implemented.	**ASFB/RAFTS to provide a checklist for members at end of each year and actions will be**	Annual	**November 2007**

	reviewed at meeting of Council each February.		
Catchment characteristics – The Gs Task Force Report asked that a detailed list of catchments should be developed and maintained with respect to: *The joining of separate water catchments through brackish or estuarine water conditions which could allow the spread of Gs between such catchments.* *The joining of catchments through water movements conducted for whatever reason – e.g. Hydro electricity, canals, water abstractions etc.* An example of this work is contained in the Contingency Plan and this was undertaken by the Dee District Salmon Fishery Board. The inventory produced by the Dee Board contains the following information: ***River Dee Catchment Characteristics*** ***1. Flow Information*** ***2.Length of Main Stem and Major Tributaries*** ***3. Location and Size of Lochs*** ***4. Presence of Water Abstraction / Transfer Sites*** ***5. Location of Weirs and Fish Passes*** ***6. Type/watercourse/grid ref/weir height (m)/comment*** ***7. Presence / Absence of Fish Fauna*** ***8. Relevant Designations (ie SACs/SSSIs etc)*** ***9. Presence / Absence of Fish Farming*** ***10. Angling Information*** ***11. Presence / Absence of Wild Fish Hatcheries*** ***12. Levels of Monitoring (electro-fishing/fish counters/other)*** ***13. Recreational Activities, ie canoeing,rowing,sailing.coarse fishing, game fishing*** ***14. Relevant Agencies on the Dee Catchment*** ***15. Length of Each Watercourse*** ***16. Abstraction points for potable water in the catchment.*** Much of this information will be held already by Boards and Trusts and it is recommended that all organisations should have such an inventory for future contingency. Producing this inventory should not be too much of an onerous task. The inventory produced by the Dee Board will be made available to a Board who requires more detail.	**Boards, in liaison with Trusts, to compile inventory of catchment characteristics. ASFB will provide Dee example for guidance.**	Annual	**November 2007**

There are also other diseases and pathogens which could be introduced to the region.
Whilst there is a risk of introductions by equipment used by anglers and watersports enthusiasts, the biggest risk of the introduction of GS and other fish pathogens is by the movement of live fish.
New legislation will for the first time give some control over the movement of live fish within Scotland. The enforcement of this legislation will be a new challenge for the Board and close cooperation with FRS, the police and fishery owners will be required.

6.1.3 Adequacy of information to make management decisions.
There is a lack of information and of data collection tools for; stillwaters, large rivers and non-salmonids. See Section 10 for details.

6.1.4 Training of staff

The Board and Trust must deliver a wide range of actions (set out in Section 9) to deliver effective fishery management in the region. The decision making process leading up to these actions must be based on the best scientific data available and the effects of these actions should then be monitored. The actions carried out by the Board and Trust must comply with current legislation and best practice. The range of activities carried out by the Board and Trust and the small number of staff employed mean that staff must be multi-skilled. So that Bailiffs can assist with electro-fishing, tagging, hatchery work and other aspects of research and management.

Because of the extensive legal powers given to Bailiffs and the risks involved in fishery protection work a high level of training is required. Bailiffs must pass the Institute of Fishery Management Bailiffing and Scottish Law examinations before being issued with a warrant card. It is also important that bailiffs are trained to an adequate standard in boat handling and first aid.

Bailiffs involved in electro-fishing should be trained to the standards developed by the SFCC and delivered through SVQ II and SVQ III, this not only meets health & safety requirements but ensures that the data gathered is reliable and of a recognised standard.

In recent years the ASFB working with IFM and Lantra has helped to develop SVQ II & III qualifications in Fishery Management. These qualifications are designed to be appropriate for Bailiffs, and Head Bailiffs. The requirements for SVQ IV have been outlined and this would be designed for mangers of Boards and Trusts.

An area of training which has yet to be addressed is in the voluntary sector. In other areas of countryside management and wildlife conservation extensive use of volunteers has been made. There has been some use of volunteers from local angling clubs over the years with positive results. With a better provision for training much more use could be made of volunteers. This would be of benefit to volunteers and would allow extra projects to be undertaken and existing projects to be expanded.

6.1.5 Resourcing

There is a need to find new sources of funding and increased partnership working to deal with the large land management issues highlighted below.

The need to manage all species of fish and habitats has resource implications even for the most basic monitoring of non salmonid species. The management of migratory fish stocks has been supported by the Fishery Board assessment levied on salmon proprietors. This source of funding should continue to be used for the management of migratory fish but other sources of funding must be found to manage other species.

Sources of funding for training both of Board staff and volunteers need to be found.

6.2 Issues by management unit (ranked in order of importance in table at the end of section but not within management unit)

6.2.1 Conon Main stem

Predation	Pike
	Perch
	Sawbilled Ducks
	Seals
	Mink
	Trout predation on smolts at obstacles to migration
	Otter predation at obstacles to migration
Exploitation	Rod & line
	Coastal netting
	Estuary Netting
	Poaching
Flow Regulation	Rapidly changing levels on Upper Conon which expose river bed
	Glen Marksie
	Compaction
Obstructions To migration	Cumulative effect of obstacles
	Tor Achilty Dam (upstream & downstream)
	Conon Falls
	Luichart Dam
	Distillery weir
	Glen Marksie
Alien species	Mink
	Himalayan Balsam
	Rhododendron
	Gyrodactylus salaris
	American signal crayfish
Water quality	Marybank & Strathpeffer sewage outfalls
Channel Modification	Floodbanks
	Croys
	Weirs

Lack of sediment transfer

Difficulty of monitoring stocks in large water bodies

Other recreational use

Aquaculture	Orrin trout farm
	Presence of fish farm sites in Cromarty Firth

Lack of information on status of sea trout stocks.
Limited information on status of Eels, lampreys & other fish species

6.2.1.2 Bran

Access — Luichart
Achanalt Falls
Achanalt Barrage
Inappropriate road culverts

Predation — Sawbilled ducks
Pike / perch
Trout & otter predation at obstacles to migration

Smolt loss at Achanalt Barrage

Riparian habitat
Degradation — Overgrazing by livestock
Overgrazing by deer
Loss of riparian woodland

Bankside erosion

Cultural oligotrophication

Mixing of flows between tributaries

Flow regulation

Genetic status of salmon stocks

Unknown status of brown trout in hill lochs

Limited information on status of Eels & other fish species

Alien species — Mink
Gyrodactylus salaris
American signal crayfish

6.2.1.3 Meig

Access — Corriefeol
Lower Meig obstructions
Meig Dam

Predation	Sawbilled ducks Trout & otter predation at obstacles to migration
Commercial Forestry	Glen Meinnich
Sediment Transfer	Lower Meig
Riparian Degradation	Overgrazing of Upper Meig
Channel Modifications	Lower Meig
Flow Regulation	
Mixing of Flows	homing

Lack of knowledge of stock structure / genetic status

Cultural Oligotrophication

Unknown status of brown trout in hill lochs

Limited information on status of Eels & other fish species

Alien species	Mink Gyrodactylus salaris American signal crayfish

Stocking with trout from outside catchment.

6.2.1.4 Orrin

Access	Orrin Falls Orrin Dam

Abstraction	Orrin Trout Farm Fairburn hydro scheme
Loss of Sediment Transfer	Lack of spawning habitat

Flow regulation

Flash flooding of Aultgowrie Burn

Riparian Degradation	Overgrazing of Upper Orrin
Channel Modifications	Orrin Trout farm
Predation	Sawbilled ducks Trout & otter at obstacles to migration
Mixing of Flows	homing

Lack of knowledge of stock structure / genetic status

Cultural Oligotrophication

Overgrazing of upper catchment

Alien species	Mink Himalayan Balsam Rhododendron. Gyrodactylus salaris American signal crayfish

Unknown status of brown trout in hill lochs

Limited information on status of Eels & other fish species

Presence of commercial trout farm and stillwater fishery.

6.2.1.5 Blackwater

Access	Rogie Falls
Predation	Sawbilled ducks

	Pike / perch
Commercial Forestry	pH problems on burns draining Ben Wyvis
Sediment Transfer	Glascarnoch Vaich
Riparian Degradation	Overgrazing of tributaries
Exploitation	Rod & line poaching
Channel Modifications	Bank protection Angling croys
Flow Regulation	Glascarnoch Vaich Rannoch
Mixing of Flows	homing

Cultural Oligotrophication

Alien species	Alien plant species mink Gyrodactylus salaris American signal crayfish

Unknown salmon population structure genetic mapping.

Unknown status of brown trout in hill lochs

Limited information on status of Eels & other fish species

6.2.2 Alness

Access	Allt na Seasgaich Culvert Alness weir & fish pass

	Loch Morie weir & fish pass Difficult passage upstream of Loch Morie
Channel Modification	Croys / pool creation
Abstraction	Distillery intake & screening
Predation	Seals Sawbilled ducks
Exploitation	In river poaching Rod & line Marine & estuary poaching
Forestry	Burns above Loch Morie Blackwater
Upper catchment Riparian Degradation	Overgrazing loss of riparian woodland
Alien species	Unknown distribution of alien plant species Gyrodactylus salaris American signal crayfish Mink

Unknown population dynamics for salmon, lack of upstream fish counting in either lower or upper catchments, lack of smolt production data.

Unknown genetic status of salmon stocks

Unknown number of returning adult salmon

Unknown status & distribution of sea trout stocks

Unknown status of brown trout in river and hill lochs

Limited knowledge of distribution & status of eels, lampreys & other fish species

Lack of spawning habitat & resting pools Abhainn na Glasa

Cultural oligotrophication of upper catchment.

6.2.3. Allt Graad

Access	Black Rock Gorge Culverts on four tributaries limit trout movement

Water quality	Poisoning events
Abstraction	Proposed hydro development Scottish water abstraction.
Channel Modification	Pool construction in lower river
Forestry	Allt Calice
Sedimentation	Associated with forestry

Flooding
Erosion

Unknown genetic status of salmon population

Unknown number of returning adult salmon

Unknown distribution of trout and other species in stillwaters & hill lochs.

Exploitation	Rod & line In river poaching Estuary & marine netting

6.2.4 Balnagown

Exploitation

Rod & line
In river poaching

	Estuary & marine netting
Forestry	Large scale of catchment afforested. Siltation Drying out of some tributaries
Degraded Riparian Zone	Above Strathrory Loss of riparian woodland / overgrazing
Access	Weirs at T 18 & T 23 with inadequate fish passage Forestry debris blocking some tributaries Culverts at T 97 on Balnagown, Kinrive & Larack Burn Lack of holding pools in upper catchment

Unknown status of salmon & sea trout stocks.
(does loch Sheilah still have a significant sea trout population)

Lack of information on distribution of non salmonids.

6.2.5 Sgitheach

Access	Falls at T18 limit migratory fish to lower reaches

Forestry	Large proportion of catchment afforested sediment / drainage issues
Upland Degradation	Overgrazing, loss of riparian woodland in upper catchment
Alien species	Invasive plants? Mink? Gyrodactylus salaris Signal Crayfish
Exploitation	Rod & line In river poaching Estuary & marine netting
Diffuse Pollution	Agricultural run off
Point Pollution	Septic tank discharges
Channel Modification	Channel straightening / roadside drainage on tributaries.

Limited data on status of all fish stocks

6.2.6 Peffery

Channel Modification	Canalised and bed degraded over lower & middle reaches by arterial drainage.

Access	Weir in Dingwall SEPA weir at Strathpeffer STW
Forestry	Large part of catchment afforested, sensitive geology- ph / siltation issues.

Loss of sea trout stocks in recent years

Point pollution	Strathpeffer STW
Diffuse Pollution	Forestry / agricultural run off. Storm drains / road run off.
Alien species	Mink Alien plant species Japanese Knotweed Himalayan balsam Gyrodactylus salaris Signal crayfish

6.2.7 Newhall Burn

Diffuse pollution	Agriculture /forestry Siltation from field drainage

	Forestry drainage
Forestry	Non FWG compliant forestry
Channel modification	Straightening & arterial drainage
Access	Forestry log jams Braelangwell culvert
Exploitation	Estuary / marine netting
Alien species	Invasive plant species?
Overgrazing	Stock access

6.2.8 Coastal Burns

Access	Contulich / Culcraggie fish pass

	Weirs Road culverts
Diffuse pollution	Agricultural run off / sedimentation
Abstraction	
Point pollution	
Channel modifications	Dredging & straightening
Alien Species	Invasive plant species?

Issues ranked by importance to fisheries

Issue / impact				Management units impacted						

	1.1	1.2	1.3	1.4	1.5	2	3	4	5	6	7	8
Obstructions	*	*	*	*	*	*	*	*	*	*	*	*
Climate change	*	*	*	*	*	*	*	*	*	*	*	*
Biosecurity	*	*	*	*	*	*	*	*	*	*	*	*
Exploitation (illegal)	*			*	*	*	*	*	*	*	*	*
Predation	*	*	*	*	*	*	*			*		
Exploitation (legal)	*				*	*	*	*	*			
unknown genetic status of stocks	*	*	*	*	*	*	*	*	*	*	*	*
Channel modification	*		*	*	*	*	*	*	*	*	*	*
commercial forestry			*	*	*	*	*	*	*	*	*	
Riparian overgrazing /erosion		*	*	*	*	*	*	*	*		*	
Cultural oligotrophication		*	*	*	*	*						
status of other fish species	*	*	*	*	*	*	*	*	*	*	*	*
Alien plant species	*			*	*	*	*	*	*	*	*	*
Unknown number of returning salmon						*	*	*	*			
status of sea trout	*				*	*	*	*	*	*	*	*
Flow regulation	*	*	*	*	*	*						
agricultural run off / sedimentation							*		*	*	*	*
Sediment transfer	*		*	*	*							
Smolt loss	*	*				*						
Info on still waters/hill lochs		*	*	*	*	*	*	*	*			
Trout stocking			*	*								
Monitoring Lg water bodies	*	*	*	*	*	*						
Alien animal species	*			*	*					*		*
mixing of flows		*	*	*	*							
Water quality	*						*		*	*		*
Abstraction				*		*	*					*
Aquaculture	*			*								
other recreational use	*					*						

Issues / impacts ranked by importance and nature of impact.

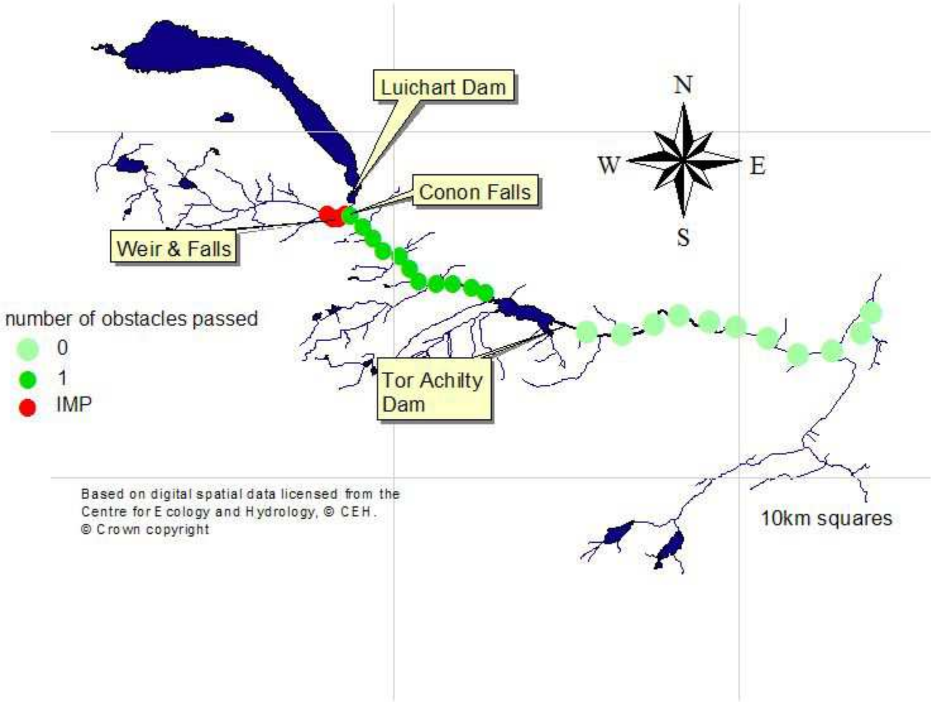
Issue / impact				Management units							

	1.1	1.2	1.3	1.4	1.5	2	3	4	5	6	7	8
Obstructions	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH
Climate change	E	E	E	E	E	E	E	E	E	E	E	E
Biosecurity	E	E	E	E	E	E	E	E	E	E	E	E
Exploitation (illegal)	EHE			EHE	EHE	EHE	EHE	EHE	EHE	EHE	EHE	EHE
Predation	CH	CH	CH	CH	CH	CH	CH			CH		
Exploitation (legal)	CH				CH	CH	CH	CH	CH			
unknown genetic status of stocks	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH
Channel modification	CH		CH	CH	CH	CH	CH	CH	CH	CH	CH	CH
commercial forestry			CH	CH	CH	CH	CH	CH	CH	CH	CH	
Riparian overgrazing /erosion		CH	CH	CH	CH	CH	CH	CH	CH		CH	
Cultural oligotrophication		CH	CH	CH	CH	CH						
Status of other fish species	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH
Alien plant species	EHE			EHE	EHE	EHE	EHE	EHE	EHE	EHE	EHE	EHE
Unknown number of returning salmon						CH	CH	CH	CH			
Status of sea trout	CH				CH	CH	CH	CH	CH	CH	CH	CH
Flow regulation	CH	CH	CH	CH	CH	CH						
agricultural run off / sedimentation							CHE		CHE	CHE	CHE	CHE
Sediment transfer	CH		CH	CH	CH							
Smolt loss	EHE	EHE				EHE						
Info on still waters/hill lochs		CH	CH	CH	CH	CH	C	CH	C			
Trout stocking			EHE	EHE								
Monitoring Lg water bodies	EHE	EHE	EHE	EHE	EHE	EHE						
Alien animal species	EE			EE	EE					EE		EE
mixing of flows		CH	CH	CH	CH							
Water quality	EHE						EHE		EHE	EHE		EHE
Abstraction				CHE		EHE	CHE					EHE
Aquaculture	EHE			EHE								
Other recreational use	EE					EE						

CH Chronic historical
EHE Episodic historical & emerging
CHE Chronic historical & emerging
EE Episodic & emerging

6.3 Obstacles to Migration

Conon Obstacles

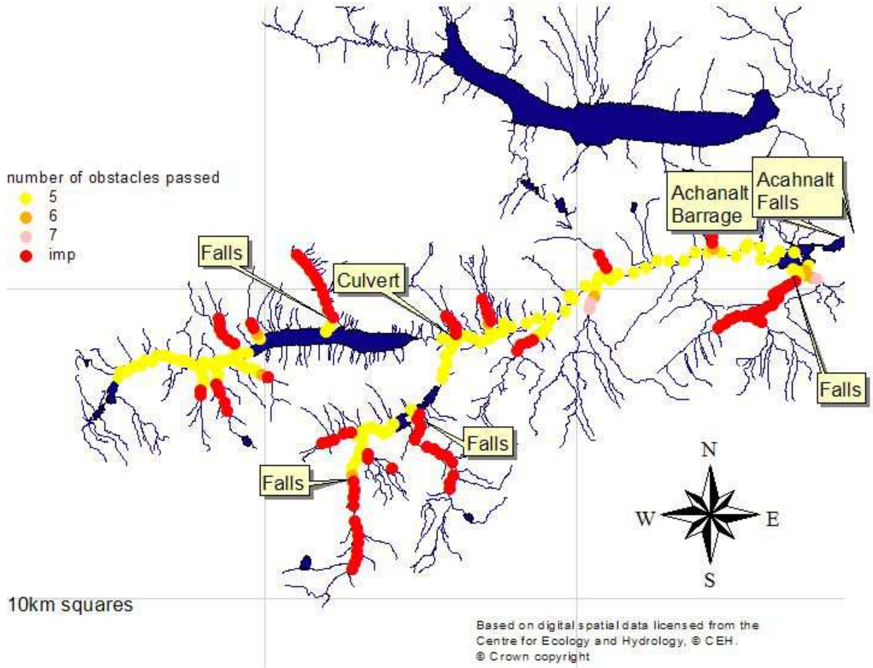


The lowest significant obstacle in the Conon is Tor Achilty Dam. Tor Achilty has a Borland lift to provide fish passage. The main impact on adult fish is an increase in predation, particularly by otters, when fish are delayed and congregate below the dam. Smolts passing downstream are vulnerable to avian and fish predators, either when delayed above the dam or disorientated after passing through the turbines. Migrating silver eels are at risk of damage when passing through the turbines.

At Conon Falls the fish pass is a mixture of boulder strewn semi-natural sections and formed concrete fish ladder. A variety of flows are required to allow passage through the different sections of the pass.

At Luichart Dam a Borland Lift allows access upstream but the siting of the top gate away from the dam wall restricts its ability to pass fish downstream. In the past fish have been trapped below Luichart Dam when water has been released from the ground sluice. New operating procedures and structures built by SSE have reduced this risk.
Access to and from Glen Marksie Burn is barred by a weir and pipeline which diverts the flow of the burn into Loch Luichart.

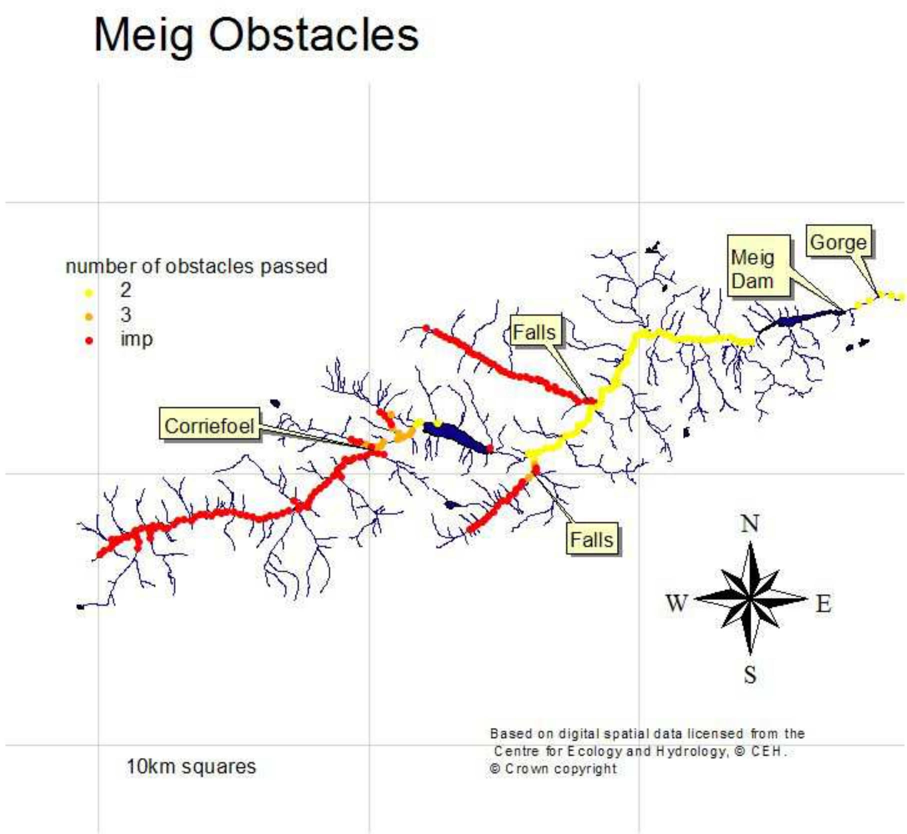
Bran obstacles



The fish ladder at Achanalt was modified as a result of radio-tracking work to improve its performance. There is still an increased risk of predation by otters and of poaching below the ladder. The small Borland Lift in the centre of Achanalt Barrage may allow some fish to pass upstream but it is equally likely that fish will pass under the Barrage gates which are opened even after moderate rainfall.

The Barrage has a Wolf trap attached to it to allow the capture and transport of smolts past Luichart Dam. Rainfall during the smolt run often results in the Barrage being opened, which results in a loss of smolts downstream.

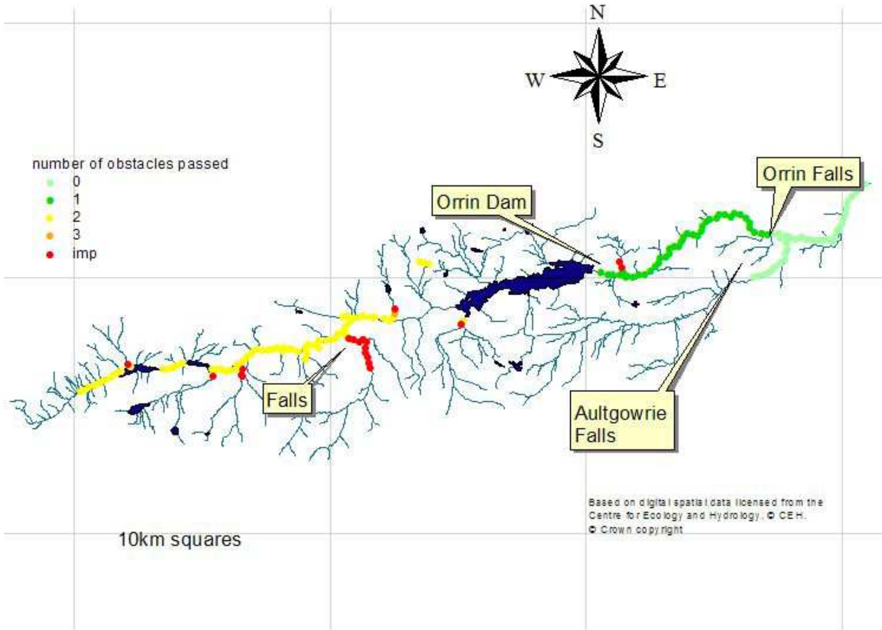
Fish have access to the lower reaches of most Bran tributaries but as the gradient of the valley sides increases waterfalls restrict access upstream. Unsympathetic culvert construction along the road from Achnasheen to the west restricts access to a number of burns.



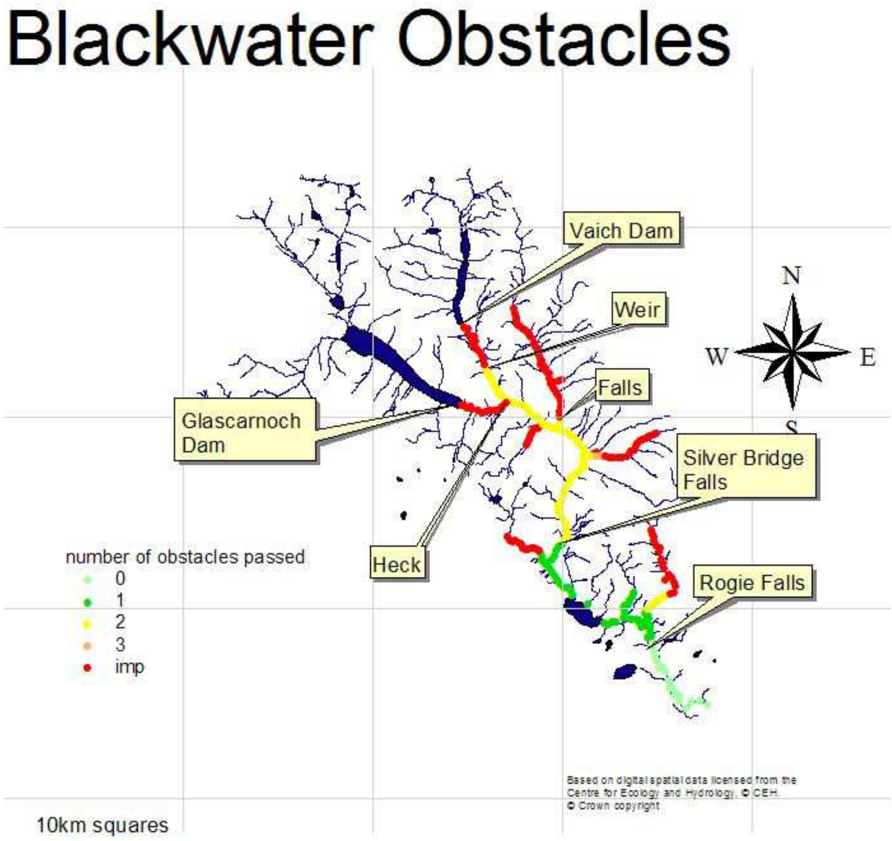
Fish have access too and from Loch Meig by a Borland Lift in Meig Dam. An improved flow regime assists fish in passing through the gorge below Meig Dam and reduces the risk of them being delayed below the dam, where they are vulnerable to predation and poaching.

Falls low down on the two largest tributaries; Glen Meinnich and Glen Chorainn restrict access for migratory fish. The fall at Corriefeol is by-passed by a semi-natural channel which allows some fish to access the large area of good habitat upstream.

Orrin obstacles



Orrin Falls is a significant obstacle to migrating fish; fish congregating below the falls are vulnerable to poaching and predation. At present the operation of a private hydro scheme restricts fish passage for four days a week. Migratory fish are excluded from most of the Aultgowrie Burn by a large waterfall. Orrin Dam is an important obstacle to upstream and downstream migration. The large area of excellent habitat upstream of Orrin Dam makes the improvement of access a high priority. Upstream of Orrin Dam migratory fish have good access to and from the headwaters.

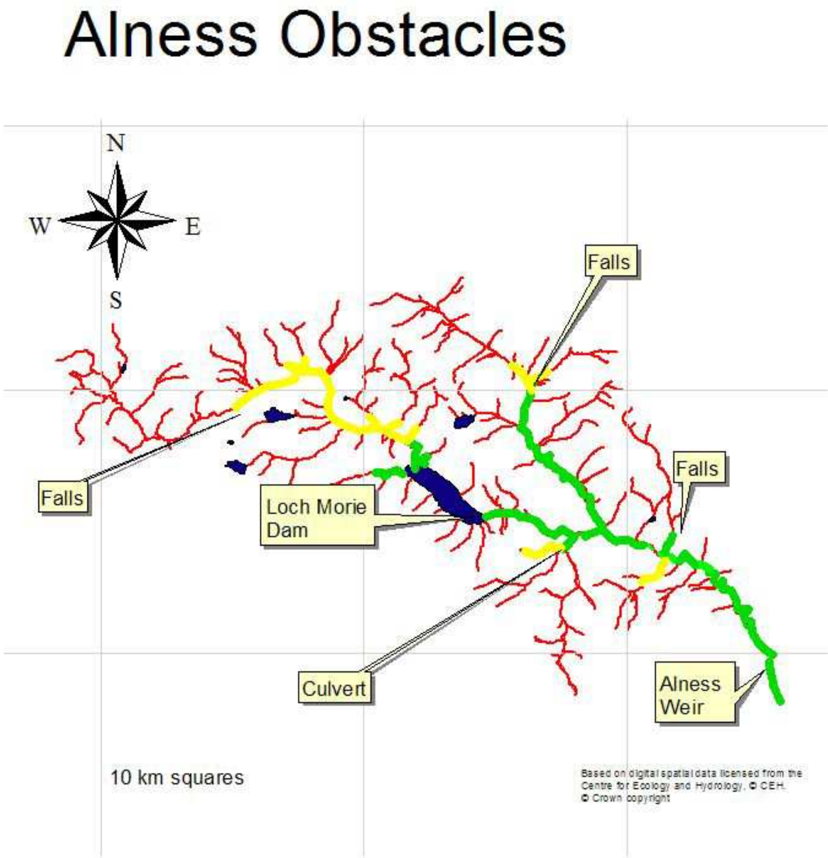


The fish ladder at Rogie is well designed and allows fish to ascend at a wide range of flows. However in very low flows Rogie Falls can delay migrating salmon and the pools downstream are especially vulnerable to poaching. Glascarnoch and Vaich Dams have no provision for fish passage and cut off the headwaters of the system. A weir constructed in Strath Vaich restricts trout movement but also modifies habitats upstream and could be removed as it no longer fulfils a function.

The Heck below Glascarnoch is designed to prevent fish accessing the Glascarnoch River which does not have a compensation flow agreement.

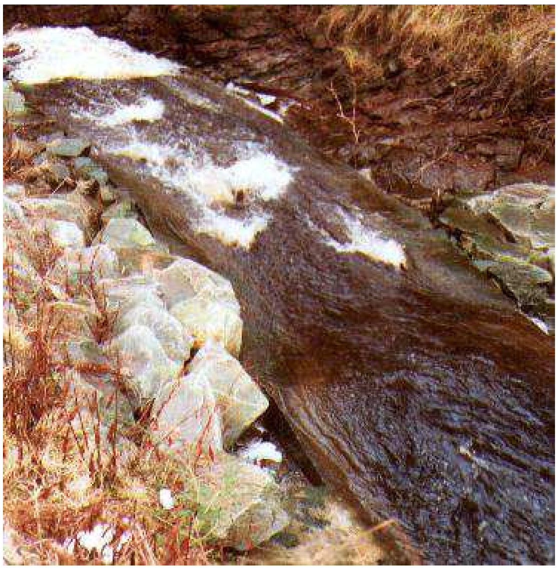
The falls at Silver Bridge are a significant obstacle and often prevent fish released after stripping operations have finished at Loch na Croic from passing upstream.

The Heck at Loch na Croic prevents fish from passing upstream until the broodstock for the hatchery has been collected. The flow regime upstream of Loch na Croic was not considered at the time of hydro construction to be suitable to support adult salmon. In years when large numbers of salmon were released above Loch na Croic fish congregated at Silver Bridge and many were lost to furunculosis and systematic poaching.



The Alness is less restricted by obstacles than its neighbouring rivers. The Weir at Alness and the Loch Morie Dam both have effective fish passes, although there is a perennial problem of poaching below Alness Weir in low water conditions. Migratory fish have access to excellent habitat in the lower and middle reaches of the Blackwater, with a series of falls restricting access to the headwaters particularly in a dry year.

Allt na Seasgaich is an important spawning tributary of the Lower Alness. Sea trout as well as salmon are reported as having spawned in the burn. Broodstock collection from the main river at the mouth of Allt na Seasgaich in recent years has produced good numbers of sea trout as well as salmon. Highland Regional Council installed a culvert and fish pass arrangement where Allt na Seasgaich flows under the Boath road. This has been shown by electro-fishing to act as an impassable barrier to salmon. This culvert prevents access to the upper reaches of Allt na Seasgaich and its tributaries Allt Leacach and Allt Srath an Loin. These areas contain 8,000 square meters of habitat suitable for salmonid production with a potential to be stocked with 40,000 fry. Approaches have been made to HRC Highways Dept to resolve this problem.

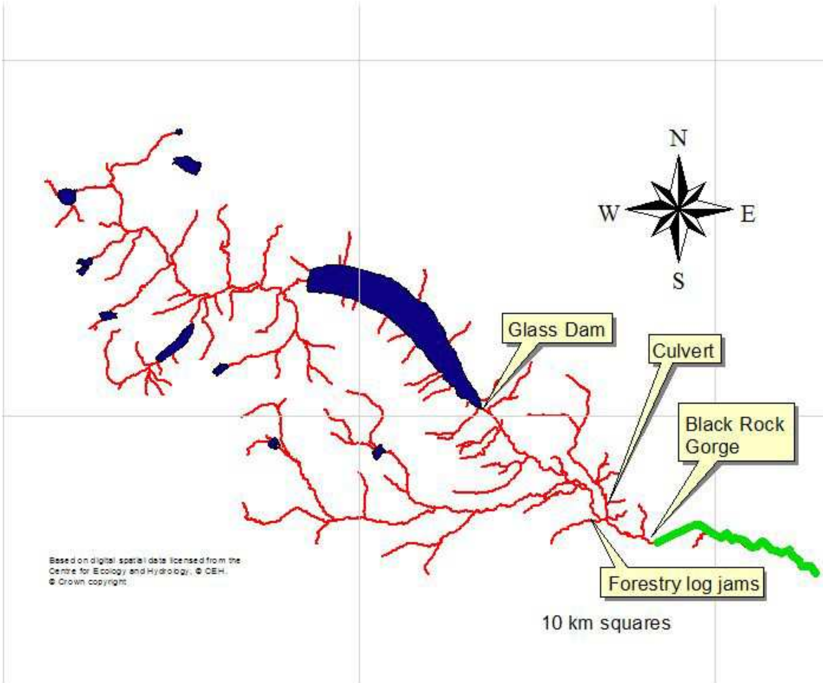

Impassable fish pass


Poorly designed culvert

Abhainn na Glasa is the main tributary of the Alness system above Loch Morie. Abhainn na Glasa rises 190m over a 7 kilometer length. The steep gradient results in a very large substrate size, comprising mainly of boulder and cobble with very little associated spawning gravel. There are also very few areas of deeper water to act as holding pools for adult salmon over this length. Preliminary electro-fishing work found very few salmon fry or parr in this area. The provision of some holding pools along this length would allow salmon to ascend above Loch Morie more easily. The construction of artificial spawning channels alongside Abhainn na Glasa would allow salmon to make use of the otherwise favourable nursery habitat.


Abhainn na Glasa

Allt Graad Obstacles



The biology of the migratory fish stocks of the Allt Graad is dominated by the presence of the Black Rock Gorge, without which the Allt Graad would be a significant salmon river. The area below the gorge to which migratory fish have access limits the smolt production of the river. The area of available habitat below the gorge is just under 35,000 square meters. Above the gorge there is a further 54,000 square meters of habitat in the main stem of the Allt Graad alone. This area has an estimated fry capacity of 250,000 fry. The potential exists, should sufficient Allt Graad broodstock be available and given suitable hatchery facilities, to more than double the smolt production of the river.

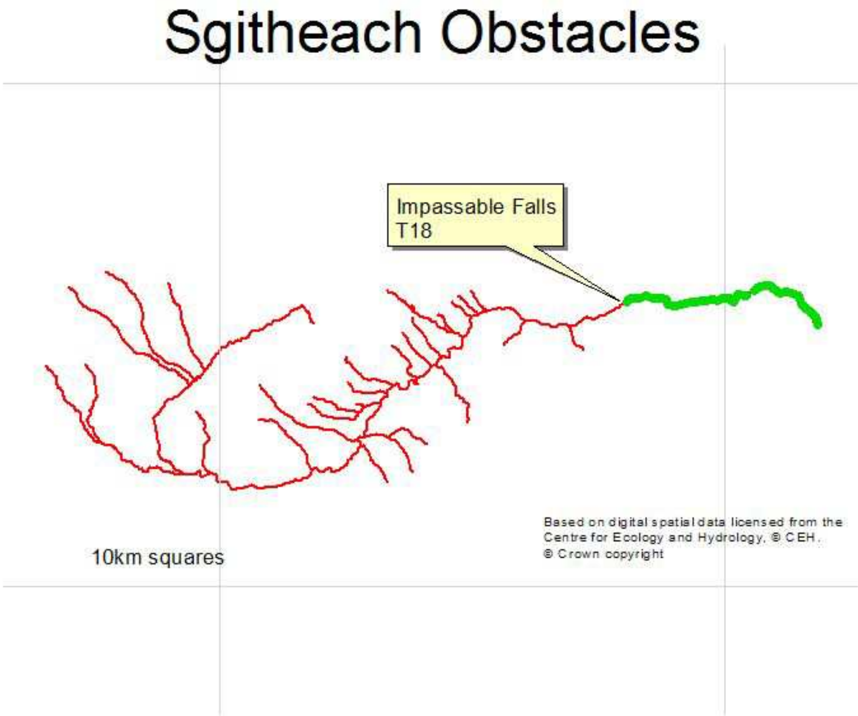
A further consequence of the limited area available to salmon and sea trout below the gorge is the vulnerability of these populations to extinction. There are serious threats to the migratory fish stocks of the Allt Graad. Poaching poses an ongoing threat and in particular the practice of deliberately poisoning the holding pools below the gorge. This not only kills adult salmon, preventing them from spawning but also kills several year classes of juveniles, so that the effects of such a poisoning can have long-term impacts.

There is also a risk of accidental poisoning of the river from the Assynt Water Treatment Works and discharges of suspended solids have been reported from the works on several occasions. The Lower Allt Graad is vulnerable to damaging floods and redd washout which has been exacerbated by forestry practices and drainage in the middle catchment.

Upstream of the Gorge further obstacles to migration exist which may have significant impacts on local trout populations. In particular culverts on Allt Gharbaidh, the Glen Burn, the Loch Burn and Allt Cailice are impassable and isolate the trout populations above them.

Allt nan Caorach and its tributaries have potential for smolt production but are steeper, have more waterfalls and contain poorer habitat than the main stem of the Allt Graad. They are also more difficult to access than the Allt Graad.

Culvert on Glen Burn



Sgitheach obstacles Trans no	East	north	alt	type	Passable
SGO10	260250	865650	30	Fallen trees	Passable (potentially difficult)
SGO14	259025	865500	55	waterfall	Passable (potentially difficult)
SGO16/17	258375	865700	70	waterfall	Passable (potentially difficult)
SGO18	258350	865725	100	waterfall	Not passable (U/S only)
SGO21	257750	865500	115	waterfall	Unsure
SGO23	257400	865325	120	waterfall	Passable (potentially difficult)
SGO30	255725	865500	150	waterfall	Unsure
SGO33	255200	865400	170	waterfall	Unsure
SGO37	254700	864675	200	waterfall	Unsure
SGO38	254550	864650	250	waterfall	Unsure
SGO60	251400	862050	220	waterfall	Unsure
SGO66	250175	862050	265	waterfall	Unsure
SGO67	249950	862075	270	waterfall	Unsure
SGO68	249900	862100	280	waterfall	Unsure
SGO76	248750	863050	340	waterfall	Not passable (U/S only)
SGO77	248700	863250	350	waterfall	Unsure

An electro-fishing survey carried out in the summer of 2001 found salmon fry and parr to be present in the Sgitheach as far upstream as the falls on transect 16, no salmon were found upstream of this point. At transect 18 there are a series of falls, the largest of which is clearly impassable.

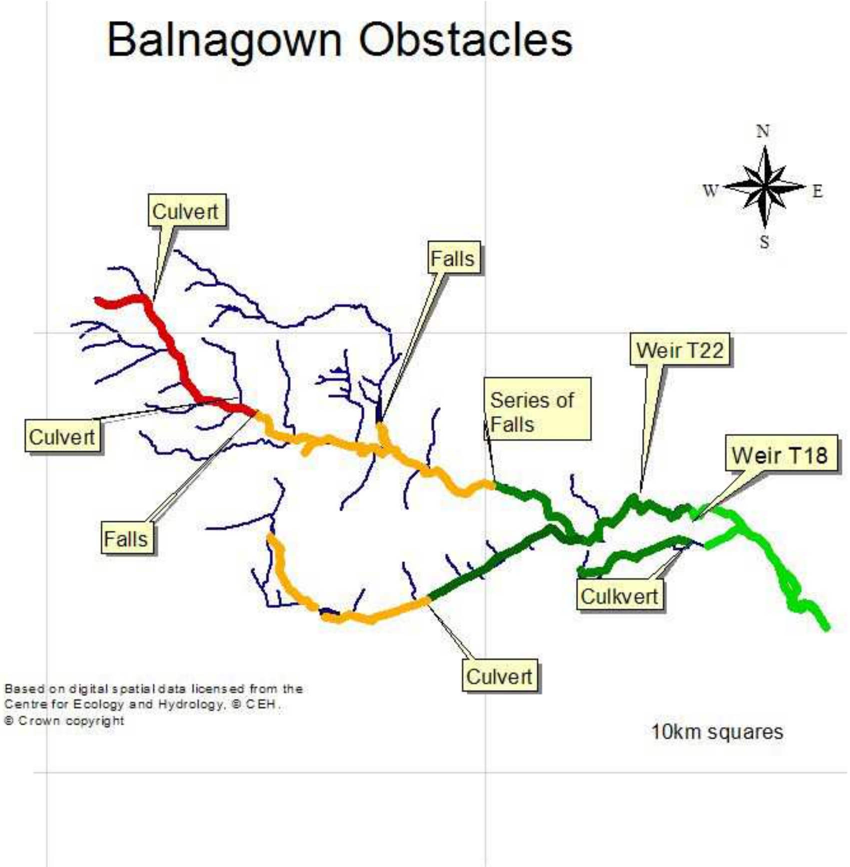
Other obstacles to migration include fallen trees forming a log jam at transect 10 and a weir at transect 14 which are both passable.

The falls at transect 18 seriously limit the potential of the Sgitheach to produce migratory salmonids. Below these falls at Swordale, there is an area of 25,500 square meters of habitat available to migratory fish, whilst there is a further 91,500 square meters of wetted area above the falls. In addition, some of the best habitat for juvenile salmonids is above the falls so that the estimated salmon production from above the falls would be 4.7 times greater than that from the area currently in use. Some of the falls at Swordale could be eased to give salmon easier passage but one fall in particular is more than 5 meters high and would require the construction of a fish pass. This would be expensive and also allow the trout populations above and below the falls to mix.

The limited area available to salmon and sea trout below Swordale does make these populations vulnerable to pollution and poaching events, which could have long-term impacts. A limited stocking exercise above the falls would not only increase the production of migratory fish from the Sgitheach but would also reduce the risk of extinction from pollution or poaching events. However to achieve this broodstock of Sgitheach origin would have to be caught and held until stripping and hatchery facilities would be required.

Waterfall at transect 18

Waterfall at transect18



The table below shows the details of obstructions to migration in the Balnagown catchment.

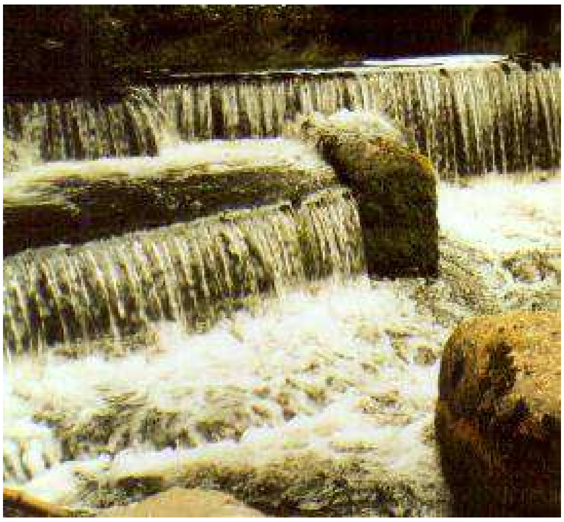
obs_id	east	north	River	type	Passable
BG12	276550	874900	Balnagown	Weir	Passable (species/flow dependent)
BG13	276575	874950	Balnagown	Watergate	Passable (species/flow dependent)
BG14	276400	875150	Balnagown	Weir	Passable (species/flow dependent)
BG18	275775	875825	Balnagown	Weir	Passable (species/flow dependent)
BG22	274950	875950	Balnagown	Weir	Passable (potentially difficult)
BG29	273700	876150	Balnagown	Fallen trees	Passable (potentially difficult)
BGO46	271350	876300	Balnagown	Waterfall	Passable (potentially difficult)
BGO47	271200	876300	Balnagown	Fallen trees	Passable (potentially difficult)
BG48	270950	876400	Balnagown	Waterfall	Unsure
BG50	270600	876450	Balnagown	Waterfall	Passable (potentially difficult)
BG51	270400	876500	Balnagown	Waterfall	Unsure
BG78	266000	877525	Balnagown	Weir	Passable (species/flow dependent)
BG78a	266000	877575	Balnagown	Weir	Passable (species/flow dependent)
BG85	264725	878200	Balnagown	Waterfall	Unsure
BG97	262900	879550	Balnagown	Culvert	Unsure
BG/AD2	267700	877850	Allt Dearg	Weir	Passable (species/flow dependent)
BG/LB1	275625	875475	Larack Burn	Culvert	Passable (species/flow dependent)
BG/LB3	275225	875225	Larack Burn	Forestry debris	Unsure
BG/KR12	269975	874560	Kinrive burn	Watergate	Passable (species/flow dependent)

BGKR13a	269755	874435	Kinrive burn	Watergate	Passable (species/flow dependent)
BG/KR13	269750	874435	Kinrive burn	Watergate	Passable (species/flow dependent)
BG/KR14	269500	874315	Kinrive burn	Watergate	Passable (species/flow dependent)
BG/KR15	269310	874250	Kinrive burn	Culvert	Unsure
BG/KR19	268375	873810	Kinrive burn	Forestry debris	Unsure
BG/KR20	268150	873685	Kinrive burn	Forestry debris	Unsure
BG/KR21	267935	873625	Kinrive burn	Forestry debris	Unsure
BG/KR23	267435	873500	Kinrive burn	Culvert	Not passable (U/S only)
BG/AM2	262075	879675	Allt Meadonach	Waterfall	Not passable (U/S only)
BG/MD1	264425	878550	Mheallain Dhuibh	Culvert	Not passable (U/S and D/S)

Electro-fishing above and below obstacles at which fish passage was uncertain would establish the degree of obstruction caused at these points. If a decline in juvenile densities is apparent upstream of these obstacles then improved fish passage facilities should be considered.

Passage at some of the obstacles listed as being potentially difficult could be improved by increasing the pool height below the obstacle. This would be particularly effective at the weirs at transect 18 and transect 22. The fish pass at transect 22 has insufficient depth below it to allow fish passage except in high flow conditions.

Weir at transect 18



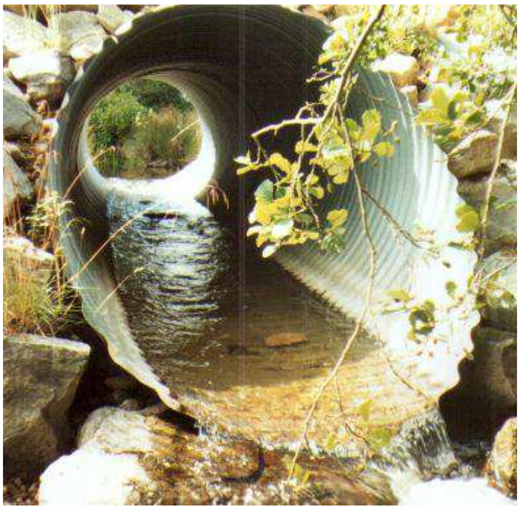
Inefficient fish pass at transect 22

Difficult falls at transect 85

There are a number of falls which may limit upstream migration the most difficult of these is at transect 85 below the junction with Allt a Mheallain Dhuibh. There are smaller falls between transects 48 and 51 which could be eased by increasing pool depth below the falls.

Fallen trees and forestry debris which cause obstructions to migration should be removed these are particularly in evidence on the Kinrive and Larack burns.
Watergates are an important part of riparian fencing schemes which establish valuable riparian buffer zones. They should however be checked to ensure that flood debris does not turn them into barriers to migration.

Forestry debris on Larack burn



Kinrive culvert

Larack culvert

Culverts on both the Larack and Kinrive burns could be improved to ensure fish passage. This could be done by lowering the culvert level so that a natural streambed is formed in the base of the culvert or by installing a baffle system to increase depth and slow flow through the culvert. The culvert at transect 97 on the Balnagown is probably impassable but there is so little habitat above it that it is unlikely to be cost effective to improve it. Any future proposed road crossings should be looked at carefully and Fishery Board advice sought to ensure that no new obstructions to migration are created.

Culvert at T 97 on the Balnagown

6.4 Conifer Afforestation

The Ministry of Agriculture Fisheries and Food in 1991 looked at afforestation as an impact on salmon smolt production as part of a Salmon Advisory Committee report. The main findings are shown below.
'Afforestation and land-drainage can adversely affect the hydrological characteristics of nursery areas for young salmon by reducing water yield, changing patterns of stream run-off, causing erosion and increasing sediment transport. Afforestation close to river banks can produce heavy shading thus reducing production and possibly affecting temperature regimes.

Reduced yields of water have been reported as a result of conifer afforestation. The principle mechanisms responsible appear to be increased transpiration, and, more important, increased evaporation from tree canopy. Losses of water are related to the area planted, planting density and tree size. The Forestry Commission Scotland's guidelines suggest that such water losses may amount to 2% of the total yields for the catchment for every 10% afforested. Such losses may be critical to those streams where flows are already restricted.

The extensive drainage works associated with afforestation of moorland and bog may also cause changes in the flood response of streams. Such drainage works permit faster run-off of rainfall thereby giving rise to increased peak flows in streams and more rapid changes in flow. Such flash floods may cause serious erosion problems with resultant loss of both bed and bank cover, so essential to juvenile stocks. The drainage works can increase significantly the transport of sediment in the drainage channel. Road construction to service the afforested or improved land may also increase the transport of sediment until such time as the exposed soil is stabilised.

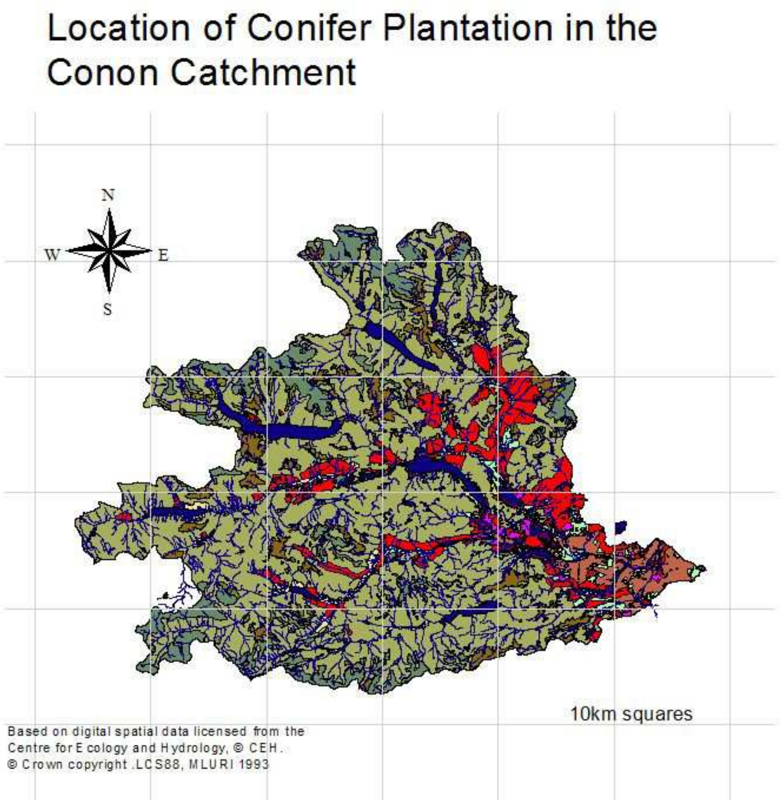
Sediment yields are increased in the early stages of the forestry cycle and during clear felling. Such increases have been measured in a number of catchments. When such sediment loads are deposited, they blanket the stream bed, blocking the gravel, thereby preventing spawning or the successful development of fish eggs and parr and also reducing the availability of food for fish. Deposition of suspended material also causes compaction of the gravel which reduces the flow of well oxygenated water through it, thus affecting the survival of eggs and alevins.

One of the major effects of afforestation of upland areas is that in some areas it exacerbates the acidification of the streams draining such areas. Coniferous trees filter out and concentrate atmospheric pollutants which are then washed down by rain onto the soil and into streams. Root systems also take up calcium and magnesium, two of the most important buffering elements, but the impact of this latter process has yet to be quantified.
These processes operate in areas of shallow, well leached soils overlying slow-weathering rocks such as granite. The acid conditions produced may themselves be toxic to salmon or result in increased solubility of toxic metals such as aluminium.

The sensitivity of salmon to acid conditions varies with life stage. Eggs are vulnerable but have developed, in experimental conditions, at pH ~4.5. Hatching at this pH level may be unsuccessful because the hatching enzyme produced by the embryo functions best in slightly alkaline conditions and its action is blocked in acid conditions. Older juveniles can tolerate acid conditions more successfully than newly- hatched or young fry because of the lower proportion of gill area to body volume which makes it easier to maintain the correct salt balance within the body.

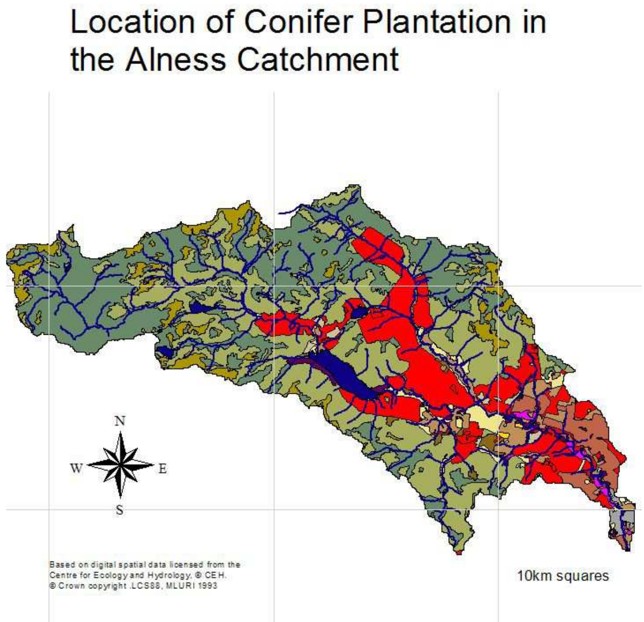
Various practical measures have been suggested for ameliorating the effects of afforestation on the nursery areas of salmon waters. These are described in the Forestry Commission Scotland's 'Forests and Waters Guidelines' and include such measures as modifying drainage and ploughing techniques. Ameliorative techniques are also described to cater for roadworks both during their construction and their maintenance, and advice is provided on minimising the adverse effects on streams of harvesting the forest. However, the guidelines do not address the issue of the location of forests.'

The map below shows the distribution and extent of conifer afforestation in the Conon Catchment in red.



Some of the areas most affected by forestry in the Meig system are being restructured by Strathconon Estate and are capable of supporting fish stocks. The largest impacts are in the Blackwater system. Several water courses which drain heavily afforested catchments overlying sensitive geology (see Section 5) have lost their fish stocks. The extent of afforestation in these catchments is such that large scale removal of forestry on the sensitive geology would be required rather than restructuring around watercourses.

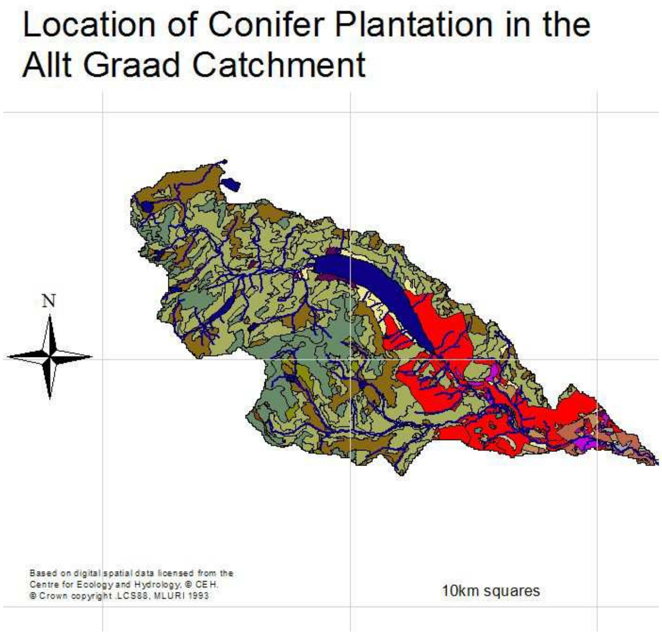
The map below shows the distribution and extent of conifer afforestation in the Alness catchment in red



It can be seen that the Blackwater system and parts of the main Alness are heavily afforested. Much of the forestry in the Blackwater system is more recent planting which does comply with the Forest and Water Guidelines. Whilst there is a buffer strip around much of the Blackwater, there is considerable scope to improve habitats within the riparian zone.

Most of the forestry above Loch Morie is 'old style' plantation which has seriously degraded the fishery habitat within it. To restore these habitats this forestry requires significant restructuring before restoration of riparian and instream habitats can begin.

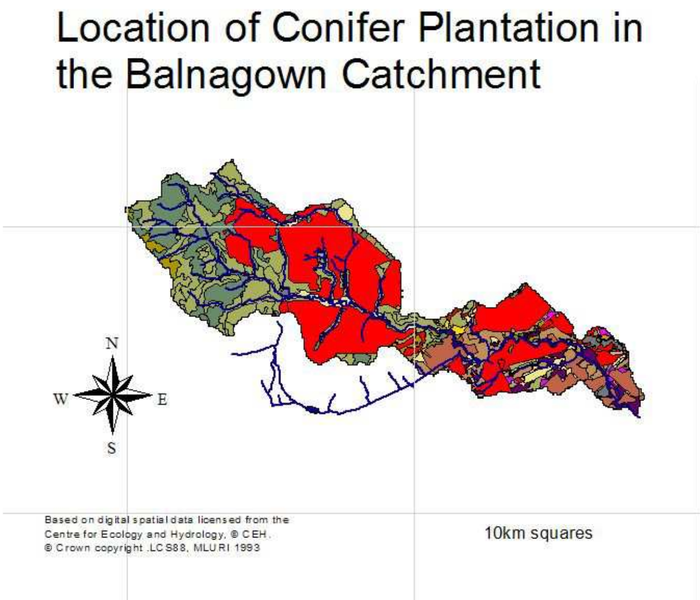
The map below shows the distribution and extent of conifer afforestation in the Allt Graad catchment in red.



The extent of forestry in the Allt Graad below Loch Glass has influenced the biology and hydrology of the system. In recent years there have been a number of damaging spates in the Allt Graad these spates have been associated with large land slips when sections of afforested banks have collapsed and washed into the river. The shaded banks without the root systems of native grasses, shrubs and trees to hold them together have been particularly vulnerable to erosion.

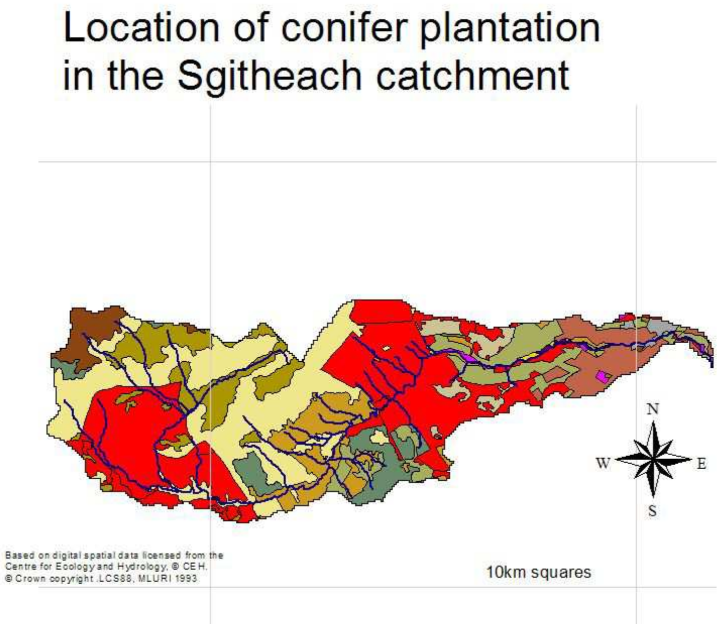
The effects of forestry have degraded some areas of the Allt Graad catchment very significantly. Perhaps the worst affected is Allt Calice. The photograph below shows the extent of habitat degradation (see habitat survey for detail).

The map below shows the distribution and extent of conifer afforestation in the Balnagown catchment in red.



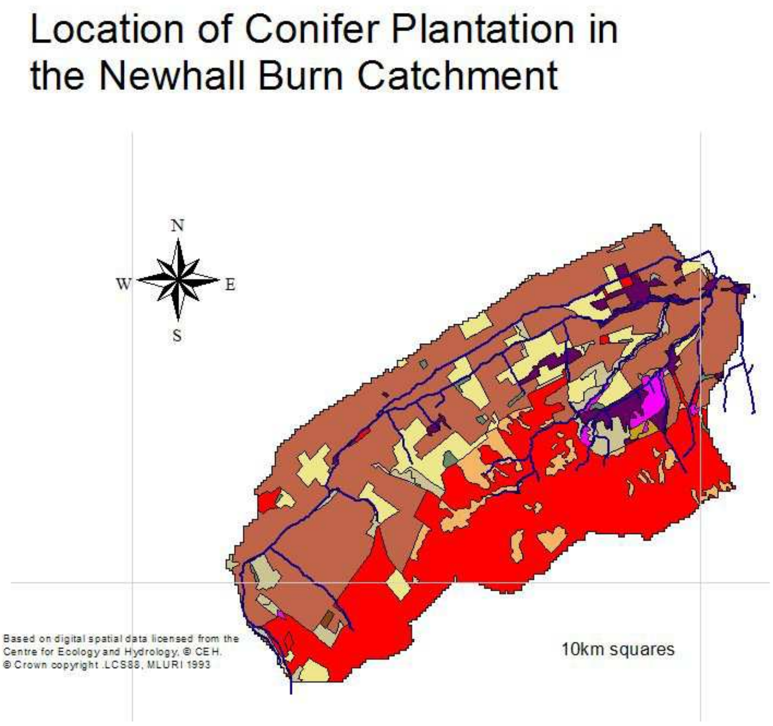
The map shows the enormous scale of afforestation in the middle reaches of the Balnagown. During habitat survey works in 1999 some watercourses in this area were found to be dry, despite having clearly been significant streams in the past. The area around Loch Sheilah which was historically important for sea trout is heavily afforested.

The map below shows the distribution of conifer afforestation in the Sgitheach catchment in red.



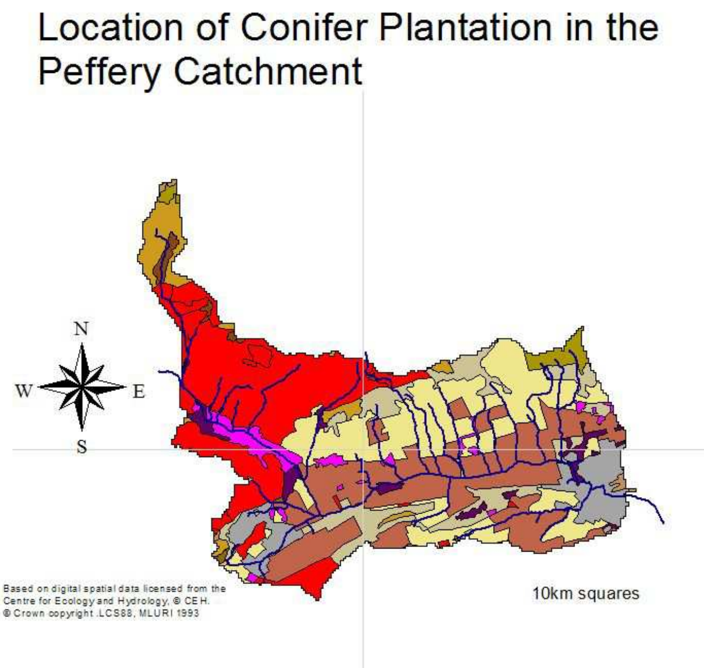
The main affects of forestry in the Sgitheach catchment are likely to be on hydrology, and sediment transfer. The acidification issues on the neighbouring Blackwater are not likely to be as significant in the Sgitheach catchment because of the less sensitive underlying geology (see Section 5).

The distribution and extent of conifer afforestation in the Newhall Burn catchment is shown in red on the map below.



The headwaters of the easternmost sub catchments of the Newhall Burn system are affected by extensive afforestation. The underlying geology is likely to result in effective buffering against acidification. The other effects of afforestation could be addressed by riparian management and reducing sediment loads by preventing forestry drainage entering watercourses directly.

The map below shows the distribution and extent of conifer afforestation in the Peffery Catchment in red.



The riparian zone of the Peffery within the extensive conifer plantations on the southern slopes of Ben Wyvis is partly protected by band of mixed woodland. The forestry impacts are likely to be associated with the hydrological effects of drainage and also a reduction in pH at high flows because of the more sensitive geology underlying the west of the Peffery catchment.

6.5 Deforestation and cultural oligotrophication.

The loss of riparian woodland is a characteristic of the upper catchments of many rivers in the Highlands. This was largely caused by the clearance of native woodland for grazing in the 19th century and has been maintained by grazing pressure by deer and sheep since.

This issue is recognised in the Ross & Cromarty (East) Biodiversity Action Plan (sections 2.1 & 4.2). It has also been recognised by the SEPA Area Advisory Group for the North Highland region.

The consequences of this loss of riparian woodland have been;

- A loss of biodiversity within and at the margins of the woodland.
- Increased erosion of river banks leading to siltation and degradation of rivers
- A loss of buffer habitat which filtered and slowed down water flow from surrounding land. This increases pollution and flood risk.
- Increase in summer water temperatures because of lack of shading.
- Reduction in nutrient status of rivers because of lack of leaves and invertebrates from the riparian zone.
- Fragmentation of habitat and the loss of the natural corridor which connected habitats and species.

Biodiversity benefits of restoration

All of the effects listed above can be reversed by the restoration of a strip of native woodland along the banks of upper catchment rivers.

The biodiversity gains from such riparian woodland restoration are disproportionately high compared with the benefit of establishing native woodland away from watercourses.

The reason for this is that the long linear length of the woodland gives large areas of transition between the woodland and the riverbank and between the woodland and the surrounding land. Each of these transitional zones on either side of the woodland supports their own range of habitats and species.

The connectivity provided by riparian woodland restores natural corridors which link habitats throughout catchments.

In addition to these benefits the presence of riparian woodland improves the water courses that run through it and these benefits continue downstream. The presence of riparian woodland protects river banks from excessive erosion, filters run off from surrounding land, reduces water velocity and flooding, provides shade reducing summer temperatures, increases freshwater productivity by introducing leaves and invertebrates and provides bank side cover for fish.

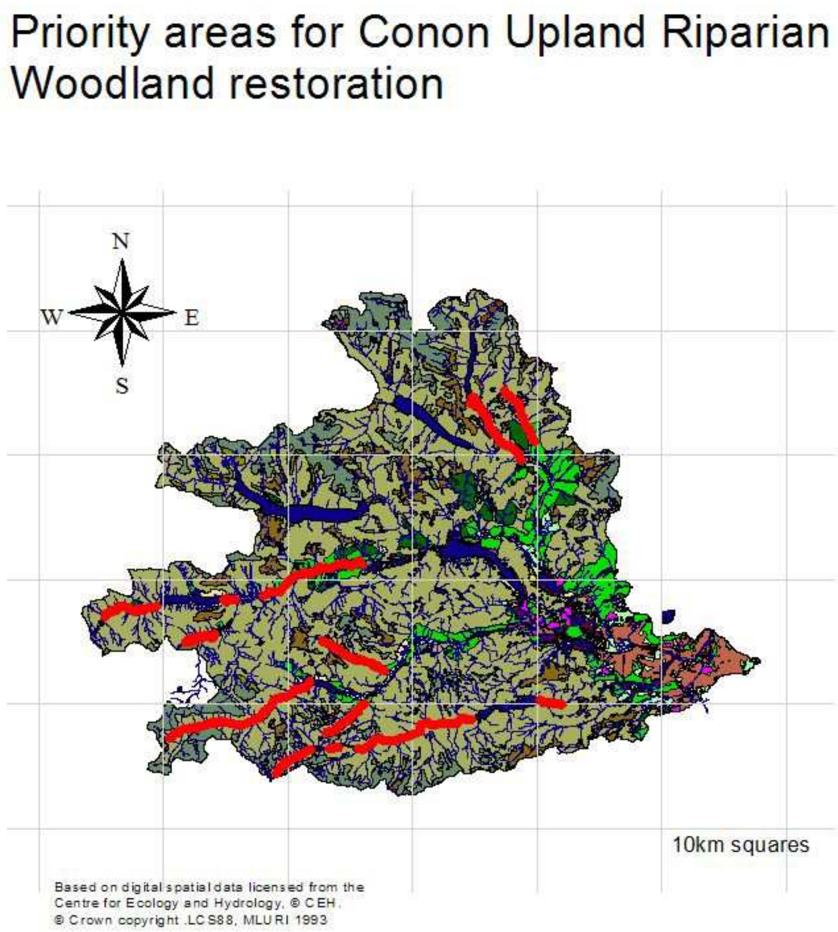
Hydrological effects described in 2002 SNH report on the Conon Valley.

Removal of the native forests is likely to have altered the hydrology of the upper catchments which could have changed river flows and flooding of the lowland floodplain. The native forests would have been open structures creating efficient interceptors of rain, snow and mist. The potential evaporation in these exposed areas would have been significant and so the likely evaporation losses would have been greater than at present with the moorland ground cover. The effect on river flows down the catchment would have been a reduced volume of runoff, particularly in the summer season. Storm runoff and flood flows in the early autumn period could also have been reduced as the drier soils wetted up after a dry summer period however it is unlikely that runoff from winter rainfall events has changed significantly. Winter snow storage and snow melt could have been affected by the loss of forest cover with the trees protecting the snow pack until a major warm front crossed the area causing rapid snow melt, enhancing the downstream flood.

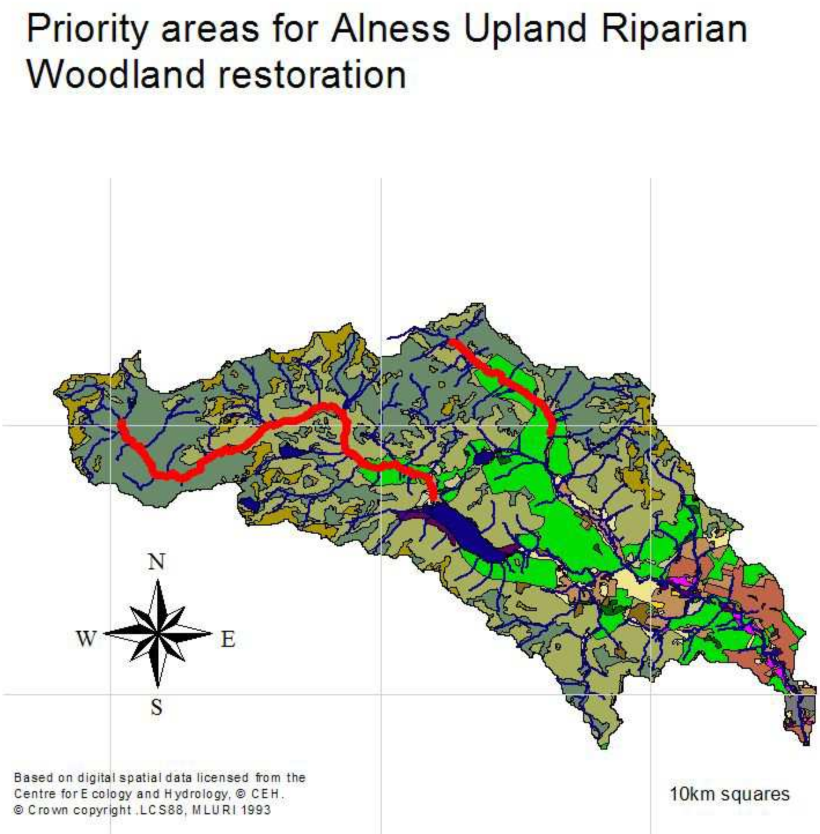
The other possible effect of removal of the forest is in accelerated soil erosion. The original tree canopy would have provided protection from rainfall impact and the roots would have helped to bind the soils together. Removal of the tree cover would have accelerated the erosion processes and also reduced the soil water storage. This could have caused more rapid runoff and greater downstream flood peaks.

The combined downstream effects of the deforestation in the headwater areas are therefore likely to be complex and it is difficult to quantify the effects especially when other possible scenarios, such as changing snowfall patterns or seasonality of flooding, are also considered.

The map below shows in red areas of the Conon system which would benefit most from riparian habitat improvement works.



The map below shows in red areas of the Alness catchment which would benefit most from riparian habitat improvement works.



The area of the Blackwater marked is largely owned by the Forestry Commission Scotland and is surrounded by deer fencing. This would greatly reduce the cost of riparian restoration work in this area.

The area above Loch Morie has potential for riparian habitat improvement projects. The benefits would be greatest at the top of this reach where the river gradient reduces and in the lower reaches and lower tributaries, where riparian habitat restoration would be beneficial following restructuring of existing conifer woodland.

6.6 River Regulation

The Ministry of Agriculture Fisheries and Food 1991 looked at river regulation and dams as an impact on salmon smolt production as part of a Salmon Advisory Committee report. The main findings are shown below.

‘Dams frequently drown-out spawning and nursery areas for salmon as they are often constructed in the headwater tributaries of rivers. Any remaining spawning and nursery ground upstream of the impoundment is generally inaccessible to spawning fish unless a fish pass is incorporated; this is rarely done as it is expensive and the recovery of habitat may be small.
Regulation of streams downstream of a dam imposes significant changes in the habitat.
These include:-

(a) modified flow regime, particularly;

- removal of most flow fluctuations (e.g. spates) when the impoundment is not full;
- damping of flow fluctuations even when the impoundment is full and spilling;
- maintenance of a minimum flow by a compensation release (which may be greater than the natural drought flow);
- Considerable enhancement of low flows when regulation of hydro-electric generation releases are being made.

(b) modified water quality, including:

- changes in the pattern of occurrence of low and high temperatures;
- reduction in turbidity by settlement in the reservoir;
- changes in water chemistry due to storage;
- changes in water chemistry due to submerged mineral sources (e.g. mining waste);
- water of low temperature and low dissolved oxygen if a deep draw-off is used;
- changes in water due to diversions.

The reduction of spawning and nursery areas by drowning-out and cutting-off represent a loss that is difficult to replace. In some cases restocking schemes have been implemented as part of a compensation package.

The modified flow regime can have a considerable effect upon the upstream progress and spawning of adult salmon, denying access to potentially good nursery streams. Lack of high flows also reduces natural scouring of spawning gravel. Lack of scouring can lead to siltation and compaction of gravel. It also impairs the ability of the main river to cleanse itself of debris borne into it by side tributaries at times of spate flow in the tributaries. However in other ways regulated streams may make very good nursery grounds. The equable flow and temperature regime encourages high production of rooted plants, invertebrates and fish. For example, the River Meavy downstream of Burrator Reservoir in Devon supports some of the highest densities of young salmon and trout in Great Britain. In this case, regular spilling of the dam in autumn provides the flushing flows and the stimulus for adult immigration.

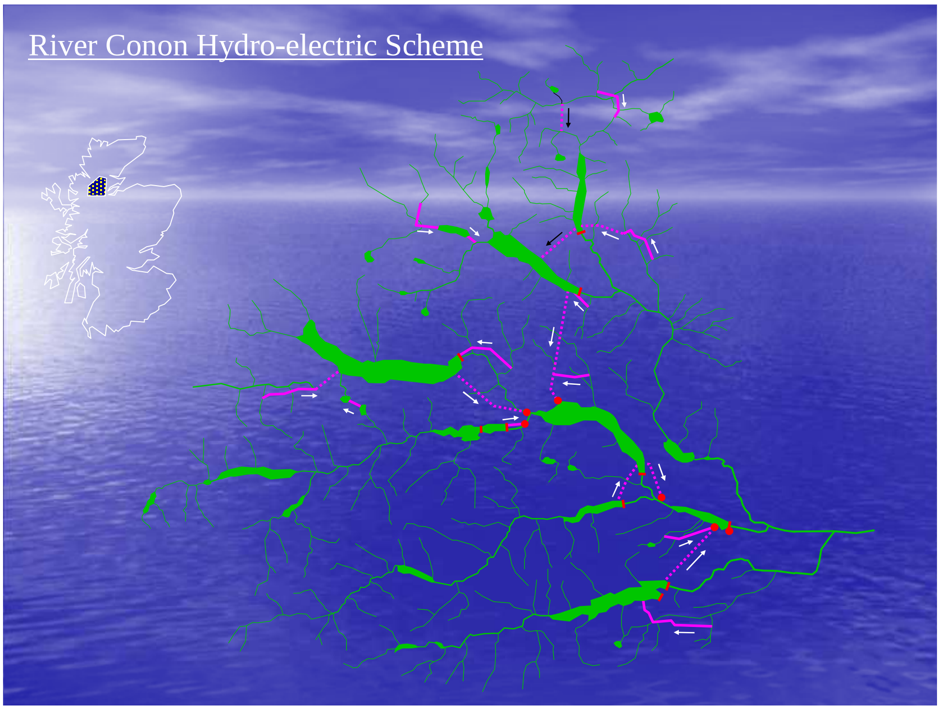
The modified water quality downstream of dams has occasionally been blamed for poor stocks of fish, but this is again usually linked with a failure to stimulate adult immigration for spawning.

There is scope for regulated flows to be managed in such a way that they enhance habitats for juvenile salmon; however, if badly managed they may have adverse effects.

Maintained production equivalent to highest natural levels can be achieved by optimising flow conditions including:
-an appropriate compensation flow;

-use of reservoir surface water layers for releases;

-appropriate time of spilling (or large artificial release) for gravel cleaning and salmon migration and spawning.



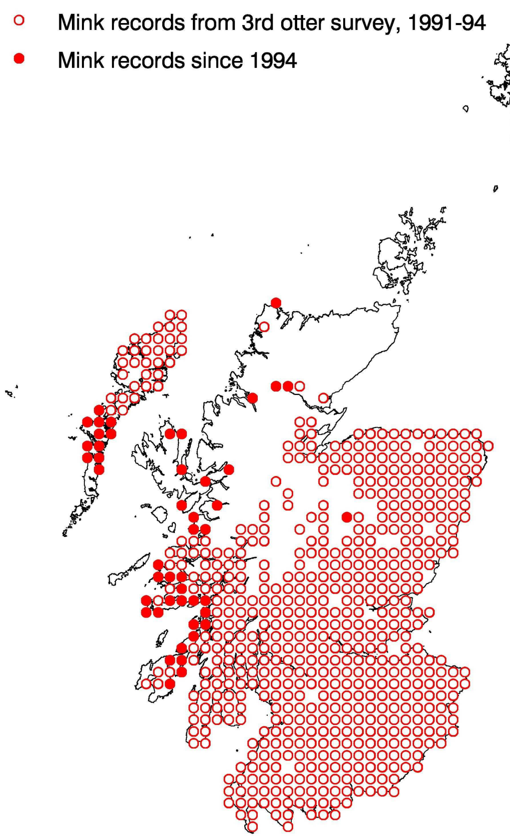
The location of hydro dams and water transfers in the Conon system are shown on the map above. A history of the development of the Conon Basin Hydro Scheme is included in Section 4. A description of the regulated flows from the hydro dams is included in Section 5.

6.7Alien Animal species

Mink

At present SNH are developing a Species Action Plan for mink the draft priorities are set out below;

- Eradicate mink from the Western Isles
- Prevent colonisation of the mink-free area in NW and North Highlands
- Prevent colonisation of the Northern Isles and the remaining Hebridean islands that are currently mink-free
- Maintain vigilance in the NW Highlands (where mink are currently thought to be spreading) and initiate an immediate response to remove any live mink reported in this area
- Within the established mink range, target key river catchments and designated sites for mink management to protect internationally and nationally important populations of vulnerable native species

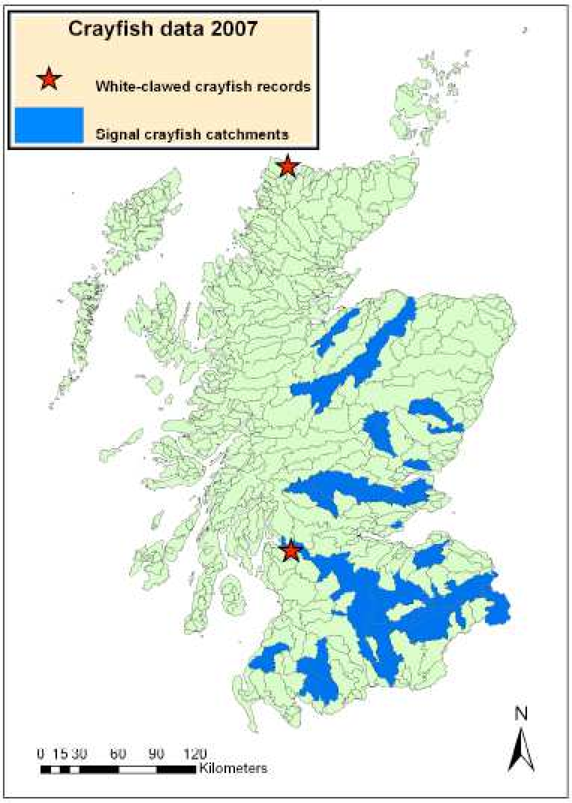


From the map above it can be seen that the Cromarty Firth region is at the northern boundary for mink distribution in Scotland. Collaboration between SNH, District Fishery Boards, Trusts and landowners would be required to contain the spread of mink.

American Signal Crayfish

At present SNH are developing a Species Action Plan for North American Signal Crayfish the draft priorities are set out below;

- Increase public awareness of North American signal crayfish as an invasive species and the need to prevent its spread.
- Assess the distribution and status of North American signal crayfish populations in Scotland.
- Take practical action towards the eradication or containment of North American signal crayfish in Scotland.
- Promote and enable a co-coordinated approach to the North American signal crayfish issue in Scotland and other parts of the UK.



From the map above it can be seen that North American Signal Crayfish are present in the Nairn catchment. A collaborative project between SNH and Fishery Trusts in the Moray Firth Region could be developed to monitor any spread of crayfish outside its present distribution.

6.8 Agricultural Drainage and Siltation

The Ministry of Agriculture Fisheries and Food 1991 looked at agricultural drainage as an impact on salmon smolt production as part of a Salmon Advisory Committee report. The main findings are shown below.

'Drainage of land for arable production and improved grazing has been extensively practised by providing underground pipes ('land drains') and drainage ditches, and by the dredging of main channels to lower the water table. This has the effect of increasing the speed of run-off so that the peak flows are greater and the base-flow reduced. Both these extremes are potentially damaging for juvenile production.

Input of suspended solids as a result of farm practices can render gravel unsuitable for spawning and incubation.

The post-war intensification of arable farming practices has tended to increase the likelihood of serious soil erosion. For example, modern crop patterns often leave land vulnerable to erosion during the autumn and winter, when peak rainfall occurs. This results in increased soil erosion to watercourses, particularly where the land gradient is steep or where low-lying land is prone to flooding during this period.

Access to the stream bank by grazing livestock can cause damage by destruction of bankside vegetation and breakdown of banks, allowing a considerable input of soil material into the water. In severe cases the banks may be destroyed, leading to considerable channel widening and shallowing and a very high input of suspended solids.

Channelisation for land drainage and flood alleviation generally involves straightening and deepening the channel. This results in removal of much of the habitat diversity and in particular shallow areas important for salmon parr and much spawning gravel. Considerable damage has been done in the past, from which recovery has been slow. Publication of the 'Rivers and wildlife handbook' by the RSPB and RSNC in 1984 was of major assistance.

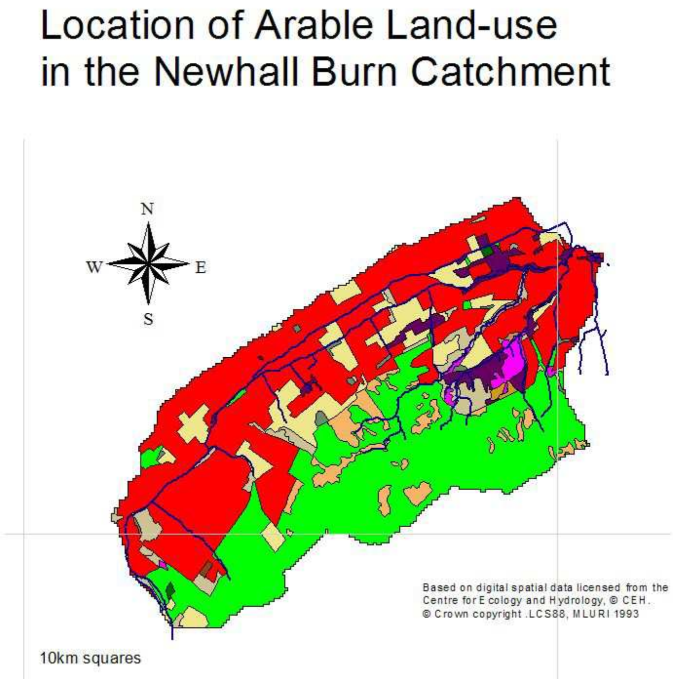
Bankside cover can be important to juvenile salmon in small shallow streams. Clearing of such cover, either intentionally or by allowing intensive grazing, can significantly reduce the carrying capacity. On the other hand, domination of the banks by coniferous plantations can reduce light penetration and thus primary productivity, reducing fish production. It also greatly restricts the more valuable community of bankside vegetation.

New drainage schemes are now less numerous and it is likely that some existing schemes, particularly in rural and upland areas, will slowly deteriorate. It is however important that the criteria for the maintenance of such capital schemes should now be reconsidered. Natural recovery from unsympathetic channelisation is slow but does occur, but improved awareness by river and estate managers should ensure that less damage is done in the future.

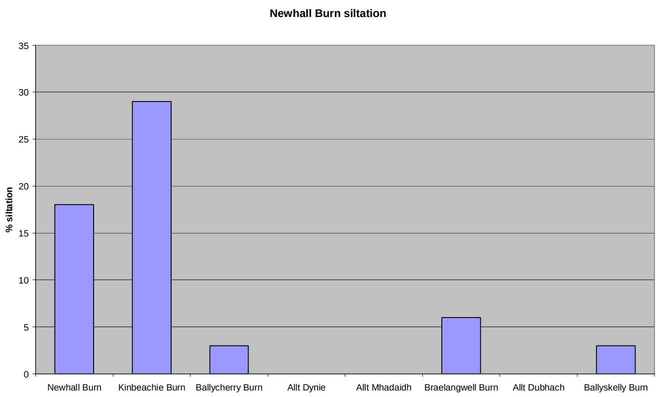
Input of silt from arable farming can be controlled by leaving uncultivated areas (ideally several metres wide) alongside the stream and any feeder tributaries. This also satisfies the requirement for bankside cover. Further, avoiding access by cattle in intensively grazed areas (except for limited drink areas) can prevent damage to bankside vegetation and to banks themselves.'

The catchments most heavily impacted by agricultural drainage and siltation are to the lower lying east of the region. Of these the most heavily impacted are the Newhall Burn, the Peffery and several of the smaller coastal burns.

The map below shows the extent of arable farming in the Newhall Burn catchment.

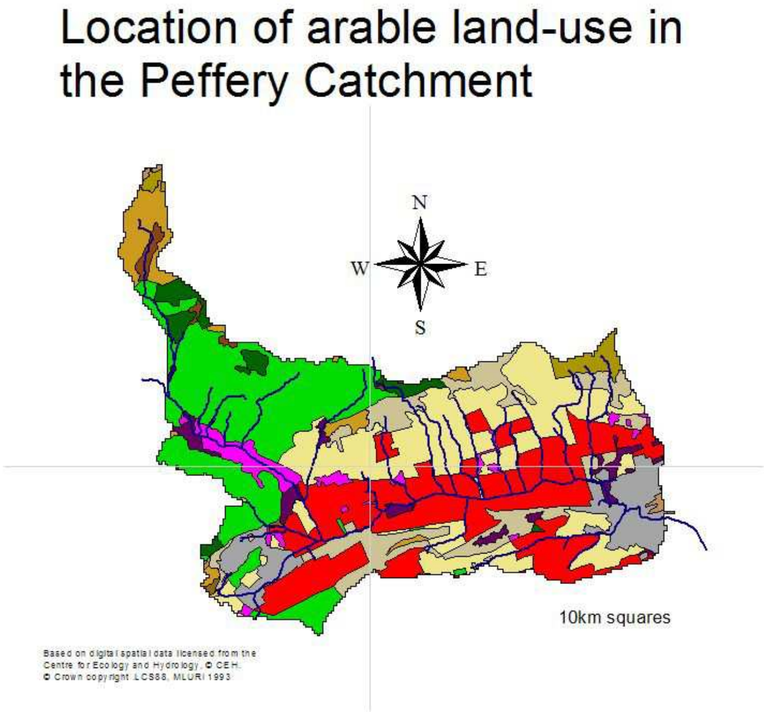


A 2001 habitat survey of the Newhall Burn identified agricultural siltation as a significant impact on the system.



The chart above shows the high percentage of siltation in the Newhall and Kinbeachie burns which flow through arable land compared with other burns in the catchment.

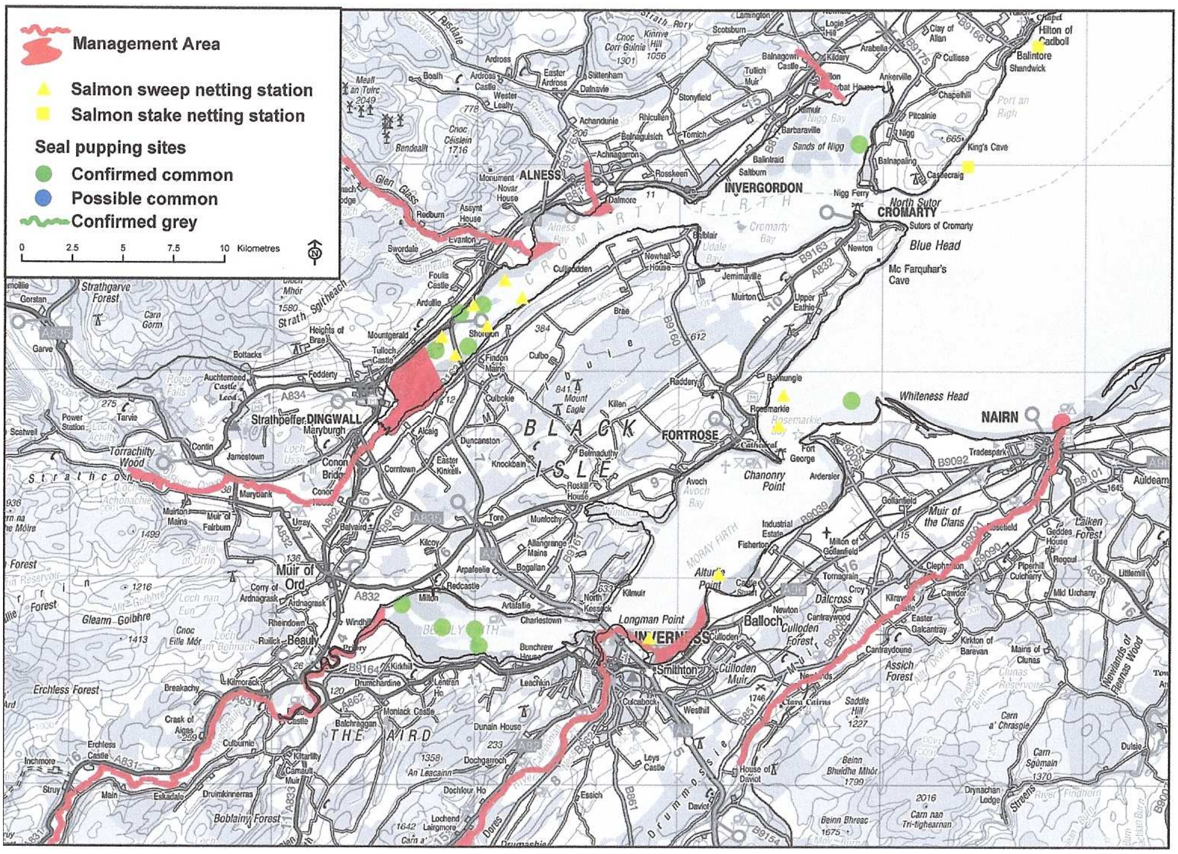
The map below shows in red the extent and distribution of arable land-use in the Peffery catchment



The extent of intensive agriculture in the middle reaches of the Peffery can be seen from the map above. This middle section of the Peffery has been further degraded by channel straightening and dredging works which have removed much of the natural substrate, channels form and habitat diversity from a river which was once an important nursery for sea trout.

6.9 Predation

The seal management areas described in the Moray Firth Seal Management Plan (see Section 5.1) are mapped in red below.



6.10 Trout Stocking

In addition to the biosecurity risks described in the previous chapter there are genetic risks associated with the stocking of trout and other species. The Wild Trout Trust has recently agreed a position statement on trout stocking which is set out below.

Wild Trout Trust – Position statement on supplementary stocking

Summary

The native and wild trout of the UK and Ireland are an important part of our natural heritage.

The Wild Trout Trust believes that careful management of land and river habitats can sustain wild trout populations in rivers, streams and connected stillwaters across much of the UK and Ireland at levels that will support sensitive fishery pressures. Where degradation or loss of habitat has limited populations of wild trout we recognise that some stocking, using identifiable fish of appropriate size, might be required (ideally temporarily) to meet social and economic objectives. Where stocking is considered necessary to sustain a fishery, we recommend native and wild trout populations are protected by using a precautionary stocking policy, based upon the use of fish that are derived from local, native broodstock whenever that is possible or upon

Introduction

The Wild Trout Trust (WTT) is a charity dedicated to the conservation of wild trout in Britain and Ireland through protection and restoration of habitat and to habitat restoration as a means of creating fisheries with no or minimal reliance on stocking farmed fish. This statement is intended to describe the Trust's position on stocking and the support offered to fishery owners, clubs and managers in the UK and Ireland.

Studies and descriptions of the impact of stocking on wild brown and sea trout have been undertaken and debated for many years. For example, Harry Plunkett Greene described the impact of stocking on the Bourne and Test in 1905, pleading for fishery managers to turn their attentions to better habitat management rather than introduce stock fish. The debate was revived in 2003 by the publication of the Environment Agency (for England and Wales) National Trout & Grayling Strategy (www.environment-agency.gov.uk/fish). This document seeks to introduce measures to protect wild brown trout populations from the potentially detrimental effects of stocking.

Much of the ensuing debate has centred on the genetic impacts on wild trout populations due to interbreeding with farmed trout. The WTT believes that this should be considered with other impacts upon wild trout populations such as habitat degradation and diffuse pollution because all of them can limit wild trout populations and lead to pressures for stocking. The expectations of anglers play a role in determining stocking levels but increased recruitment within wild populations could ease or solve the difficulties.

Definitions

As a result of increasing human interference with trout populations there are trout in rivers and stillwaters in the UK and Ireland that broadly can be defined as – *native trout, wild trout* and *farmed trout.*

The WTT recognises a native trout as a fish that is the product of natural reproduction between fish drawn from a population that does not include artificially introduced genes.

Native trout populations are not static, new genes reach them through natural invasion by trout migrating (without human interference) from other native populations. The capacity of trout to adopt an anadromous life cycle is a key part of this natural invasion process; it is likely to have been the basis for the invasion of trout into rivers and stillwaters in much of the UK and Ireland after the last ice age. These native populations are identifiable through genetic markers; they represent populations that are of particular importance to fishery managers and conservationists.

The term wild trout includes all native trout as defined above, but also any trout that are the result of natural spawning. Fish that are the product of hybridisation between native trout and artificially introduced strains are wild trout, as are the product of natural reproduction within wholly introduced trout populations.

This definition acknowledges the extent to which stocks have been managed through artificial introductions and breeding over the last 150+ years. Such populations are the focus of the WTT's habitat restoration activities, but the conservation of the more narrowly defined native trout will be given priority wherever they are found or their presence is suspected. (This is in keeping with the Wild Trout Trust's name and its main aim of supporting the natural reproduction of trout in rivers and streams so as to produce sustainable wild populations.)

Farmed trout are defined as trout whose production is managed directly by human interference. Just as there are variations in the extent to which wild populations also are native, so there is a range of rearing methods and genetic sourcing in farmed trout.

For example, trout fry derived from eggs stripped from wild trout or even native trout broodstock, or which emerge from an incubation box directly into their parents' natal river are farmed trout because they are not the result of natural spawning. However such interventions might also be described as the stocking of hatchery reared ova. At the other end of the rearing and genetic continuum is the use of non-native selectively bred trout reared to maturity in an intensive system. Such fish play an important part in sustaining some fisheries: they are particularly important to the many stillwater fisheries that lack any spawning capacity. However, their introduction into rivers and stillwaters that contain wild trout and/or native trout populations is not without risks, some of which are described below.

Stocking

Trout fisheries in the British Isles range from those totally reliant on wild trout to those with a mixture of wild trout and farmed trout, through to those totally reliant on farmed trout.

There are three main reasons for stocking:

- Restoration – the reintroduction of fish to waters that have lost their populations because of pollution or habitat degradation (after improvement of the water quality or habitat).
- Mitigation – the introduction of fish to compensate for a long-term or permanent impact upon the population, for example, where a dam has flooded spawning habitat.
- Enhancement – the introduction of fish to increase anglers' catches. This can range from a few fish to supplement the wild population, to supporting an entire fishery.

Trout can be introduced at different life-stages, from fertilised-egg to adult fish. Generally restoration and mitigation stocking use early life-stages; enhancement stocking involves adult fish. The popular deep substrate incubation boxes ('trout Jacuzzis') can be regarded as a form of mitigation-stocking where lack of spawning habitat has been identified as inhibiting natural breeding.

Stocking is important to sustain many trout fisheries but it is important that, where wild trout exist, they are protected from the impact of introducing farmed trout.

Genetic Impacts

Native wild brown trout are genetically diverse. They are found in many forms, varying according to their ancestry and adaptation to local conditions. Different forms of trout can be separated geographically or they can co-exist, separated by specific spawning or feeding behaviours: this is illustrated by the co-existence of sonaghan, gillaroo and ferox trout in Lough Melvin.

> "British and Irish trout populations form a geographical mosaic derived from one or more of at least six lineages that evolved separately during the last Ice Age then colonised after the retreat of the ice about 14,000 years ago. Since then populations have diverged further through natural selection and random genetic changes" (Ferguson, 2006)

Farmed trout differ from wild trout because they have been domesticated in culture, often over many generations. The original choice of broodstock, artificial selection and the relaxation of natural selection mean that, compared with wild trout, the farmed trout both look and behave differently. farmed trout have different learning opportunities, in feeding and avoiding predators for example that would be detrimental to the process of natural selection.

Damage to wild trout populations occur when farmed trout and wild trout interbreed and the offspring breed with the wild population in subsequent generations. The hybrids have a lower survival rate and reproductive success than wild fish; this results in reduced numbers of fish in the population.

As most stocking involves a small number of farmed strains, breeding of farmed fish with wild trout results in potential genetic homogenisation of wild populations. The result could be the loss of local adaptations and loss of overall genetic adaptability; this is likely to be important if brown trout are to maintain their ability to adapt to changing environmental conditions such as global warming and new diseases.

Local adaptations that are important for survival in particular waters often are based on a relatively small number of genes. Adaptations such as the precise timing of spawning and emergence from the gravel, or the timing and direction of migration can occur within a few generations. Such behaviour often differs among wild trout populations: it is important that this is not disrupted.

In the United States, many unique forms of wild native rainbow trout and cutthroat trout have been lost or damaged by stocking with domesticated farm-reared rainbow trout. Similarly populations of migratory fish such as steelhead and pacific salmon have been lost or damaged by the introduction of fish from hatcheries where the selection of broodstock did not take account of the different forms of each species with different run timings, spawning timings and spawning locations: all highly heritable traits. (Benkhe, 2002)

The conservation of biodiversity was addressed at the Rio Earth Summit in 1992. It was recognised that species such as trout were genetically diverse and it was important to conserve this diversity rather than simply at the species level. In the United States, the Endangered Species Act has led to the recognition of 'evolutionarily significant units' or 'distinct population segments' to allow appropriate management of the different forms within a species. In the British Isles there is currently insufficient knowledge of the genetic diversity of wild trout to follow the US model, and a precautionary approach should be adopted to protect our wild fish.

This is reflected in the proposal in the latest reassessment of the UK's Biodiversity Action Plan that wild trout should be designated as a species requiring further research.

"The total diversity of a species would be significantly diminished if these life history forms were lost. The greater the range of diversity, the greater are the options for a species' continued existence and evolution into the future as it is exposed to changing environments." (Benkhe 2002)

Has the damage already been done?

In some parts of the British Isles stocking of farmed fish has been undertaken for many decades, and it has been argued that this will have led to widespread decline in native genetic diversity. There is no evidence of a widespread decline and stocking with farmed brown trout has a lesser genetic impact on wild populations than might be expected for many reasons, mostly associated with the domesticated nature and poor survival of farmed fish. However, there is evidence that interbreeding does occur (e.g. in the River Dove, Derbyshire) and the more stocking is carried out, the greater the likelihood of detrimental genetic changes occurring. In addition, stocking can result in a reduction in fitness of a wild population due to the low fitness of hybrids but without causing significant detectable genetic changes. (Ferguson, 2006)

Protection of Wild Trout

Stocking

Any decision to stock should be arrived at after careful and continual assessment of the reasons for wishing to stock. If wild trout production is low, the reasons should be explored and addressed. Commonly one or more habitat constraints may be limiting the production of wild trout. The WTT and its conservation partners can assist with identification of problems and suggesting remedies.

Supportive breeding

Supportive breeding is the production of trout in hatcheries using wild local broodstock caught annually from the water system to be stocked. Whilst this may seem to be an attractive option, because the stock fish are being produced from a native gene pool, there are pitfalls:

- Knowledge of the genetic population structure in the water concerned is required before supportive breeding is undertaken. In some systems there may be different populations of trout isolated from each other by differences in spawning time or location. Mixing of these stocks could lead to a breakdown of the natural population structure and loss of local adaptations.

- To prevent inbreeding, 25 or more of pairs of fish should be used for broodstock. This may represent a significant proportion of the breeding population in some systems and the loss of natural production resulting from the removal of broodstock should be considered against the gain from hatchery rearing.

- Fish produced can have reduced survival and reproductive success compared to wild fish.

If these pitfalls can be overcome, supportive breeding may represent the best available technique to sustain wild trout fisheries where natural reproduction is severely hampered by problems such as chronic abstraction, widespread insensitive land use, or entrenched policy positions.

<u>Non-breeding trout</u>

If stocking is necessary to sustain a fishery and supportive breeding is not a viable option, the WTT recommends that non-breeding trout (all-female triploids) are used as stock fish. These are sterile and cannot interbreed with wild fish. Triploids are produced by heat or pressure treating trout eggs to produce fish with three sets of chromosomes, rather than the usual two. Most farmed rainbow trout stocked into stillwater fisheries are triploid.

Except in the very rare locations where wild rainbow trout populations exist in the UK and Ireland, the WTT does not have a policy preference on the use of sterile brown trout in favour of sterile rainbow trout. Assuming that the process of creating triploids from diploid eggs has been effective, neither species will contribute to the gene pool of wild trout. However, since competition between wild and sterile brown and rainbow trout is poorly understood, the same precautionary principle that guides our position on stocking also suggests that sterile brown trout should be used in preference to sterile rainbows where wild trout are present.

Are Triploids Genetically Modified?

The common view of a Genetically Modified Organism (GMO) is that it is an organism that has been the subject of genetic engineering; that is, it has had its genetic material altered, usually by recombinant DNA technology. That technique involves the combination of DNA from different sources, in a test-tube, to create a new gene that is then inserted into an organism causing it to express new or altered traits. The key point is that new genetic material is introduced. Historically, the term GMO included organisms produced by cross-breeding but with the advent of DNA technology the term has become synonymous with 'genetically engineered organism'.

WTT's opinion is that triploid trout should not be viewed as GMOs as they do not have any genetic material introduced from other organisms, it is all their own. A triploid has an extra set of the same chromosomes it would have as a diploid. Indeed, triploid trout can and do occur at low levels in the wild. The process of inducing triploidy by heat or by pressure at the egg stage is an intervention by man: the change could be fairly described as genetic, but classing it as genetic engineering as defined above is misleading.

Stock level management

If stocking is carried out, careful consideration should be given to the number and size of fish introduced. In addition to genetic impacts, the introduction of farmed trout has more immediate impacts upon wild trout through competition for territory and predation upon juveniles.

If fish are being introduced to support catches, the size of fish introduced should not exceed the usual size of an adult wild trout and numbers introduced should typically result in no more than around 2 – 3 adult fish per 100m² of water surface area (including wild fish already present). In order to reduce behavioural and ecological impacts from the introduction of farmed trout it is best to stock little and often throughout the angling season, taking account of the numbers of fish harvested.

If smaller fish are being stocked, the numbers of wild trout present at each life-stage relative to the available habitat should be considered. For example, if spawning habitat is good but lack of juvenile habitat is restricting the population, there is no point stocking any juvenile fish as they will compete with existing wild juveniles for limited habitat. In this situation there is a case for stocking adult fish to support catches whilst the lack of juvenile habitat is addressed with a view to phasing out stocking once the habitat restriction has been removed.

If spawning habitat is restricting the population there may be a case for introducing eggs (via an incubation box) or fry, whilst working to improve spawning habitat.

Introduced fish should be non-breeding triploids or those produced by supportive breeding (see below). It is important to remember that introduced fish of any size will occupy habitat that could be used by wild fish; the first option should be to maximise wild production and use introduced fish only to fill unoccupied space.

Targeted harvesting

It is known that stocked adult farmed trout have a very poor survival rate during their first winter in the wild; non-breeding triploids have a slightly higher rate of survival than fertile fish. It is sensible to encourage anglers to harvest (only) the stocked fish, particularly towards the end of the season. This can be done if farmed trout are marked to distinguish them from wild trout by fin clipping or dye-marking. Encouraging the harvesting of farmed trout and catch-and release of wild trout will also reduce the genetic impact on wild trout where non-breeding stock fish are unavailable.

The catchment is crucial

It is essential that efforts and resources are targeted on addressing the catchment scale issues that affect habitat and water quality. The WTT advocates a comprehensive approach to fisheries-management that works towards the joint objectives of sustainable populations of trout whilst delivering gains to biodiversity. Local habitat restoration projects associated with sustainable landuse throughout catchments can deliver substantial improvements to the welfare of wild trout and many associated species and habitats. The WTT will work with new and existing rivers trusts to deliver these benefits.

Conclusion

The UK and Ireland's native trout populations represent an important part of these countries' natural heritage, in addition to being important biological indicators and valuable resources.

The WTT advocates the use of sustainable river and land management and habitat restoration to promote natural production of wild trout and the associated gains in biodiversity. It is vital that fisheries' interests receive appropriate technical, practical and financial assistance from statutory authorities and charitable organisations such as the WTT to achieve sustainable fisheries- management.

The WTT recognises that some fisheries may not always be able sustain viable populations of wild trout and they may have to rely on some form of supplementary stocking to support angling. However, before any stocking is undertaken the WTT recommends that fisheries managers should evaluate their individual stocking policies in terms of carrying capacities, and to identify any restrictions that may be limiting natural production of wild trout. In partnership with other stakeholders, fisheries managers also should seek to influence catchment-wide issues that affect the environment that wild trout need to thrive.

In order to help fishery managers and community groups in the UK and Ireland to understand, evaluate and implement the full range of habitat management options the WTT will maintain an advisory, practical, technical and financial service available to everyone working to create and manage habitats for wild trout.

If stocking is required for maintenance or recovery of a fishery where wild trout are present the WTT believes that the use of fertile farmed trout presents potential risks to both the genetic integrity and fitness of wild trout (especially native trout*)* populations.

In instances where stocking can be demonstrated as an appropriate management action

WTT recommends the adoption of the precautionary principle of using of all-female

sterile triploid trout unless a proven supportive breeding programme is possible.

Where stocking with egg-boxes is appropriate (that is, where all other habitat restrictions have been removed but limited recruitment remains), the WTT recommends the use of triploid eggs or those obtained from local broodstock.

The WTT acknowledges that in some exceptional circumstances, such as severe pollution incidents, there would be a justifiable need for restoration-stocking using farmed diploid fish. This should be undertaken only if it is impractical for natural re-colonisation and would ideally involve sourcing of broodstock from within the catchment.

These precautionary actions are necessary because there is insufficient information on the nature and extent of wild trout in the UK and Ireland. WTT would support further efforts to identify the full extent of genetically different populations of wild trout in the United Kingdom and Ireland. The WTT will support appropriate research into the understanding of wild trout and native trout through dedicated funding.

In delivering its objectives the WTT welcomes opportunities to work with public and private partners on wild trout conservation projects.

References

Benkhe, Robert J. (2002) *Trout and salmon of North America*. The Free Press, New York. ISBN 0-7432-2220-2

Ferguson, A. (2006) *Genetic impacts of stocking on indigenous brown trout populations.* Science Report: SC040071/SR Environment Agency.

SEPA Water Framework Directive Characterisation

As part of the development of the water framework directive SEPA have characterised water bodies into the following categories:

1a – At Risk
1b – At Risk (probably)
2a – Not at Risk (probably)
2b – Not at Risk

The water bodies of the Cromarty Firth region, their SEPA classifications and pressures leading to characterisation are shown in the tables below.

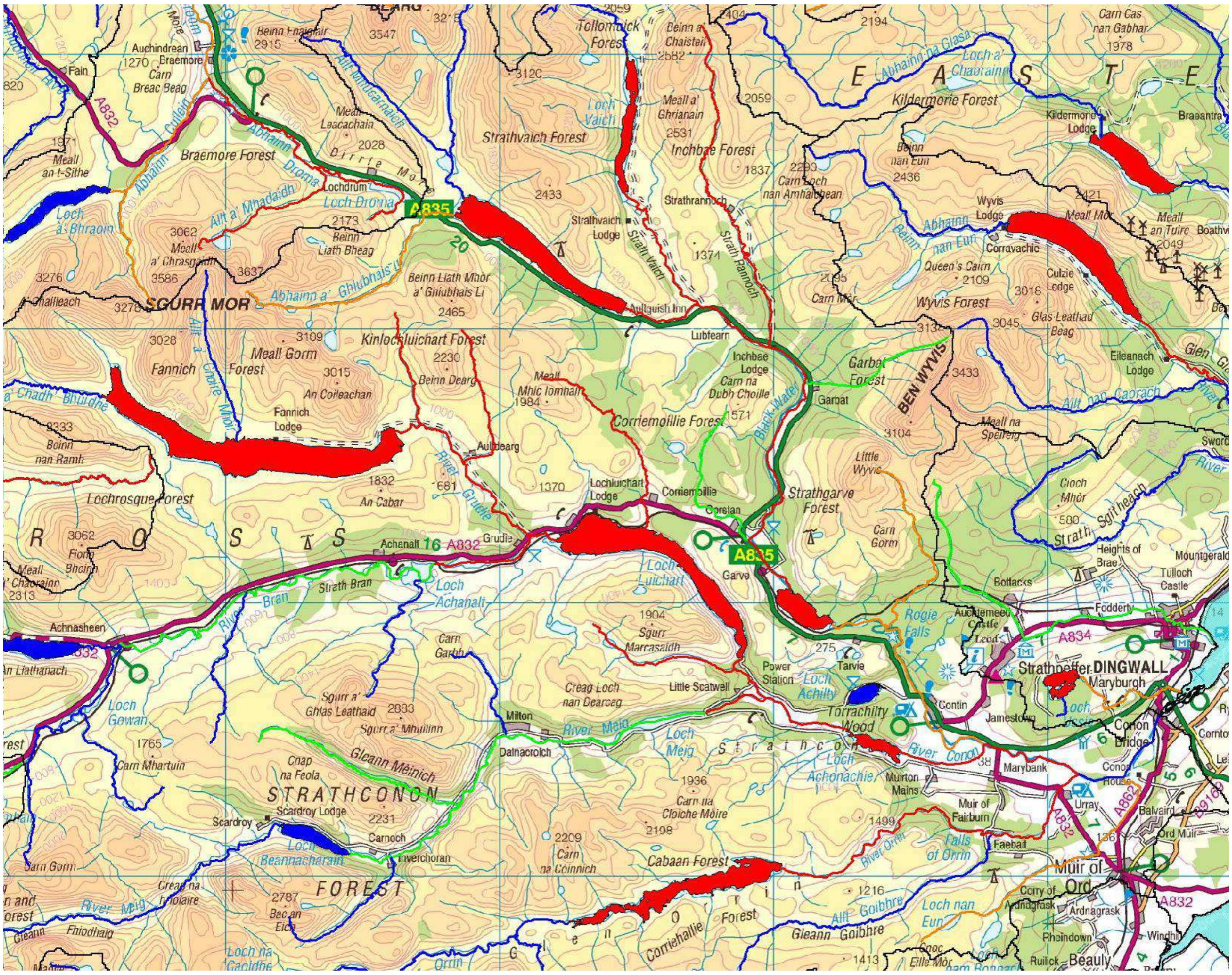
d	Name	Categoı	Artific	Moc	Length (r	Catchme	Catchment Name	reportinı	Pressure Description	Industry Sector Description	Purpose	Primary
20130	River Carron - sea to Allac	River	N	N	19823	13	River Carron (Sutherland)	2b				
20131	Abhainn a Ghlinne Mhoir	River	N	Y	26828	13	River Carron (Sutherland)	1a	Morphological Alterations	Production and distribution of electricity		
20131	Abhainn a Ghlinne Mhoir	River	N	Y	26828	13	River Carron (Sutherland)	1a	Flow Regulation	Production and distribution of electricity		Y
20131	Abhainn a Ghlinne Mhoir	River	N	Y	26828	13	River Carron (Sutherland)	1a	Abstraction	Production and distribution of electricity		
20132	Allt Feur-lochain	River	N	N	2863	13	River Carron (Sutherland)	2b				
20133	Allt a Ghlinne	River	N	N	7144	13	River Carron (Sutherland)	2b				
20134	Black Water	River	N	N	29635	13	River Carron (Sutherland)	1b	Morphological Alterations	Forestry, logging and related service activities		Y
20135	Garbh Allt / Salachie Burn	River	N	N	10180	13	River Carron (Sutherland)	2b				
20136	Water of Glencalvie	River	N	N	20513	13	River Carron (Sutherland)	1b	Morphological Alterations			Y
20137	Alladale River	River	N	N	11622	13	River Carron (Sutherland)	2b				
20139	Fearn Canal	River	N	N	13026	14	Cromarty Coastal	1a	Point Source Pollution	Sewage disposal activities		Y
20139	Fearn Canal	River	N	N	13026	14	Cromarty Coastal	1a	Diffuse Source Pollution	Manufacturing		
20139	Fearn Canal	River	N	N	13026	14	Cromarty Coastal	1a	Morphological Alterations	Growing of crops; market gardening; horticulture		Y
20139	Fearn Canal	River	N	N	13026	14	Cromarty Coastal	1a	Diffuse Source Pollution	Manufacturing		
20140	Garrick Burn	River	N	N	6107	14	Cromarty Coastal	1b	Morphological Alterations	Agriculture, Hunting and Forestry		Y
20141	Balnagown River	River	N	N	24814	14	Cromarty Coastal	2a	Morphological Alterations			Y
20142	Pollo Burn	River	N	N	17636	14	Cromarty Coastal	1a	Morphological Alterations	Growing of crops combined with farming of animals (r		Y
20142	Pollo Burn	River	N	N	17636	14	Cromarty Coastal	1a	Diffuse Source Pollution	Growing of crops combined with farming of animals		
20142	Pollo Burn	River	N	N	17636	14	Cromarty Coastal	1a	Diffuse Source Pollution	Manufacturing		
20142	Pollo Burn	River	N	N	17636	14	Cromarty Coastal	1a	Flow Regulation	Collection, purification and distribution of water		Y
20142	Pollo Burn	River	N	N	17636	14	Cromarty Coastal	1a	Flow Regulation	Recreational, cultural and sporting activities		
20142	Pollo Burn	River	N	N	17636	14	Cromarty Coastal	1a	Flow Regulation	Collection, purification and distribution of water		Y
20143	Rosskeen Burn - Cromarty	River	N	N	2551	14	Cromarty Coastal	1a	Morphological Alterations	Growing of crops combined with farming of animals		
2 143	Rosskeen Burn - Cromarty	River	N	N	2551	14	Cromarty Coastal	1a	Diffuse Source Pollution	Agriculture, Hunting and Forestry		
20143	Rosskeen Burn - Cromarty	River	N	N	2551	14	Cromarty Coastal	1a	Diffuse Source Pollution	Manufacturing		Y
20144	Rosskeen Burn - Tomich t	River	N	N	6449	14	Cromarty Coastal	1b	Morphological Alterations	Growing of crops combined with farming of animals (r		Y
20144	Rosskeen Burn - Tomich t	River	N	N	6449	14	Cromarty Coastal	1b	Diffuse Source Pollution	Refuse disposal activities		Y
20144	Rosskeen Burn - Tomich t	River	N	N	6449	14	Cromarty Coastal	1b	Flow Regulation	Collection, purification and distribution of water		Y
20146	River Skitheach	River	N	N	22853	14	Cromarty Coastal	2b				
20147	River Peffery	River	N	N	16050	14	Cromarty Coastal	1b	Morphological Alterations	Forestry, logging and related service activities		Y
20147	River Peffery	River	N	N	16050	14	Cromarty Coastal	1b	Point Source Pollution	Sewage disposal activities		
20147	River Peffery	River	N	N	16050	14	Cromarty Coastal	1b	Diffuse Source Pollution		Urban Development	
20147	River Peffery	River	N	N	16050	14	Cromarty Coastal	1b	Morphological Alterations	Growing of crops combined with farming of animals (r		Y
20147	River Peffery	River	N	N	16050	14	Cromarty Coastal	1b	Flow Regulation	Production and distribution of electricity		Y
20148	Ussie Burn - sea to Loch U	River	N	N	5158	14	Cromarty Coastal	1b	Flow Regulation			Y
20148	Ussie Burn - sea to Loch U	River	N	N	5158	14	Cromarty Coastal	1b	Morphological Alterations	Forestry, logging and related service activities		
20148	Ussie Burn - sea to Loch U	River	N	N	5158	14	Cromarty Coastal	1b	Morphological Alterations			Y
20148	Ussie Burn - sea to Loch U	River	N	N	5158	14	Cromarty Coastal	1b	Diffuse Source Pollution	Growing of crops combined with farming of animals		
20148	Ussie Burn - sea to Loch U	River	N	N	5158	14	Cromarty Coastal	1b	Flow Regulation	Collection, purification and distribution of water		Y
20149	Ussie Burn - Loch Ussie tc	River	N	N	992	14	Cromarty Coastal	2b				
20150	Newhall Burn	River	N	N	14421	14	Cromarty Coastal	1a	Morphological Alterations			
20150	Newhall Burn	River	N	N	14421	14	Cromarty Coastal	1a	Diffuse Source Pollution	Growing of crops combined with farming of animals (r		Y
20150	Newhall Burn	River	N	N	14421	14	Cromarty Coastal	1a	Diffuse Source Pollution	Sewage disposal activities		Y

20151	Rosemarkie Burn	River	N	N	5982	14 Cromarty Coastal	2b				
20152	Roskill Burn	River	N	N	10420	14 Cromarty Coastal	1b	Morphological Alterations	Growing of crops combined with farming of animals (ı		Y
20152	Roskill Burn	River	N	N	10420	14 Cromarty Coastal	1b	Diffuse Source Pollution	Growing of crops combined with farming of animals		
20152	Roskill Burn	River	N	N	10420	14 Cromarty Coastal	1b	Morphological Alterations	Forestry, logging and related service activities		
20152	Roskill Burn	River	N	N	10420	14 Cromarty Coastal	1b	Morphological Alterations		Flood defence	
20153	Killen Burn	River	N	N	11171	14 Cromarty Coastal	1a	Morphological Alterations	Forestry, logging and related service activities		Y
20153	Killen Burn	River	N	N	11171	14 Cromarty Coastal	1a	Diffuse Source Pollution	Growing of crops combined with farming of animals		
20153	Killen Burn	River	N	N	11171	14 Cromarty Coastal	1a	Morphological Alterations	Growing of crops combined with farming of animals		
20153	Killen Burn	River	N	N	11171	14 Cromarty Coastal	1a	Point Source Pollution	Sewage disposal activities		Y
20154	Big Burn (Munlochy)	River	N	N	7796	14 Cromarty Coastal	1b	Morphological Alterations	Growing of crops combined with farming of animals (ı		Y
20154	Big Burn (Munlochy)	River	N	N	7796	14 Cromarty Coastal	1b	Diffuse Source Pollution	Growing of crops combined with farming of animals (ı		Y
20154	Big Burn (Munlochy)	River	N	N	7796	14 Cromarty Coastal	1b	Morphological Alterations	Forestry, logging and related service activities		
20155	Allanglach Burn	River	N	N	6164	14 Cromarty Coastal	1b	Morphological Alterations			Y
100107	Loch Eye	Lake	N	N	n/a	14 Cromarty Coastal	1a	Diffuse Source Pollution	Recreational, cultural and sporting activities		Y
100107	Loch Eye	Lake	N	N	n/a	14 Cromarty Coastal	1a	Morphological Alterations	Recreational, cultural and sporting activities		
100139	Loch Ussie	Lake	N	N	n/a	14 Cromarty Coastal	1a	Morphological Alterations	Recreational, cultural and sporting activities		Y
100139	Loch Ussie	Lake	N	N	n/a	14 Cromarty Coastal	1a	Flow Regulation	Collection, purification and distribution of water		Y
100139	Loch Ussie	Lake	N	N	n/a	14 Cromarty Coastal	1a	Diffuse Source Pollution	Agriculture, Hunting and Forestry		
20156	Alness River - Cromarty Fi	River	N	N	14437	15 River Alness	2b				
20157	Alness River - Strone to L	River	N	N	3767	15 River Alness	2b				
20158	Abhainn na Glasa - Loch M	River	N	N	20531	15 River Alness	2b				
20159	Black Water	River	N	N	15682	15 River Alness	2b				
20160	Allt na Seasgaich	River	N	N	7760	15 River Alness	2b				
100111	Loch Morie	Lake	N	N	n/a	15 River Alness	1a	Morphological Alterations	Recreational, cultural and sporting activities		Y
100111	Loch Morie	Lake	N	N	n/a	15 River Alness	1a	Flow Regulation	Operation of fish hatcheries and fish farms		Y
20161	River Glass - Cromarty Fir	River	N	N	8409	16 River Glass	1b	Abstraction	Collection, purification and distribution of water		
20162	River Glass - Redburn to L	River	N	N	4657	16 River Glass	1a	Morphological Alterations	Collection, purification and distribution of water		
20162	River Glass - Redburn to L	River	N	N	4657	16 River Glass	1a	Abstraction	Collection, purification and distribution of water		Y
20162	River Glass - Redburn to L	River	N	N	4657	16 River Glass	1a	Abstraction	Production and distribution of electricity		
20162	River Glass - Redburn to L	River	N	N	4657	16 River Glass	1a	Flow Regulation	Collection, purification and distribution of water		Y
20163	Abhainn Beinn nan Eun - I	River	N	N	10911	16 River Glass	2b				
20164	Allt nan Caorach	River	N	N	13314	16 River Glass	2b				
100115	Loch Glass	Lake	N	N	n/a	16 River Glass	1a	Morphological Alterations	Collection, purification and distribution of water		Y
100115	Loch Glass	Lake	N	N	n/a	16 River Glass	1a	Flow Regulation	Collection, purification and distribution of water		Y
20165	River Conon - Cromarty Fi	River	N	N	4467	17 River Conon	1b	Flow Regulation	Production and distribution of electricity		Y
20165	River Conon - Cromarty Fi	River	N	N	4467	17 River Conon	1b	Diffuse Source Pollution		Land Draina	Y
20165	River Conon - Cromarty Fi	River	N	N	4467	17 River Conon	1b	Diffuse Source Pollution		Land Draina	Y
20166	River Conon - Orrin conflu	River	N	Y	7654	17 River Conon	1b	Morphological Alterations	Production and distribution of electricity		Y
20166	River Conon - Orrin conflu	River	N	Y	7654	17 River Conon	1b	Flow Regulation	Production and distribution of electricity		Y
20166	River Conon - Orrin conflu	River	N	Y	7654	17 River Conon	1b	Morphological Alterations	Growing of crops combined with farming (	Land Reclama	
20167	River Conon - Loch Achon	River	N	Y	5738	17 River Conon	1a	Morphological Alterations	Production and distribution of electricity		Y
20167	River Conon - Loch Achon	River	N	Y	5738	17 River Conon	1a	Flow Regulation	Production and distribution of electricity		Y
20167	River Conon - Loch Achon	River	N	Y	5738	17 River Conon	1a	Abstraction	Production and distribution of electricity		Y
20168	River Bran - Loch Luichart	River	N	Y	5102	17 River Conon	1a	Morphological Alterations	Production and distribution of electricity		Y

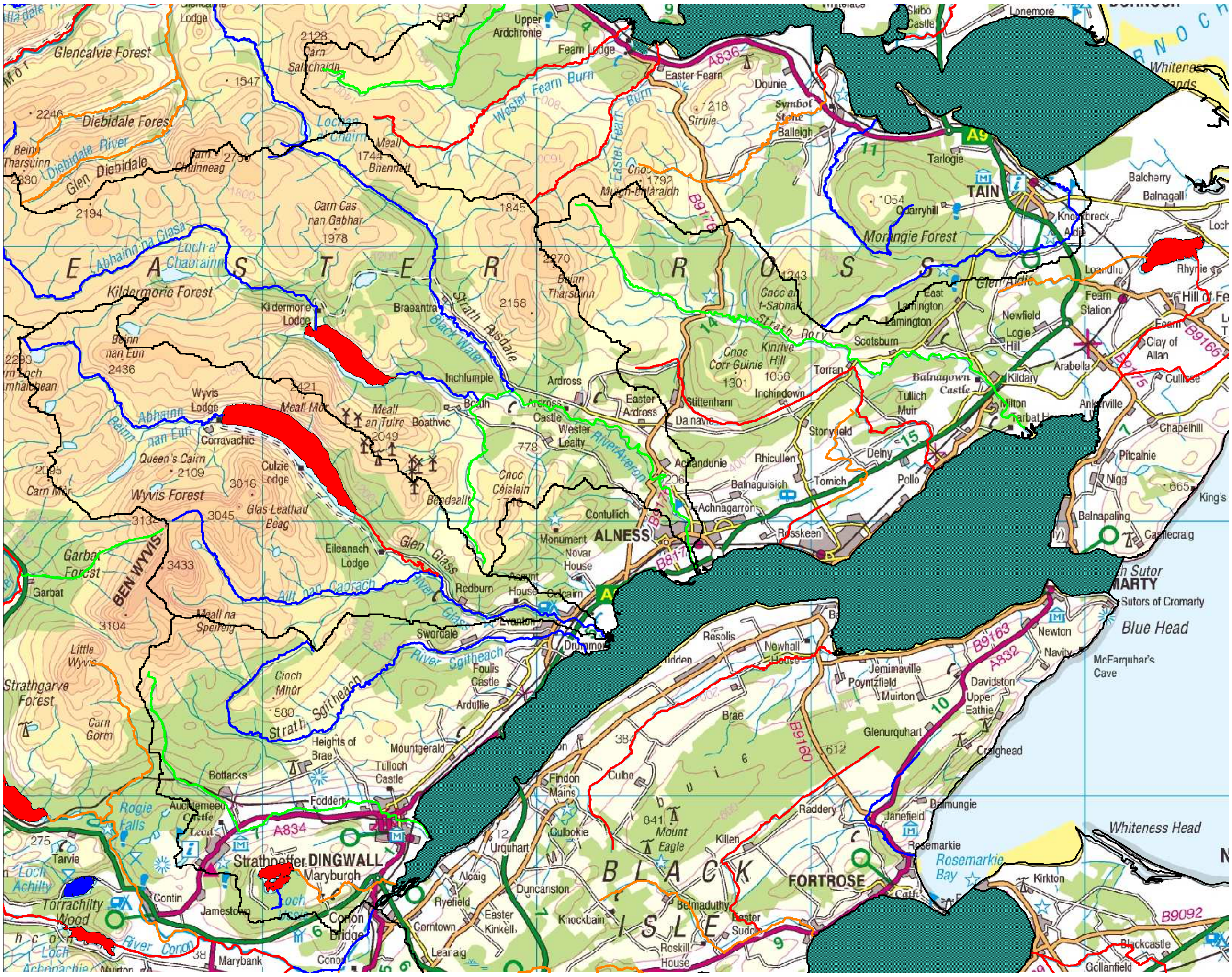
20168	River Bran - Loch Luichart	River	N	Y	5102	17 River Conon	1a	Abstraction	Production and distribution of electricity	Y
20168	River Bran - Loch Luichart	River	N	Y	5102	17 River Conon	1a	Morphological Alterations	Production and distribution of electricity	Y
20168	River Bran - Loch Luichart	River	N	Y	5102	17 River Conon	1a	Flow Regulation	Production and distribution of electricity	Y
20169	River Bran - Loch Achanal	River	N	N	16428	17 River Conon	2a	Morphological Alterations	Production and distribution of electricity	Y
20170	Abhainn Loch a' Chroisg	River	N	N	1532	17 River Conon	2a	Morphological Alterations		Y
20171	Abhainn Dubh	River	N	N	8758	17 River Conon	2a	Morphological Alterations		Y
20172	Logie Burn - Cromarty Firl	River	N	N	3730	17 River Conon	1b	Morphological Alterations	Growing of crops combined with farming of animals	
20172	Logie Burn - Cromarty Firl	River	N	N	3730	17 River Conon	1b	Point Source Pollution	Sewage disposal activities	
20173	Logie Burn - Muir of Ord t	River	N	N	8127	17 River Conon	1b	Morphological Alterations	Manufacture of food products, beverages and tobacco	Y
20173	Logie Burn - Muir of Ord t	River	N	N	8127	17 River Conon	1b	Point Source Pollution	Manufacture of food products, beverages and tobacco	Y
20173	Logie Burn - Muir of Ord t	River	N	N	8127	17 River Conon	1b	Morphological Alterations	Manufacture of food products, beverages and tobacco	
20173	Logie Burn - Muir of Ord t	River	N	N	8127	17 River Conon	1b	Point Source Pollution	Manufacture of food products, beverages and tobacco	Y
20174	River Orrin - Conon conflu	River	N	Y	15070	17 River Conon	1a	Morphological Alterations	Production and distribution of electricity	Y
20174	River Orrin - Conon conflu	River	N	Y	15070	17 River Conon	1a	Abstraction	Operation of fish hatcheries and fish farms	Y
20174	River Orrin - Conon conflu	River	N	Y	15070	17 River Conon	1a	Morphological Alterations	Other mining and quarrying	Y
20174	River Orrin - Conon conflu	River	N	Y	15070	17 River Conon	1a	Abstraction	Production and distribution of electricity	Y
20174	River Orrin - Conon conflu	River	N	Y	15070	17 River Conon	1a	Flow Regulation	Production and distribution of electricity	Y
20174	River Orrin - Conon conflu	River	N	Y	15070	17 River Conon	1a	Abstraction	Production and distribution of electricity	
20175	River Orrin - Orrin Reserv	River	N	N	2262	17 River Conon	2a			
20176	River Orrin - upper catchn	River	N	N	24549	17 River Conon	2a			
20177	Allt Goibhre	River	N	N	15248	17 River Conon	1a	Abstraction	Production and distribution of electricity	Y
20180	Black Water - Loch Garve	River	N	N	9533	17 River Conon	1b	Flow Regulation	Production and distribution of electricity	Y
20180	Black Water - Loch Garve	River	N	N	9533	17 River Conon	1b	Morphological Alterations	Forestry, logging and related service activities	
20182	Abhainn a' Gharbhrain	River	N	N	19350	17 River Conon	2a			
20183	Rogie Burn	River	N	N	8640	17 River Conon	1b	Morphological Alterations	Forestry, logging and related service activities	Y
20183	Rogie Burn	River	N	N	8640	17 River Conon	1b	Diffuse Source Pollution	Forestry, logging and related service activities	Y
20183	Rogie Burn	River	N	N	8640	17 River Conon	1b	Abstraction	Production and distribution of electricity	
20184	Allt a' Mhuilinn	River	N	N	6881	17 River Conon	1b	Morphological Alterations	Forestry, logging and related service activities	Y
20184	Allt a' Mhuilinn	River	N	N	6881	17 River Conon	1b	Flow Regulation	Collection, purification and distribution of water	Y
20185	Allt a' Gharbh Bhaid	River	N	N	6134	17 River Conon	1b	Morphological Alterations	Forestry, logging and related service activities	Y
20186	Abhainn Srath Rannoch	River	N	Y	14925	17 River Conon	1b	Morphological Alterations	Production and distribution of electricity	Y
20186	Abhainn Srath Rannoch	River	N	Y	14925	17 River Conon	1b	Flow Regulation	Production and distribution of electricity	Y
20186	Abhainn Srath Rannoch	River	N	Y	14925	17 River Conon	1b	Morphological Alterations	Forestry, logging and related service activities	
20187	Abhainn Srath a' Bhathaic	River	N	Y	6015	17 River Conon	1a	Flow Regulation	Production and distribution of electricity	Y
20187	Abhainn Srath a' Bhathaic	River	N	Y	6015	17 River Conon	1a	Abstraction	Production and distribution of electricity	Y
20188	Allt Tom nan Muc	River	N	Y	5093	17 River Conon	1a	Morphological Alterations	Production and distribution of electricity	Y
20188	Allt Tom nan Muc	River	N	Y	5093	17 River Conon	1a	Flow Regulation	Production and distribution of electricity	Y
20189	Abhainn an Torrain Duibh	River	N	Y	10222	17 River Conon	1b	Flow Regulation	Production and distribution of electricity	Y
20189	Abhainn an Torrain Duibh	River	N	Y	10222	17 River Conon	1b	Morphological Alterations	Production and distribution of electricity	
20190	River Meig - Conon conflu	River	N	Y	2473	17 River Conon	1a	Morphological Alterations	Production and distribution of electricity	Y
20190	River Meig - Conon conflu	River	N	Y	2473	17 River Conon	1a	Flow Regulation	Production and distribution of electricity	Y
20190	River Meig - Conon conflu	River	N	Y	2473	17 River Conon	1a	Abstraction	Production and distribution of electricity	Y
20191	River Meig - Loch Meig to	River	N	N	15114	17 River Conon	2a			
20192	River Meig - Inverchoran t	River	N	N	1739	17 River Conon	2a			

20193	River Meig - Loch Beanna(	River	N	N	15632	17 River Conon	2a			
20194	Allt Bail a' Mhuilinn	River	N	N	4646	17 River Conon	2a			
20195	Allt Gleann Meinich	River	N	N	9829	17 River Conon	2a	Morphological Alterations	Production and distribution of electricity	Y
20196	Allt Gleann Chorainn	River	N	N	6472	17 River Conon	2a	Flow Regulation	Production and distribution of electricity	Y
20197	Allt a' Ghlinne	River	N	N	6239	17 River Conon	2a	Morphological Alterations	Production and distribution of electricity	Y
20198	Allt Coire Mhuilidh	River	N	N	8888	17 River Conon	1b	Flow Regulation	Production and distribution of electricity	Y
20198	Allt Coire Mhuilidh	River	N	N	8888	17 River Conon	1b	Abstraction	Production and distribution of electricity	
20199	River Grudie - Bran conflu	River	N	Y	6686	17 River Conon	1b	Flow Regulation	Production and distribution of electricity	Y
20199	River Grudie - Bran conflu	River	N	Y	6686	17 River Conon	1b	Morphological Alterations	Forestry, logging and related service activities	
20200	Abhainn a' Chadh' Bhuidh	River	N	N	9268	17 River Conon	2a			
20201	Allt Dearg	River	N	Y	6333	17 River Conon	1a	Abstraction	Production and distribution of electricity	Y
20201	Allt Dearg	River	N	Y	6333	17 River Conon	1a	Flow Regulation	Production and distribution of electricity	Y
20202	Allt a' Choin Idhir	River	N	Y	4626	17 River Conon	1a	Morphological Alterations	Production and distribution of electricity	Y
20202	Allt a' Choin Idhir	River	N	Y	4626	17 River Conon	1a	Abstraction	Production and distribution of electricity	Y
20202	Allt a' Choin Idhir	River	N	Y	4626	17 River Conon	1a	Flow Regulation	Production and distribution of electricity	Y
20203	Allt a' Choire Mhoir	River	N	N	6785	17 River Conon	2a			
20204	Allt Bad an Fhliuchaidh	River	N	N	6523	17 River Conon	2a			
20205	Allt a' Chomair	River	N	N	6891	17 River Conon	2a			
20206	Abhainn a' Chomair	River	N	N	18200	17 River Conon	2a			
20839	River Grudie - outflow fro	River	N	Y	1255	17 River Conon	1a	Morphological Alterations	Production and distribution of electricity	Y
20839	River Grudie - outflow fro	River	N	Y	1255	17 River Conon	1a	Flow Regulation	Production and distribution of electricity	Y
23379	Black Water - Garbat to B	River	N	N	5200	17 River Conon	1b	Flow Regulation	Production and distribution of electricity	Y
23379	Black Water - Garbat to B	River	N	N	5200	17 River Conon	1b	Morphological Alterations	Production and distribution of electricity	Y
23379	Black Water - Garbat to B	River	N	N	5200	17 River Conon	1b	Morphological Alterations	Forestry, logging and related service activities	
23379	Black Water - Garbat to B	River	N	N	5200	17 River Conon	1b	Abstraction	Production and distribution of electricity	Y
23379	Black Water - Garbat to B	River	N	N	5200	17 River Conon	1b	Morphological Alterations	Recreational, cultural and sporting activities	Y
23380	Glascarnoch River - Black	River	N	N	3165	17 River Conon	1b	Flow Regulation	Production and distribution of electricity	Y
23380	Glascarnoch River - Black	River	N	N	3165	17 River Conon	1b	Morphological Alterations	Production and distribution of electricity	Y
23380	Glascarnoch River - Black	River	N	N	3165	17 River Conon	1b	Morphological Alterations	Recreational, cultural and sporting activities	Y
23380	Glascarnoch River - Black	River	N	N	3165	17 River Conon	1b	Abstraction	Production and distribution of electricity	Y
23380	Glascarnoch River - Black	River	N	N	3165	17 River Conon	1b	Morphological Alterations	Forestry, logging and related service activities	
23392	Black Water - Conon Conf	River	N	N	10042	17 River Conon	2a			
.00108	Loch Vaich	Lake	N	Y	n/a	17 River Conon	1a	Morphological Alterations	Production and distribution of electricity	Y
.00108	Loch Vaich	Lake	N	Y	n/a	17 River Conon	1a	Flow Regulation	Production and distribution of electricity	Y
.00113	Loch Glascarnoch	Lake	Y	N	n/a	17 River Conon	1a	Morphological Alterations	Production and distribution of electricity	Y
.00113	Loch Glascarnoch	Lake	Y	N	n/a	17 River Conon	1a	Abstraction	Production and distribution of electricity	Y
.00113	Loch Glascarnoch	Lake	Y	N	n/a	17 River Conon	1a	Flow Regulation	Production and distribution of electricity	Y
100124	Loch Fannich	Lake	N	Y	n/a	17 River Conon	1a	Morphological Alterations	Production and distribution of electricity	Y
100124	Loch Fannich	Lake	N	Y	n/a	17 River Conon	1a	Abstraction	Production and distribution of electricity	
100124	Loch Fannich	Lake	N	Y	n/a	17 River Conon	1a	Flow Regulation	Production and distribution of electricity	Y
100131	Loch Luichart	Lake	N	Y	n/a	17 River Conon	1a	Morphological Alterations	Production and distribution of electricity	Y
100131	Loch Luichart	Lake	N	Y	n/a	17 River Conon	1a	Abstraction	Production and distribution of electricity	
100131	Loch Luichart	Lake	N	Y	n/a	17 River Conon	1a	Flow Regulation	Production and distribution of electricity	Y
100134	Loch Garve	Lake	N	N	n/a	17 River Conon	2b			
100137	Loch a' Chroisg	Lake	N	N	n/a	17 River Conon	2b			
100140	Loch Achilty	Lake	N	N	n/a	17 River Conon	2b			
100142	Loch Achonachie	Lake	Y	N	n/a	17 River Conon	1a	Morphological Alterations	Production and distribution of electricity	Y
100142	Loch Achonachie	Lake	Y	N	n/a	17 River Conon	1a	Abstraction	Production and distribution of electricity	
100142	Loch Achonachie	Lake	Y	N	n/a	17 River Conon	1a	Morphological Alterations	Forestry, logging and related service activities	Y
100142	Loch Achonachie	Lake	Y	N	n/a	17 River Conon	1a	Flow Regulation	Production and distribution of electricity	Y
100146	Loch Beannacharain	Lake	N	Y	n/a	17 River Conon	2b			
100148	Orrin Reservoir	Lake	Y	N	n/a	17 River Conon	1a	Morphological Alterations	Production and distribution of electricity	Y
100148	Orrin Reservoir	Lake	Y	N	n/a	17 River Conon	1a	Flow Regulation	Production and distribution of electricity	Y
100148	Orrin Reservoir	Lake	Y	N	n/a	17 River Conon	1a	Abstraction	Production and distribution of electricity	Y

The SEPA water body characterisations for management unit 1 are shown on the map below.
1(a) Waterbodies are shown in red
1(b) Waterbodies are shown in orange.



The SEPA waterbody characterisations for management units 2-8 are shown on the map below.
1(a) waterbodies are shown in red.
1(b) waterbodies are shown in orange



6.12 Fisheries development

The highest priority, either for the maintenance of existing fisheries or the development of new fisheries is that they do not compromise the biological sustainability of the fish stocks they depend on. For salmon and sea-trout genetic population mapping will be important in understanding how each fishery impacts on individual populations.

Catch and release has proved a valuable tool in allowing rod fisheries to continue whilst maintaining spawning escapement. This can be seen in recent fishery development work on the Alness which has increased fishing effort and rod catch but because of the increasing proportion of fish released in anglers has reduced the number of fish killed.

The Cromarty Firth Fishery Board has invited Roger Dowsett from Troutquest (who carried out the angling development and promotion work on the Alness) to look at similar opportunities on the Conon, Blackwater and other tributaries.

Information gained from the Moray Firth Sea Trout Project starting in 2008 will be used to ensure the sustainability of existing fisheries and of any potential development.

The proposed survey work on hill lochs in the region will inform of potential to develop sustainable brown trout angling tourism.

Ferox trout are known to be present in several larger lochs in the region. At present there is limited angling activity for ferox trout. Because of their biology caution and an effective conservation policy should be employed in any angling development.

There are existing still water rainbow trout fisheries at Loch Achilty, Loch Orrin, Tarvie and Invergordon. There are still water brown trout fisheries at Loch Achonachie, Loch Scardroy, Loch Eye and Loch Cran. There are biosecurity and genetic issues associated with the stocking of some of these stillwaters which would be explored in the proposed Biosecurity Plan for the region.

There is some scope for the development of recreational fisheries for non-salmonid species. There is already a pike fishery on the lochs of the Rivers Bran and Blackwater which could be further developed. The hire of boats could provide local income and could be linked to the development of fly fishing for pike which has increased in popularity in recent years.

Other coarse fishing opportunities in the region are limited by the natural distribution of fish species and the introduction of species outside their normal biological range should be discouraged.

SEPA fish surveys backed up by bailiffing evidence show the presence of several marine and estuarine species in the Cromarty Firth which have potential for recreational angling. Mackerel, sea-bass and grey mullet are all present in the Firth.

The precautionary approach should be applied to any proposal for the development of new commercial fisheries in the coastal zone. In particular the risk of by catch of sea trout should be considered.

There may be some scope for linking angling development work with other freshwater environmental education initiatives to meet the aims of the Scottish Government Strategic Framework for Freshwater Fisheries.

Section 7. Potential Management Actions

7.1 Prioritisation of issues identified in Section 6.

Issue				Management units								
	1.1	1.2	1.3	1.4	1.5	2	3	4	5	6	7	8
Obstructions	H	H	H	H	H	H	M	H	M	H	M	M
Exploitation (illegal)	H			H	H	H	H	H	H	H	H	H
Biosecurity	H	H	H	H	H	H	H	H	H	H	H	H
Climate change	M	M	M	M	M	M	M	M	M	M	M	M
Predation	H	H	H	H	H	H	H			H		
Exploitation (legal)	H				H	H	H	H	H			
unknown genetic status of stocks	H	H	H	H	H	H	H	H	H	H	H	H
Channel modification	M		M	M	M	M	M	M	M	M	M	M
Commercial forestry			M	M	H	H	M	H	M	H	H	
Riparian overgrazing /erosion		H	H	H	H	H	M	M	M		M	
Cultural oligotrophication		H	H	H	H	H						
status of other fish species	H	H	H	H	H	H	H	H	H	H	H	H
Alien plant species	M			M	M	M	M	M	M	M	M	M
status of sea trout	H				H	H	H	H	H	H	H	H
Flow regulation	H	H	H	H	H	H						
agricultural run off / sedimentation							M		M	M	H	H
Sediment transfer	H		H	H	H							
Smolt loss		H				M						
Info on still waters/hill lochs		M	M	M	M	M	M	M	M			
Trout stocking			M	M								
Monitoring Large water bodies	H	H	H	H	H	H						
Alien animal species	M			M	M					M		M
mixing of flows		M	M	M	M							
Water quality	M						M		M	M		M
Abstraction				M		M	H					M
Aquaculture	M			M								
other recreation use	M					M						

Analysis of Potential Management Options

7.2 Potential management strategies to deal with prioritised issues and associated challenges.

7.3 Expectations from each management solution proposed.

7.4 Potential solutions in the context of the existing legislative frameworks.

7.5 Consider how your organisation will formally assess the effect of specified solutions (e.g. ensuring adequate baseline / follow-up monitoring).

7.6 Financial cost-benefit analysis for each solution identified.

7.7 Potential sources of funding to implement management options considered above.

7.2 -7.7

Climate change
The issue of the increased risk of damaging floods and redd washout can be mitigated for by maintaining a hatchery programme which incubates some eggs in the relatively stable and safe hatchery environment. This approach requires a risk assessment to ensure that the benefits of ensuring survival during incubation are not outweighed by negative impacts of hatchery manipulation.

The issue of rising temperatures and drought risk could be mitigated for by ensuring access to colder, higher upper catchment areas. This may happen naturally in some areas as increased autumn rainfall and temperatures allow fish to penetrate further upstream. The two areas of greatest potential are the Upper Orrin and Upper Meig with some potential in the headwaters of the Alness above Kildermorie.

1) Restoration of access for salmon to the Upper Orrin above Orrin Dam

Expected outcome
Restore access to 150,252 m2 of favourable habitat
Produce 5,000 – 12,000 smolts per year (lowest recorded output 3 / 100m2 highest 8 / 100m2)
Produce 250- 600 returning adult salmon (based on current 5% return rate)
* Note in first year after dam construction in 1959 over 1,000 adults passed through Dam.

Flow regime which successfully allowed smolt exit in 2006 included in CAR licence for operation of Orrin Dam.

Monitoring by installing rotary screw trap at foot of Orrin Dam and counting returning salmon at adult trap below Dam.

Cost Moderate. Involves:-
Operation of adult trap at below Orrin Dam & trucking fish above dam.
Stocking with eyed ova above dam until sufficient adults return to become self sustaining.
Monitoring: - 8 weeks smolt trapping, 1 days electro fishing.

Benefit High:-
Would give managed retreat into colder higher habitat as climate change progresses.
Would allow a sustainable rod and line fishery to be established on the Lower Orrin as well as enhancing fisheries downstream of Orrin mouth.
At a 15% exploitation rate this could increase rod catch by 40 – 90 salmon per year generating an extra £68,000 - £153,000 per year in economic activity (£1,700 / rod caught salmon).

Funding.
SSE already funds the DSFB to carry out trapping and trucking exercise.
Smolt trapping and electro-fishing monitoring either funded by Trust or seek exterior funding

2) Improvement in access to Upper Meig at Corriefeol.

Expected outcomes:-
Enhance access to 121,363 m2 of favourable habitat for juvenile salmon.
Produce extra 3,700 – 9,700 smolts per year.
Produce an extra 185- 485 adult salmon per year.

CAR licence required for fish pass improvement works. Site visit with SEPA suggest that fees for licence likely to be waived because of environmental benefit.

Monitor by number of adults passing through Meig Dam fish counter.
Potential for PIT tagging project as decoders already installed at Meig and Tor Achilty.

Cost- High
Engineering design has been commissioned; works will be put out to tender to get final cost.

Benefit- High
Long term sustainable increase in smolt production from an upper catchment.
Likely to benefit spring salmon stocks.
May provide refuge area from effects of climate change.
Increase in rod catch downstream maintaining the viability of fisheries.

Funding
Some funding may be available through the Trust and Board but likely that external fundraising will be required.

The restoration of riparian woodland particularly in upper catchments would reduce evaporation and decrease extremes of summer temperature by shading.

Expected outcomes:-
Restore nutrient status and productivity of upper catchments.
Reduce excessive summer temperatures and evaporation by shading.
Reduce erosion and siltation of nursery habitat.

May be landscape issues and deer access / management issues.

Monitoring by electro-fishing before and after works.

Cost: - High
Even with improved deer management, extensive deer fencing and water gates would be required.
A tree nursery producing trees of local origin would be advantageous if planting could be undertaken on a large enough scale.

Benefits;
In the short term are likely to be moderate but in the longer term may be very important in maintaining habitat that is suitable for juvenile salmon as temperatures increase.
Has a much wider ecological benefit than just a fishery issue, with benefits for hydrology, flora, fauna and landscape.

Funding
Beyond present resources of DSFB or Trust. Requires significant grant funding through agri-environmental and biodiversity initiatives. Possible EU funding.

By developing research links with rivers further south in Europe it should be possible to see the effects of climate change and the effectiveness of management strategies at the southern edge of the range of Atlantic salmon and other northern species. Rivers in the Asturias region of Northern Spain have a similar mix of catchment altitude and land-use (including hydro) to the Cromarty Firth region. European funding could be available for such a project.

Expected outcomes
Produce data on climate change at sites of similar altitude and habitat types.
Produce data on effects of climate change on habitats and fish stocks.
Learn from management options employed.

Animal welfare licensing may be required for research.

Monitoring protocols would need to be developed but are likely to include electro-fishing, habitat surveying and photographic methods.

Cost; moderate
Benefit; could be significant in longer term

Funding European funding through LEADER may be available

Biosecurity

Produce Biosecurity Plan for the region. Funding may be available through RAFTS.

Maintain and develop current *Gyrodactylus salaris* awareness campaign using; posters / leaflets press and media, seminars, signage at access points and angler declaration scheme. Develop liaison with canoeists and other watersports interests.

Disinfection of Board / Trust staff and equipment when working between catchments.

Encourage similar disinfection protocols by SEPA, Scottish Water and other public bodies via SEPA AAG.

Enforce legislation on fish movements. Scottish Gov & DSFB.

Prepare for Biosecurity risks posed by species and pathogens either already present in UK or at risk of introduction.
Minimise risk of introduction or spread of such species.

Liaise with Scottish Government, SEPA, SNH and ASFB

Monitor fish numbers and check fish health during survey work.

Cost; Moderate / Low
Time cost in production of Biosecurity plan.
Organisation of awareness campaign; distribution of leaflets / posters, signage and angler declaration forms.

Benefits; High
Consequences of introduction of *Gyrodactylus salaris*. Risk from other pathogens.

Funding
Awareness campaign Board
Biosecurity Plan possible RAFTS funding in 2008.

Exploitation (Illegal)

Maintain fishery protection patrols / surveillance of rivers by bailiffs

Maintain coastal patrols by boat, sea kayak and Scottish Fishery Protection Agency funded helicopter.

Maintain / develop liaison with police, neighbouring fishery boards and other agencies.

Develop and publicise Operation Fishnet look for sponsorship.
Ensure legal operation of netting stations by awareness information campaign supported by Bailiffing enforcement.

Raise profile of salmon poaching as wildlife crime.

Maintain regular training / skills audit to ensure bailiffs are fully trained and comply with current legislation and best practice.

Outcomes;
Maximise spawning escapement of all stocks. Ensure compliance with current legislation by anglers and netsmen. Minimise exploitation by illegal methods.

Apply 2003 Consolidation Act. Ensure Bailiffs are fully aware of current legislation and enforce in accordance with IFM / ASFB training manual.
Child protection issues, human rights / surveillance issues.

Monitored by notebook and diary reports kept by Bailiffs.

Cost; High
Over 500 man days per year for region.
Boat costs.
Vehicle costs.
Training costs / equipment costs.

Benefit; High
Current level of illegal activity much reduced on recent and historical levels.
Potential for large damage to stocks.

Funding:
Board, boat costs offset by contribution from neighbouring Boards.

Look for funding for boat patrols through Operation Fishnet from SNH, WDCS, and other sponsors such as Talisman.

Exploitation (Legal)

Maintain effective conservation policies for both rod & line and net fisheries.

Collect catch data and link to adequacy of spawning escapement.

Modify conservation policy in line with estimated adequacy of spawning escapement of different stocks applying the precautionary principle.

Investigate the development of new fisheries but only on the basis of sustainable fish stocks. This will require monitoring of stocks and exploitation rates.

Outcomes;
Maximise spawning escapement of exploited stocks. Maintain viable existing fisheries And develop new sustainable fisheries as appropriate.

Current conservation policy is by voluntary agreement and should remain so unless it ceases to be effective when compulsion under the 2003 Consolidation Act could be considered.

Use catch returns to determine level of compliance with policy. Use fish counters and traps to assess adequacy of escapement.

Cost; Low.
Production and promotion of annual conservation policy.

Benefit: High
Currently 60% return rate of rod caught salmon.

Funding
Board

Obstructions

1. Conon

Implement stocking strategy set out in Section 5.

Outcomes;
Maintain salmon stocks and sustainable fisheries by mitigating for the effects of hydro development. Mitigate for effects of climate change.

CAR licenses required for hatchery abstractions. Close liaison required with SSE who own and maintain the hatchery facilities.

Monitoring:
Electro-fishing monitoring programme, smolt trapping programme, PIT tagging programme, research into stocking densities and genetics.

Cost; High
323 man days
3,500 miles

Benefit; High
Has maintained a sustainable run of salmon to the Blackwater and other tributaries for more than 50 years. Has supported viable fisheries after hydro development.
Has given opportunities for collaborative research projects with FRS and others

Funding
SSE / Board

1.1 Conon

Tor Achilty Dam.
Maximise smolt survival through turbines by maintaining flow at over 2 MW during smolt run in line with findings of balloon tagging research. SSE

Maintain operation of Borland Lift and monitor fish passage by use of counter and PIT tag decoder.

Conon Falls / Luichart Dam

Maintain freshet regime to give variation in flow allowing fish to access and ascend Conon Falls fish ladder.

Maintain operation of Borland Lift and monitor fish passage by use of counter.

Install PIT decoder.

Maintain downstream passage by smolt transfer from Bran trap.

Glenmarskie

Divert flow of burn into original channel during smolt run to allow passage.

Stock upstream of intake.

Distillery Weir

Liaise with Glen Ord distillery to improve passage and screening.

1.2 Bran

Achanalt Falls

Maintain operation of fish ladder.

Achanalt Barrage

Operate smolt trap and transfer smolts to below Tor Achilty.

Outcomes:
Maintain run of salmon to the River Bran & support fisheries downstream.
Compensate for lost Blackwater production due to hydro development.
Provides opportunities for research projects with entire smolt run trapped.

Requires close liaison with SSE on flow regimes. Some research may require Home Office Licence under animal welfare legislation if no direct local management outcome produced.

Monitoring by PIT tag programme and fish counter at Luichart Dam.

Cost; High
70 man days and 2160 miles per year.

Benefits; High
Has restored a run of salmon to the Bran since 1995. Developed a long term research programme with FRS & SSE.

Funding; Trapping work by agreement with SSE. Research programme supported by FRS and Trust.

Operate Borland lift outside of smolt trapping period.

Investigate installation of secondary smolt trap at top of Achanalt Fish Ladder to capture smolts lost under barrage during high flows.

Investigate fish passage at road culverts on Bran. Liaise with Highland Council / SEPA to improve passage where appropriate.

1.3 Meig

Meig Dam

Operate Borland Lift and monitor fish passage by use of Fish Counter and PIT tag decoder. Use lower fish pass gate rather than ground sluice to release freshets.

Obstacles in gorge below Meig Dam

Maintain current freshet regime to ensure variation in flow allowing fish to access Meig Borland Lift.

Corriefeol

Obtain engineering design to improve existing fish pass.

Obtain tenders to carry out design improvements.

Fundraise, select contractor and carry out fish pass improvement works.

1.3 Orrin

Orrin Falls
Negotiate new generating regime to provide a flow during daylight hours which will allow migratory fish to ascend Orrin Falls. Agree flow regime as part of CAR licence for private hydro scheme. (CFDSFB, Fairburn House, SEPA).
Maintain / improve stop log arrangement below Orrin Falls.

Maintain / improve screening at intake to lade. (Fairburn House)

Orrin Dam
Downstream passage:-
Install smolt curtain in Orrin Reservoir to guide smolts towards entrance to fish pass.
Pass freshet over top gate of fish pass to attract smolts into pass during smolt run.
Attempt to replicate loch levels & generating regime of spring 2006 which resulted in successful smolt passage.

Upstream passage:-
In the short term operate adult trap below dam, truck and release adult salmon over dam.
In the longer term investigate restoration of Borland Fish Lifts for upstream passage.

1.5 Blackwater

Rogie Falls

Maintain Rogie Falls Fish Ladder. Operate summer & winter top gate settings, remove timber and debris from ladder as required.

2 Alness

Implement stocking strategy set out in section 7.

Allt na Seasgaich culvert
Negotiate through SEPA / AAG to have adequate fish pass installed at road crossing.

Alness weir
Maintain fish pass in weir; remove debris from pass as required. Maintain and clean screens at distillery off take.

Loch Morie Dam
Maintain fish pass remove debris as required.

In longer term investigate installation of fish counters at Alness Weir and Loch Morie Dam.

Kildermorie
Investigate bypass channel above Kildermorie as route for improved access to headwaters.

3 Allt Graad

Investigate improving access at culverts on tributaries and forestry log jams identified in habitat survey.

Improve screening at off takes.

4 Balnagown

Investigate engineering options to improve passage at weirs at transects 18 & 23 and culvert at transect 97.

Investigate improving passage at culverts on Kinrive Burn and Larack Burn

Either downstream boulder placements of timber K dam would be options.

6 Peffery

Modify Strathpeffer Water Treatment Works Gauging Weir to improve upstream passage.

Improve passage at Dingwall weir.

7 Newhall Burn

Remove forestry log jams.

Investigate improving passage at Braelangwell culvert.

8 Coastal Burns

Maintain distillery fish pass and screening on Contulich / Culcraggie Burns.

Improve passage at weirs identified in 2002 habitat survey.

Predation

Seal management plan.

Support SMRU research programme monitoring seal behaviour, photo id / counting, tracking as required.

Support development of non- lethal deterrents.

Shoot seals within management zone, using nominated marksmen and timing shooting to give maximum protection to fish stocks.

Keep records and submit annual return to Scottish Government.

Outcomes:
Minimise predation on returning salmon to maximise spawning escapement.
Achieve this without compromising the conservation status of Common Seals in Dornoch Firth SAC.

Requires licensing by Scottish Government under Seal Conservation Act. Requires partnership with SNH and SMRU.

Monitored by SMRU research programme and annual return of seals shot to Scottish Government.

Cost; Moderate to Board. High research costs to SMRU

Benefit;
Removal of problem seals foraging in and around river mouths. Evidence from Ness that seals shot are not quickly replaced by other seals from the general population.
Test effectiveness of non-lethal methods of seal scaring.

Funding
Board, Trust SMRU.

Sawbill management plan

Continue development of plan with Moray Firth Boards, Scottish Government, SASA and SNH.

Carry out sawbill counts as agreed with working group;
- Regular main stem canoe counts.
- Foot count on tributary on rolling basis.
- Collaborate with neighbouring boards to carry out estuary boat count.

Apply for Moray Firth wide licence with neighbouring boards.

Nominate marksmen and set up accreditation scheme.

Develop non-lethal methods of scaring predatory birds during smolt run.

Out comes:
Minimise predation on migrating salmon smolts.
Increase number of returning adult salmon.

License required from Scottish Government under Wildlife & Countryside Act.
Requires ongoing consultation with SNH, Scottish Government and SASA to develop Plan.

Monitoring;
Regular canoe counts before and during smolt run. Single tributary count each year.
Estuary boat count each year.

Cost: Moderate
Canoe counts 15 man days
Coastal count 3 man days + fuel and mileage.
Tributary count 20 man days.

Benefit; High
Level of sawbill predation could be limiting salmon populations, disruption in feeding and dispersal away from bottleneck areas will increase smolt survival.

Funding
Board / Trust.
Wider research project required with input from FRS & NERC?

Predation at obstructions to migration by natural, naturalised and non-native predators.

Maximise efficiency of fish passes so that migrating fish are delayed for the minimum duration;
- Luichart and Meig freshets.
- Orrin smolt freshet.
- Tor Achilty flow regime during smolt run.

Control non-native predators near obstructions to migration.

Unknown genetic status of salmon and sea trout stocks.

Fundamental weakness in present management as stocks should be managed on a population basis.

Work with FRS and RAFTS towards a national genetic mapping of salmon and sea trout populations. Seek significant funding for national project.

Seek advice from FRS on strategy for collecting and storing genetic samples during electro-fishing and trapping operations.

Continue scale collection from rod caught fish.

Start collection of genetic samples as part of Moray Firth Sea Trout Project.

Outcome
Mapping of location and extent of individual populations. Identification of spring salmon nursery habitats. Extent of exploitation by fisheries on individual populations. Estimation of number of breeding pairs in population.

Need for Home Office License. Requires liaison with FRS and may be constrained by FRS resources.

Monitored as part of national programme.

Cost;
Collection of genetic material during electro-fishing and trapping operations – moderate
Genetic analysis of samples- high

Benefit; High
Individual populations should be the basic unit of management.

Funding;
Collection of genetic material – Trust
Genetic analysis – needs significant funding for national project.

Channel Modification

Assess extent of fishery impact from individual or collective channel modifications.

Liaise with SEPA through AAG to apply CAR licensing scheme to channel modifications which have fishery impacts.

Options include benign neglect allowing river to reassert channel form or targeted removal.

Liaise with land owners on Alness, Allt Graad and Blackwater to identify which weir / croy constructions enhance the fishery and should be maintained and which should be removed or allowed to fall into disrepair.

River Peffery extensive restoration project required to restore channel and substrate to straightened middle reaches.

Outcomes;
Restore natural or semi-natural channel form and substrate to habitats where modifications are limiting fishery production.

CAR license required. Needs liaison with SEPA and fishery owners.

Monitored by pre and post works electro-fishing.

Cost:
Assessing value of existing modifications, applying benign neglect to undesirable structures – Low
Targeted removal of structures – Moderate
Restoration of dredged / straightened channels – High.

Benefit;
Moderate / high depending on extent of impact. In dredged / straightened channels may be action which will make habitat suitable for fish.

Funding
Biodiversity grant schemes, SNH, Highland Council Fishery Development grants.

Commercial Forestry

Liaise with Forestry Commission Scotland and SEPA AAG to bring forestry in line with Forest & Water Guidelines.

Raise geology specific issues on the Blackwater to encourage restructuring which would sufficiently reduce conifer cover on sensitive geology.

Investigate buffering acidified watercourses with lime as an intermediate action until restructuring can be achieved.

Work with Forestry Commission Scotland to continue native riparian woodland restoration on Strath Rannoch.

Investigate similar restoration on Forestry Commission Scotland land in the headwaters of the Alness Blackwater.

Work with Kildermorie and Strathconon Estates to encourage forest restructuring and native woodland restoration projects.

Minimise impacts of forestry on fisheries, restoring freshwater productivity. Bring water courses and riparian zone into good ecological status.

Forestry & Water Guidelines is the industry code of best practice. Direct liaison with Forestry Commission Scotland or influence policy through AAG.

Monitoring as part of electro-fishing programme. For individual projects use pre and post works electro-fishing, electro-fishing and photography.

Cost
Liaison with Forestry Commission Scotland and landowners – Low
Planting of native trees in areas already fenced – Low
Installation of deer fence to protect riparian habitat. – High
Catchment liming removal of conifers from sensitive sub catchments – High

Benefits
Moderate – high depending on extent of impact. In some areas no fish are present because of forestry impact.

Funding
Major works – Forestry Commission Scotland, landowners, grant aid.

Trust / Board
Liaison / planting.

Riparian overgrazing / erosion

Seek partnership projects through; landowners, AAG, Biodiversity Action Plan, FWAG, Scottish Native Woods and SNH to restore riparian habitats and woodlands and influence deer management policy.

Investigate potential demonstration project at Ledgowan on the Bran.

Outcomes;
Easing of grazing pressure on riparian zone and restoration of natural habitat. Reduction in erosion and extreme summer temperatures, increase in productivity.

Requires partnership approach with landowners, AAG, SNH, SNW and agri-environmental / biodiversity grant schemes.

Monitoring by pre and post works electro-fishing and habitat survey.

Cost;
Lobbying of agencies to influence policy – low
Fencing and planting projects – high.

Benefits;
Short term – moderate.
Longer term – high. Also wider biodiversity benefits.

Funding;
Board / Trust. Lobbying of agencies, identification of suitable areas for projects.
Significant grant aid required for restoration work.

Cultural oligotrophication

Improve upland riparian management as above.

Continue research with FRS and US Forest Service to establish levels of kelt carcass introduction into streams which locally increase productivity without significantly impacting on nutrient status of water bodies downstream. (Proposed project 2009).

Develop carcass analogues to replace kelt carcasses (follow on from 2009 project.

Outcomes
Restore freshwater productivity in upland areas to more natural levels. Maintain existing nutrient status in water bodies downstream of target areas.

Influenced by WFD, Habitats Directive, presence of designated sites. Requires partnership with SEPA, SNH, FRS and research bodies.

Monitoring by pre and post works electro-fishing.

Costs;
Research costs - moderate / high
Introduction of carcass analogues as a management tool - low

Benefits; High
Initial research has shown that the introduction of low levels of phosphorus in the form of kelt carcasses significantly increases juvenile salmonid production in oligotrophic burns.

Funding
US Forest Service proposed project 2009. Supported by FRS / Trust.

Status of non-salmonid fish species

Select appropriate electro-fishing monitoring sites for non salmonids after consultation with FRS /SFCC / SEPA.

Use established lamprey electro-fishing protocol to monitor status of lamprey populations in region.

Work with SFCC to improve database for non salmonids.

Conduct fish surveys in large water bodies and still waters using protocols under development by FRS / SFCC /SEPA and SNH.

Outcomes;
Improved understanding of the distribution and status of all species present in the region. Monitoring for new species colonising or being introduced. Essential information to make management decisions.

2007 Freshwater Fisheries and Aquaculture Act creates powers to regulate fish movements.

Monitoring;
Current electro-fishing monitoring programme records non salmonid species. Needs the development of techniques and site selection criteria to cover all species.

Cost;
Moderate / high, depending on the level of information required and the types of water bodies surveyed.

Benefit;
Moderate / high, depending on the extent of management which may be required or the importance of recording changes in status (rapidly declining eel populations).

Funding
Trust / biodiversity grant schemes.

Alien Plant species

Carry out 3 year project to map present distribution of alien plant species in the region and coordinate control measures.

Outcomes;
Map current distribution and extent of invasive alien plant species.
Coordinate existing control projects to increase effectiveness.
Develop new projects to control alien plant species.

Liaison with SEPA, SNH and landowners. Training and health & safety issues.

Monitored by follow up habitat surveys and photography.

Cost;
Moderate / high.
Surveying, mapping and recording – moderate.
Ongoing control of invasive species – high.

Benefits;
Moderate / high
Restoration of native species in riparian zone increases biodiversity, bank side stability, nutrient status and productivity. Whilst reducing erosion and siltation.

Funding
Esme Fairbairn Trust / Board / Trust.

Lack of data on numbers of returning adult salmon to some rivers.

Work with SSE to collate and validate counts from existing hydro counters.

Maintain trap count records.

Collect catch return data from nets and rod fishery.

Investigate installation of fish counters on Alness weir and Loch Morie Dam.

Investigate use of genetic techniques to estimate breeding population sizes.

Outcomes;
Make best use of existing counting facilities. Assess adequacy of spawning escapement. Assess stock status of Alness and investigate trends (spate nature of Alness reduces usefulness of rod data for stock monitoring.

CAR regulations may influence modification or installation of structures. Issues with security and electricity supply.

Validation of any counter would be required.

Cost; High
Both resistivity and VAKI counters are costly to install and maintain. An electricity supply would have to be found.

Benefit; High
At present it is difficult to assess the status of stocks, trends, adequacy of spawning escapement or the effects of management actions.

Funding
Substantial grant required or may be funded as part of hydro project.

Status of Moray Firth Sea Trout stocks.

Support Moray Firth Sea Trout Project for 3 years starting 2008.

Outcomes

- Identify the extent of freshwater habitat, spawning and juvenile distribution
- Identify areas of degraded habitat and through fishery management planning process identify mitigations.
- Identify anthropogenic obstacles to migration and through management planning process identify mitigations
- Establish scale sampling regime on each river and compare current age structure with previous collections i.e. Nall's work in the 1920s and 30s
- Establish tagging projects to examine exploitation rates, recapture rates and spawning locations in collaboration with local Angling Assoc, Fishery Trusts & DSFBs
- Investigate the current population dynamics to establish how many distinct populations are present
- Source and assess relevant data from FRS and other sources on marine issues effecting sea trout
- Liaise widely with local sea trout fisheries and anglers to raise sea trout profile
- Establish sea trout catch data base schemes with local stakeholder groups

Partnership required between Fishery Boards and Trust in the Moray Firth Region.

Monitoring by catch returns, habitat and electro-fishing surveys.

Cost;
Total project high but moderate to individual partners.

Benefit; High
Will guide local and regional management actions to maintain and restore sea trout stocks and habitats.

Funding;
Moray Firth Boards and Trusts, SSE, SNH, WTT and Highland Council

Flow Regulation.

Work with SSE and SEPA to establish and maintain flow regimes on regulated rivers which allow passage for migratory fish at obstructions, reduce compaction of substrates and enhance sediment transfer.

Negotiate with SSE and SEPA to redistribute unused freshet allowance to maximum benefit.

Outcomes;
Ease passage for migratory fish at obstructions. Improve sediment transfer and reduce compaction downstream of dams. Reduce predation at obstacles.

CAR regulation. Liaison with SSE, SEPA, Fairburn House other hydro developers,

Monitoring by fish counter data. New research required to look at sediment transfer restoration and compaction.

Cost; Low
Liaison with hydro operators and SEPA.

Benefit; High
Improve access for migratory fish, improve instream habitats. Reduce predation at obstacles to migration.

Funding
Trust / Board.

Agricultural run-off / sedimentation.

Work with SEPA AAG, FWAG, SNH and land managers to promote and support best practice.

Develop demonstration project with FWAG on Newhall Burn catchment to address agricultural siltation from field drainage by installing catch ponds.

Carry out initial survey for Newhall project during alien species survey.

Monitor by before and after electro-fishing surveys.

Outcomes;
Restore degraded fishery habitats in lower catchment watercourses.
Improve soil management reducing need for fertiliser addition.
Safeguard sea trout populations.

Liaise through AAG and FWAG. Also needs partnership with SNH and landowners.

Monitor by pre and post works electro-fishing, habitat survey and photography.

Cost;
Demonstration project and survey of sources of siltation – moderate.
Catchment wide restoration projects – high

Benefit; high
Many low lying and coastal watercourses are impacted by siltation. This may be a significant limiting factor for sea trout populations in the region.

Funding
Trust, FWAG, biodiversity / agri-environmental grant schemes.

Sediment transfer at hydro dams

Collaborate with SSE and Aberdeen University on sediment mobility research on Lower Orrin and Upper Blackwater which started in 2007.

Outcomes;
Restore spawning gravels and habitat diversity downstream of hydro dams.

CAR regulation. Needs partnership with SEPA, SSE and Aberdeen University.

Monitoring by habitat and electro-fishing surveys.

Cost; high
Both in terms of transport and introduction of gravels, research and monitoring.

Benefit; high
Restore natural spawning and habitats, resulting in sustainable fish populations and reducing the need for hatchery interventions.

Funding
SSE, Trust

Smolt loss

Maintain turbine operation at Tor Achilty at above 2 MW during smolt run to reduce smolt mortality.

Investigate installation of secondary smolt trap at top of Achanalt Fish Pass to catch smolts escaping under Achanalt Barrage during high flows.

Outcomes;
Maximise smolt survival at hydro structures.

CAR license for flow regimes. Partnership with SSE and SEPA. Tor Achilty flow may be constrained by run off.

Monitoring by counts at smolt traps and returning adults at hydro counters.

Cost; Low to moderate
Depending on how easily secondary trap can be modified and installed at Achanalt.

Benefit; High
At current marine survival rates every 20 smolts passing below Tor Achilty will result in a returning adult salmon. At Tor Achilty balloon tagging showed up to 50% mortality if flows reduced to compensation. High flows at Achanalt can result in the loss of many thousands of smolts under the barrage.

Funding
Board staff to install and operate trap at Achanalt Fish ladder. SSE technical support needed to modify trap to fit Achanalt ladder.

Lack of data on hill lochs

Liaise with FRS to establish data collection protocol and stratified sampling regime.

Set up data base to record fish data, photographs, spawning burns, % marginal vegetation etc.

Use angler log books / SFCC catch data base to collect hill loch data using local anglers.

Outcome;
Collect baseline fish data for hill lochs.
Collect photographic record and limited habitat survey data.
Establish potential for fishery development.

Access issues particularly during stalking season. Liaise with FRS and Tweed Foundation on survey options and use of angler log books.

Monitoring; adopt stratified sampling strategy and rolling programme of site visits.

Cost; Low
Make use of angling club volunteers.

Benefit; Moderate
May allow development of new sustainable fishery tourism in the region. May help to ease angling pressure on existing fisheries.

Funding
Trust / LBAP grant.

Trout stocking

Work with Scottish Government to apply fish movement legislation and ensure disease status of stocked fish.

Encourage proprietors or tenants stocking trout to stock their fisheries with locally sourced and reared brown trout as an alternative to bringing fish in from outside the catchment.

Potential to support Loch Achonachie AA to on grow brown trout using tank space at Strathconon or Orrin. Board could assist with broodstock collection, incubation and first feeding.

Outcome
Short term; ensure disease status and origin of stocked trout.
Longer term, encourage more sustainable stocking policies.
Reduce biosecurity / genetic risks of farmed trout from outside catchments being introduced.

CAR licensing of hatchery facilities. Control of fish movements / fish inspection under 2007 Freshwater Fisheries & Aquaculture Act. Liaison with FRS & police.

Monitoring by catch returns, angler log books and exterior marking of stocked fish.

Cost
Advice on best practice, local broodstock collection, incubation and first feeding – Low.

On growing to stockable size – Moderate

Benefit; high
Mitigates large biosecurity / genetic risk.

Funding
Local angling clubs, Board, Fishery / economic development grant.

Monitoring large water bodies

Work with FRS / SFCC / SNH and SEPA to develop accredited techniques for sampling fish populations in large rivers and still waters.

Incorporate into monitoring programme.

Outcomes;
Improved understanding of fish production and species composition of larger rivers.
Collect base line data for fish stocks of large still waters.

Health & safety issues working in deep waters. Collaborate with SFCC, SEPA, FRS and SNH.

Monitoring; requires development, validation and accreditation of techniques.

Cost; Moderate / high
Depending on techniques employed, many methods may involve larger survey teams.

Benefit; Moderate / high
Depends on scope for management intervention arising from monitoring.

Funding;
Trust / exterior funding

Alien Animal Species

Investigate potential project with SNH and neighbouring Boards / Trusts to set up a coordinated mink control programme.

Investigate potential project with SNH to set up trapping project to monitor the potential spread of American Signal Crayfish from Nairn catchment.

Outcomes;
Prevent spread of mink population reduce / eradicate mink within current range.
Monitor for spread of American Signal Crayfish.

Animal welfare considerations. Partnership with SNH will require input from ghillies and keepers.

Monitoring; keep records of animals captured set up database for records of alien species.

Cost; Low / moderate
Coordination of distribution of traps, data basing trap records and sightings.

Benefit; high
Protect fish stocks from predation.

Funding
Trust to distribute traps and maintain records.
SNH provide traps.

Mixing of flows

Investigate genetic structure of salmon populations in relation to mixing of flows between tributaries.

Water Quality

Liaise with SEPA.

Encourage Forestry Commission Scotland to address acidification problem on Blackwater tributaries.

Abstraction

Liaise with SEPA over CAR applications advise on fishery impacts.

Liaise with operators check on installation and maintenance of screening arrangements.

Aquaculture

Monitor applications for new aquaculture in the region.

Oppose applications for new fin fish farming at existing unused sites in the Cromarty Firth.

Oppose applications for any non tank based freshwater sites.

Monitor for escapes from existing farm site.

Liaise with Scottish Government on movements of fish within region and disease status.

Other Recreational Water Users

Liaise with Inverness Canoe Club and commercial operators on access issues. Should level of usage increase significantly set up access forum.

Raise awareness of *Gyrodactylus salaris* and illegal netting with local canoeists.

Outcomes for the above issues;
Monitor the impacts of other water users on fish stocks and habitats.
Liaise with other water users and regulators to minimise impacts.

CAR regulation, planning consents, countryside access code. Liaise with SEPA, SNH and recreational organisations.

Monitoring by a variety of methods including, electro-fishing and genetic analysis.

Cost; Low
Routine consultation with SEPA either through AAG or on basis of new applications. A study of fish genetics and flow mixing would be a by-product of wider population structuring research.

Benefit; Low – High
Depending on location and scale of individual impacts.

Funding
Board / Trust

Section 8. Projects and Budget

8.1 Project timetable

The proposed timetable of project development, implementation review and funding availability for the first plan cycle is shown on the table below.

Plan Consultation

		Partners	2008	2009	2010	2011	2012	2013
PL 1	Produce summary of plan / consult / promote plan	Anglers / proprietors/SEPA / SNH / HRC/ Moray Firth Partnership	DI					I/R

Species Management

	Action	Partners	2008	2009	2010	2011	2012	2013
SP 1	Maintain Fishery Protection	SFPA, MF DSFBs	I	I	I	I	I	I / R
SP 2	Promote and implement conservation policy	Proprietors, anglers, nets	I	I	I	I	I	I / R
SP 3	Develop and implement biosecurity policy	anglers / watersports /	D	I	I	I	I	I / R
SP 4	Implement salmon stocking policy	SSE	I	I	I	I	I	I / R
SP 5	Develop trout stocking policy	Angling clubs/ Stillwater owners	D	DI	DI	I	I	I / R
SP 6	Implement Seal Management Plan	SMRU /SG / MF DSFBs	I	I	I	I	I	I / R
SP 7	Develop and implement Sawbill management	MF DSFBs /SASA/ SNH /SG	D	DI	I	I	I	I / R
SP 8	Develop and implement alien species policy	SNH/ SEPA/ Landowners	P	P	P	DI	I	I / R
SP 9	Develop sea trout strategy	MF DSFBs / Trusts	P	P	P	DI	I	I / R
SP 10	Optimise smolt passage	SSE	DI	DI	DI	DI	DI	DI /R
SP 11	Optimise adult salmon passage	SSE	DI	DI	DI	DI	DI	DI /R

Habitat Management

	Action	Partners	2008	2009	2010	2011	2012	2013
HA 1	Restore upland riparian woodlands	FWAG / F CO / Landowners LBAP / SNW /AAG	P?	P?	DI	DI	DI	DI /R
HA 2	Restore areas degraded by agricultural siltation	FWAG / Landowners /AAG/LBAP	P?	P?	DI	DI	DI	DI /R
HA 3	Restore channel modifications	SEPA / landowners	DI	DI	DI	DI	DI	DI /R
HA 4	Remove appropriate migration barriers	HRC / Landowners /SEPA	P?	DI	DI	DI	DI	DI /R
HA 5	Restore nutrient status of degraded upland	FRS / US forest / NINA		P?	P?	P?	DI	DI /R
HA 6	Optimise flow regimes	SEPA / SSE / Private hydro	DI	DI	DI	DI	DI	DI /R
HA 7	Restore sediment transfer below dams	SSE / SEPA / Aberdeen Uni	P?	P?	P?			
HA 8	Forestry restructuring	Forestry Co / AAG / Landowners	AAG	AAG	AAG	AAG	AAG	AAG
HA 9	Resolve point source pollutions	SEPA	AAG	AAG	AAG	AAG	AAG	AAG
HA 11	Resolve diffuse pollution	SEPA / Landowners	P?	P?	AAG	AAG	AAG	AAG

Information gathering to support management

	Action	Partners	2008	2009	2010	2011	2012	2013
RD 1	Monitor adult salmon returns	SSE	I	DI	DI	DI	DI	DI /R
RD 2	Monitor smolt outputs	SSE	I	I	I	I	I	I / R
RD 3	Investigate genetic structuring of salmon stocks	FRS / RAFTS	P?	P?	P?	P?	P?	P?
RD 4	Develop all species electro-fishing monitoring	FRS / SFCC	DI	I	I	I	I	I / R
RD 5	Monitor exploitation rates rods & netting	Proprietors	I	I	I	I	I	I / R
RD 6	Monitor / manage seal salmon interaction.	SMRU / MF DSFBs	DI	DI	DI	DI	DI	DI /R
RD 7	Monitor / manage sawbill predation	SNH / SG /SASA	DI	DI	I	I	I	I / R
RD 8	Monitor / manage alien species	SNH	P	P	P			
RD 9	Continue PIT tagging research	FRS	DI	DI	DI	DI	DI	DI /R
RD 10	Maintain collection of salmon scales	Proprietors / ghillies	I	I	I	I	I	I / R
RD 11	Develop more sophisticated stock models	FRS	D	D	D			
RD 12	Establish carrying capacities	FRS / SFCC		P?	P?	P?	P?	P?
RD 13	Collect baseline data on stillwaters / hill lochs	Anglers /FRS	DI	DI	I	I	I	I / R
RD 14	Collect improved data on non salmonids	FRS / SFCC	DI	DI	I	I	I	I / R
RD 15	Develop new research partnerships	As available	DI	DI	DI	DI	DI	DI /R

Education / development / liaison

	Action	Partners	2008	2009	2010	2011	2012	2013
ED 1	Promote Conservation policy	Anglers / ghillies/ proprietors	I	I	I	I	I	I / R
ED 2	Promote Biosecurity policy	Anglers / ghillies/ proprietors	I	I	I	I	I	I / R
ED 3	Support sustainable fishery development	Proprietors / Troutquest	DI	DI	I	I	I	I / R
ED 4	Develop / implement Education programme	Highland Council	DI	DI	DI	I	I	I / R
ED 5	Contribute to SFCC / RAFTS working groups/ Fishery management tools development	SFCC /Rafts	I	I	I	I	I	I
ED 6	Contribute to IFM / ASFB / LANTRA industry training development	IFM/ ASFB/ LANTRA	I	I	I	I	I	I
ED 7	Carry out staff skills audit.	LANTRA	I					
	Staff training	SFCC /Inverness College /Lantra /IFM						
	1 electro-fishing		I			I		
	2 GIS		I			I		
	3 Boat skills		I	I	I	I	I	I
	4 Surveillance techniques		DI	DI	DI	DI	DI	DI
	5 Chainsaw		I					
ED 8	Contribute to WFD through AAG	AAG /ASFB working group	I	I	I	I	I	I
ED 9	Contribute to Forest Plans	Forestry Co. / Landowners	I	I	I	I	I	I
ED 10	Contribute to LBAP implementation	Highland Council / LBAP Group	I	I	I	I	I	I
ED 11	Maintain compliance with RAFTS / ASFB Code of Good Practice.	RAFTS / ASFB	I	I	I	I	I	I
ED 12	**Develop use and training of volunteers**		DI	DI				

D- Develop

I- Implement

P- Project

AAG- SEPA Area Advisory Group

R- Review

Resourced (green)

Partially Resourced (orange)

New Funding Required (red)

8.2 Budget

An indicative project budget for the first year of the plan 2008 / 2009 is shown on the table below. This budget is subject to approval of both the Cromarty Firth Board and Trust at their meetings in April. New funding sources will be sought during the following years of the plan to support projects marked in orange and red on the table above.

Cromarty Firth Fishery Board / Trust Draft Project Budget 2008-09

Code	Project Name	Stage	Materials etc.	Mileage	Labour	Total Cost	External Funding	Cost to Board
						£	£	£
PL1	Consultation version of plan		0	0	1138	1138		1138
SP1	Bailiffing Patrols		1000	12000	41900	54900		54900
SP2	Promote/implement Conservation Policy		0	0	1050	1050		1050
SP3	Biosecurity Policy - produce plan etc.		0	0	1750	1750	1750	0
SP4	Salmon Stocking Policy		0	3500	21695	25195		25195
SP5	Trout Stocking Policy		0	0	438	438		438
SP6	Seal Management Plan		0	0	455	455		455
SP7	Sawbill Management Plan	Develop & Collate	0	0	1050	1050		1050
		Counts	0	200	2470	2670		2670
		Licence Application 09	0	0	175	175		175
SP8	Alien Plant Species	Field Work & Data Entry	4500	1200	5125	10825	11000	-175
		Bank Clearance	0	120	5200	5320		5320
	Alien Animal Species		0	200	1225	1425		1425
SP9	Develop Sea Trout Strategy		0	0	1250	1250	2000	-750
SP10	Optimise Smolt Passage	Orrin Dam & Achanalt	0	2160	5115	7275		7275
SP11	Optimise Adult Salmon Passage	Orrin Falls CAR licence	0	0	350	350		350
		Install logs	0	0	98	98		98
		Orrin Dam Trap & transfer	0	1932	6290	8222		8222
		Meig/Luichart freshet etc	0	0	500	500		500
		Corriefeol estimate	0	0	525	525		525
		Other obstacles	0	0	525	525		525
HA1	Upland Riparian Woodland		0	0	1460	1460		1460
HA2	Siltation		0	120	925	1045		1045
HA3	Channel Modification		0	0	350	350		350
HA4	Remove migration barriers		0	0	195	195		195
HA5	Nutrient Restoration		0	0	545	545		545
HA6	Flow Regimes		0	0	350	350		350
HA7	Sediment Transfer		0	0	525	525		525
HA8	Forest Restructuring	Liaise FC/Kildermorie	0	0	700	700		700
HA9	Point Source Pollution	AAG	0	0	875	875		875
HA10	Diffuse pollution	AAG	0	0	0	0		0
RD1	Monitor Adult Salmon Returns	Collate FRS data	0	0	175	175		175
		Pit Tag Data	0	200	750	950		950
		Collate PT Data	0	0	350	350		350
		SSE dam counts	0	0	175	175		175
RD2	Monitor Smolt Outputs	Rotary Screw Traps (x2)	0	640	7065	7705		7705
RD3	Genetic structuring salmon stocks	Liaise FRS	0	0	175	175		175
		Collect material	0	0	0	0		0
		Salmon/grilse project	0	0	1750	1750		1750
RD4	All Species Electro-fishing monitoring	Liaise FRS/SEPA	350	0	350	700		700
		Carry out electro-fishing	0	600	3750	4350		4350
RD5	Monitor Exploitation Rates		0	0	0	0		0
RD6	Monitor Seal Interaction	Contingency	0	0	480	480		480
		Collation	0	0	175	175		175
RD7	Monitor Sawbills		0	0	175	175		175
RD8	Monitor Alien Species	Create Database	0	0	725	725		725
		Produce maps	0	0	350	350		350

		Report	0	0	350	350		350
		Liaison SNH/BTCV/owners	0	0	350	350		350
RD9	Pit-tagging research		2100	0	1750	3850		3850
RD10	Collect Salmon Scales		100	0	400	500		500
RD11	Develop Stock Model	Liaise FRS, P Birrell	0	0	350	350		350
RD12	Establish Carrying Capacity	FRS/Rafts (multi-year)	0	0	175	175		175
RD13	Still Water/Lochs	Design, liaison	0	0	175	175		175
		Stratified sampling	0	0	1750	1750		1750
RD14	Data on non-salmonids	FRS re techniques	0	0	350	350		350
RD15	Develop new research partnerships	Climate Change etc.	0	0	175	175		175
ED1	Promote Conservation Policy	Schools, ghillies, web etc.	0	0	350	350		350
ED2	Biosecurity Policy - dissemination	Press release, RAFTS etc	0	0	350	350		350
ED3	Sustainable Fishery Development	Liaise Troutquest	0	0	175	175		175
ED4	Education Programme	Highland Council, ranger	0	0	700	700		700
		Hatchery visits	0	0	700	700		700
ED5	SFCC/RAFTS working group	SFCC	0	320	700	1020		1020
		SGFMP	0	160	350	510		510
		Working Group	0	160	350	510		510
ED6	Training - IFM, ASFB, LANTRA	IFM committee	0	160	350	510		510
		Training Group	0	320	700	1020		1020
		SVQ 2/3/4, volunteers	0	240	525	765		765
ED7	Staff Training (rolling programme)	SVQ 2	300	0	130	430		430
		SVQ 3	350	0	195	545		545
		GIS (new ArcView)	420	0	350	770		770
		Boat Skills	0	0	195	195		195
		Chainsaws	720	0	390	1110		1110
ED8	WFD (through AAG)	Consultations	0	0	700	700		700
ED9	Forest Plans	FC liaison	0	0	175	175		175
ED10	LBAP		0	0	525	525		525
ED11	Code of Good Practice		0	0	175	175		175
ED12	Volunteer programmes	identifying projects etc	0	0	525	525		525
			0	0	0			0
	Equipment requirements	Chainsaw	200	0	0	200		200
		Boots and Hats	300	0	0	300		300
	Total		10340	24232	135128	169700	14750	154950

8.3 The need for volunteers to assist work programme.

The following projects either require voluntary assistance or could be expanded with volunteer input.

SP 4. Implement Stocking Policy.
Ghillies / anglers
Assist with broodstock collection, stripping, egg planting and fry planting.

SP 5. Develop Trout Stocking Policy
Angling clubs
Help develop more sustainable ways of stocking brown trout.

SP 6. Implement Seal Management Plan
Ghillies / stalkers
Act as nominated marksmen.

SP 7. Implement Sawbill Management Plan
Ghillies
Act as nominated marksmen
Ghillies / anglers
Assist with bird counts.

SP 8. Implement Alien Species Policy
Ghillies / stalkers
Operate and check mink traps and crayfish traps.
Anglers
Assist with clearance works for alien plant species.

SP 9. Assist with Sea trout Project
Ghillies / anglers
Provide historical catch data to project.
Keep catch log books.
Provide scale samples and genetic material to project

HA 1. Riparian Woodland Projects
Anglers
Assist with tree planting projects

HA 2. River restoration works
Anglers
Assist with log jam clearance, rubbish removal and instream habitat restoration projects.

RD 4. Assist with electro-fishing surveys
Anglers
Assist with electro-fishing survey works.

RD 10. Salmon scale collection
Anglers / ghillies

Collect salmon scales from any fish retained,

RD 13. Hill Loch Project
Anglers
Collect fish and habitat data from hill lochs.
Keep catch log books of visits to hill lochs.

ED 1. Implement Conservation Policy
Anglers / ghillies
Abide by conservation policy and encourage other anglers to abide by policy.

ED 2. Implement Biosecurity Policy
Anglers / ghillies
Adopt biosecurity precautions to prevent GS introduction.

ED 4. Implement Education Policy
Anglers
Assist with site visits and open days.
Help organise events for anglers with the Board / Trust to promote fishery management issues.

Section 9. Monitoring and Research Requirements

9.1 Evaluation of the adequacy of current local and national data for assessing the status of fish and fisheries in the Cromarty Firth Region.

Electro-fishing monitoring in the Cromarty Firth Region

There are a number of sites that have been used as core monitoring sites within the region. However the selection of these sites has evolved over a number of years, many were selected to check the effectiveness of stocking and do not represent a sufficient spread of habitat types. We recognize the need to review the selection of core monitoring sites.

Table 1. Core Electro fishing Sites

Catchment/ River*	**Total no. of Core sites**	**No of core sites fished**				**Total non-core sites**			**Total no of e/f sites**
		More than once a year**	**Once a year**	**Every 2 years**	**Less frequently than once every two years**	**Non core quant**	**Non core p /a**	Non core Timed	
1 Conon	2		2			6	1	16	25
2 Orrin	4			3	1	16	9	16	45
3 Meig	5			5		30	8	40	83
4 Blackwater	3			3		24	11	20	58
5 Bran	4			4		16	6	33	59
6 Conon catchment (1-5)	18					92	35	125	265
7 Peffery	2			2		7	0	0	9
8 Alness	2			2		2	34	35	73
9 Allt Graad	0			0		0	4	0	4
10 Sgitheach	0			0		0	16	0	16
11 Newhall burn & other small coastal streams	0								

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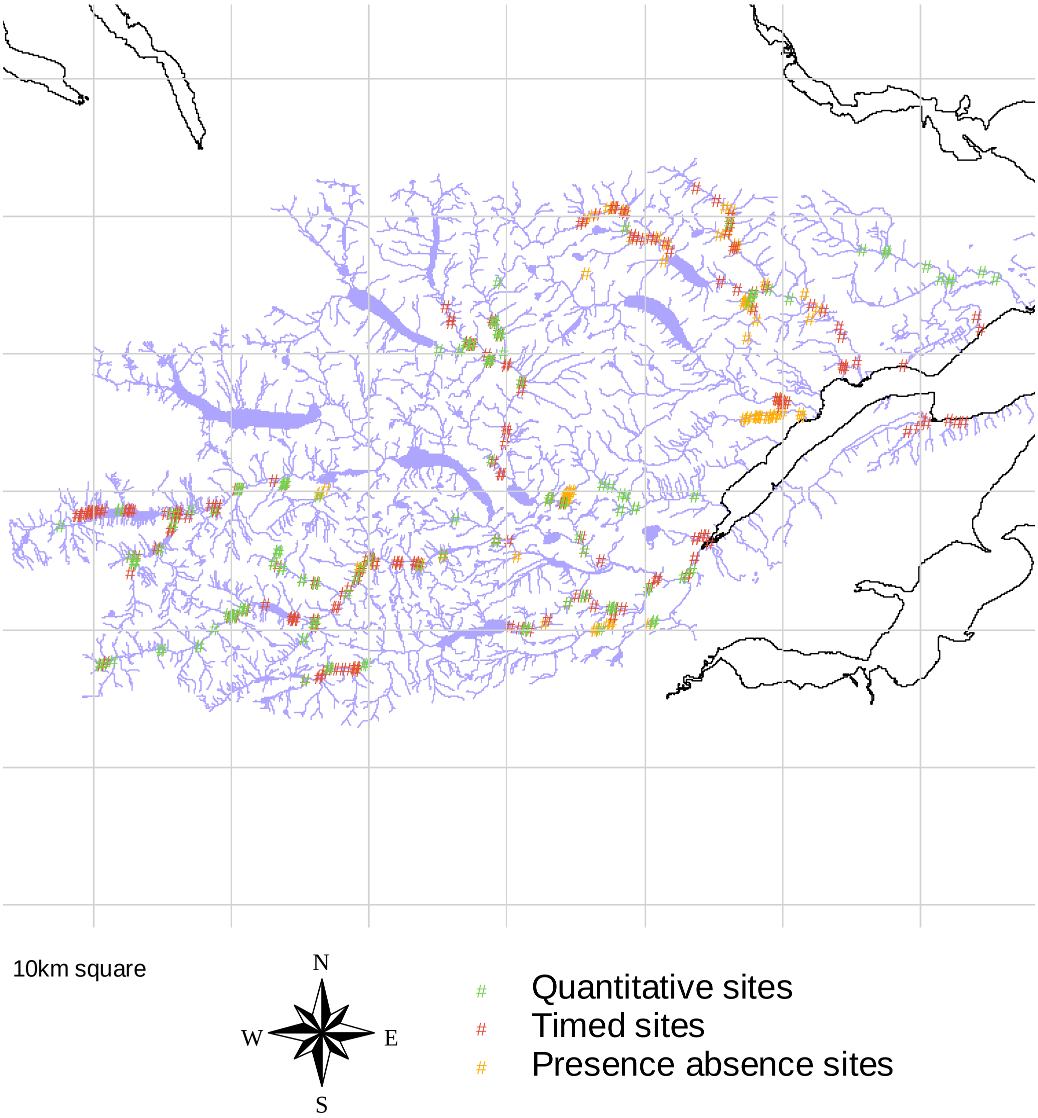
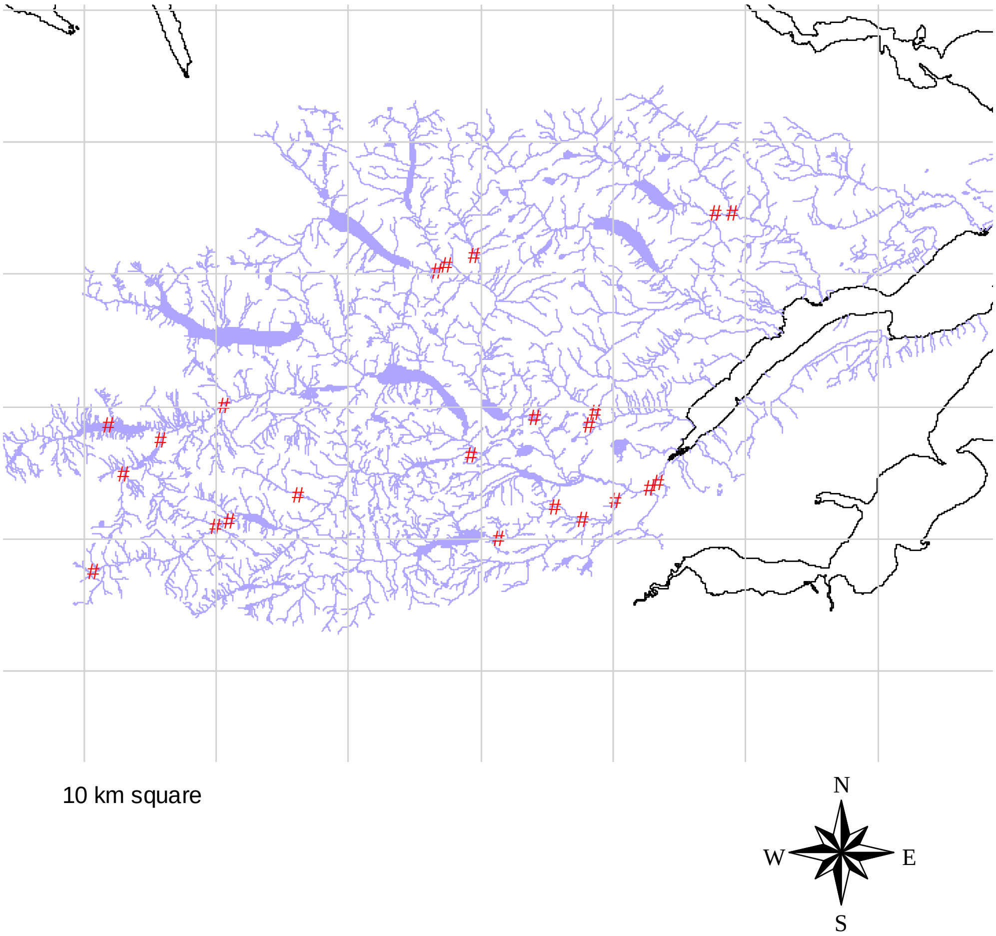
Most of the core monitoring sites on the Conon, first fished in 1996 and 1997, were selected to test effectiveness of the large scale hatchery operation on the Conon. Sites were selected on each major tributary. The sites were selected using the 1995 habitat survey of the Conon system and sites of A or B grade habitat suitability chosen.

Cromarty Firth Electro-fishing sites



Electro-fishing monitoring sites



Based on digital spatial data licensed from the Centre for Ecology and Hydrology,

In addition to the core monitoring sites described above sites have been electro fished for a variety of different purposes as shown in Table 2.

Table 2. Purpose of Electro fishing

Reason for electro fishing site:	Number of sites	Number of visits
Core monitoring	22	78
Monitoring stocking with eggs	7	17
Nutrient addition experiment	16	16
Quantitative and timed fishings. Mapping distribution/ passage of obstacles / relative abundance	260	Approx 300
Presence absence. Distribution /passage of obstacles	89	89

Details of electro-fishing surveys including reasons for survey are set out in a series of internal Board reports although some electro-fishing was undertaken in years between reports and entered into SFCC database;

Conon reports

1996 electro-fishing survey
12 quant sites mainly to check stocked areas

1997 electro-fishing survey
29 quant sites stocked areas but also some natural spawning

1997 Meig natural spawning survey
8 P/A sites to check limits of natural spawning

1998 electro-fishing survey
41 quant sites
22 P/A sites

1999 electro-fishing survey
32 quant sites
19 timed sites some on wider main stem reaches

2002 electro-fishing survey
5 quant sites
107 timed sites to give assessment of relative stock abundance around the catchment.

Alness reports

1998 electro-fishing survey of Alness
34 P/A sites to give some indication of stock distribution and limits to migration

2002 electro-fishing survey of Alness
35 timed sites to give more information on limits of migration and relative stock abundance.

2004 stocking strategy

Balnagown

1999 salmonid fry & parr survey by Bob Morgan and WGFT

Sgitheach

1998 Brief electro-fishing survey of R Sgitheach.
P/A sites to determine limit of migration at series of falls on the Sgitheach

Allt Graad

2000.
Timed fishings to determine limit of migration, relative stock abundance and check effects of recent poisoning incident.

Newhall Burn and smaller burns running into Cromarty Firth

Timed fishings to investigate distribution of salmonids

Electro-fishing Methods

Over time several different methods of electro-fishing have been used, with different methods being appropriate to different purposes.

Table 3. Electro fishing Methods

Reason for electro fishing site	**Percent of sites fished by method**					
	Fully quantitative depletion	**Semi-quantitative (single-run)**	**Timed fishing**	Presence / absence	Other method 2	Other method 3
Core-monitoring	100	0	0	0		
Distribution / limits to migration	40	0	40	20		
Nutrient addition experiment	100	0	0	0		
Other experimental	100	0	0	0		

Fully quantitative fishings are as per SFCC protocol

Timed fishings used backpack gear banner net and two operators. Samples were in riffle / shallow glide habitat and were for 5 minutes. Salmonids were recorded as 0+ and 1++ with scale samples taken as required.

Presence / absence fishings as per SFCC protocol

Electro-fishing data is stored in the SFCC database with a copy held locally and at SFCC, FRS, Faskally.

Need for review of Electro-fishing and monitoring sites

More sites are needed to cover areas of varying habitat suitability and levels of egg deposition. Ideally each sub catchment should be divided into lengths graded by habitat suitability (already classified from our habitat surveys) and recruitment status. I.e. Stocked to saturation, partially stocked, high level of natural spawning, restricted natural spawning. With sufficient sites electro-fished in each habitat type and with the areas of each already established then useful modelling of smolt out put could be undertaken. In some areas models could be tested by smolt trapping and / or back calculation from adult returns combined with marine survival rates established from tagging experiments.

When the Conon Board merged with the Alness DSFB we inherited a number of rivers with little or no previous electro-fishing data. Our priorities have been to habitat survey all catchments in our region (now completed) so that all obstructions, wetted areas and salmonid habitat suitability assessments have been recorded. In order to establish the distribution and limits to migration some presence/absence electro-fishing was undertaken. In recent years larger numbers of timed sites have been done, which as well as giving the same information as p/a sites also give an indication of relative strength of stocks when ranked. We have also been doing quantitative electro-fishing for research projects into nutrient manipulation and density of egg planting experiments. These experiments and contract SAC work in the last few years have reduced the amount of monitoring work which we have been able to carry out. We would now like to develop a new monitoring programme.

The development of an improved monitoring programme would give a better spread of sites over a variety of habitat types. It would also involve the selection of sites to monitor for non salmonids and in particular eels and lampreys. This would help to inform local fishery management and also better support WFD aims.

The development of an improved monitoring programme also needs to be guided by a better understanding of population structure which can only come from a large scale genetic analysis of stocks. Any monitoring work at present is an interim arrangement until a better understanding of population structure is achieved.

Other tools for monitoring

At present, in addition to monitoring of juvenile stocks by electro-fishing, smolt production is monitored at some sites by trapping and adult stocks are monitored by collection of rod catch data, resistivity counters at hydro dams and trapping.

Rod catch

Rod catch data has been collected from Cromarty Firth Rivers for many years and is summarised in Section 6. Whilst rod catch can show some trends in run timing and relative strength of grilse and multi-sea winter stocks, it is of less use as an index of overall abundance in the Cromarty region than in many other regions. The reason for this on the Conon system is that angling effort is concentrated on the relatively short main stem of the river. In a dry year fish may be concentrated in the lower reaches throughout the summer resulting in a high rod catch. Whilst in a wet year, many fish may pass quickly through the main stem and into the tributaries and so not be available to anglers.

The Alness is very much a spate river, fishing well in a wet year and poorly in a dry summer. The rod catch on the Alness is very much an indicator of favourable angling conditions rather than abundance of stock.

In recent years the timing of the grilse run has been unpredictable and in some years grilse have arrived after the angling season and not been represented in the rod catch.

The use of anglers log books may be a valuable tool to examine stock structure and catch per unit effort for sea trout and also for hill loch brown trout and charr.

Smolt trapping

The fixed smolt trap at Achanalt on the River Bran has been operated since 1994. In a dry spring the trap catches the entire smolt run of the Bran but heavy rainfall results in the barrage gates being opened and smolts being lost below the trap. This has given a long time series of smolt production from the Bran. The installation of a secondary trap below Achanalt Barrage might reduce downstream losses, or at least allow them to be quantified using mark and recapture.

In recent years rotary screw traps have been used on the Meig and Orrin. Mark and recapture experiments have been used to estimate smolt production from these tributaries. The traps sites on both of these rivers have been downstream of hydro dams, which give a steady regulated flow throughout the smolt run. This has resulted in very consistent recapture rates at both sites. The operation of a screw trap on the Blackwater would give a smolt production estimate from each of the four Conon tributaries.

The use of rotary screw traps and mark and recapture techniques could also be used on other rivers in the region. The Allt Graad has a regulated flow and might be most suitable for a smolt trapping project. The Alness has a much more variable flow and would be more difficult to trap effectively. The problem being that smolts are more likely to migrate on a spate and the efficiency of the trap would be reduced in high flows. There are also security and health and safety issues which would need to be considered.

Fish counters

The SSE resistivity counters on the Conon system at Tor Achilty, Meig and Luichart have been upgraded in recent years. There have been some problems with the Luichart counter but the Tor Achilty and Meig counters now seem to be working well. The SSE counts are likely to be one of the most reliable indicators of salmon abundance and spawning escapement.

The Alness system at present has no fish counters and as discussed above, the rod catch has limited use in estimating stock abundance. The installation of fish counters on the Alness would be of great value to management. There are two potential sites that might be suitable for the installation of fish counters on the Alness.

The weir near the mouth of the Alness has a Denil fish pass which could be retro-fitted with either a VAKI or resistivity counter. The provision of a mains electricity supply to power a counter would be possible. Some modifications to the crest of the weir would ensure that all the fish used the pass. The most difficult problem in installing a counter in the Alness weir would be security from vandalism.

The second potential site for a fish counter on the Alness would be at Loch Morie Dam. This dam is also fitted with a fish pass which could be adapted to house either a VAKI or resistivity counter. An electricity supply would be more difficult at this site but security should be less of an issue. This would be an important point to monitor upstream spawning escapement. Juvenile electro-fishing surveys downstream of Loch Morie show a high level of spawning wherever habitat is suitable. The juvenile stocks upstream of Loch Morie appear much less robust and have more scope for improvement. Monitoring of escapement above Loch Morie would be useful to monitor the effects of management actions upstream.

Trapping

The adult trap at Loch na Croic on the Blackwater catches the entire upstream run of salmon and grilse returning to the Blackwater. This gives one of the most robust data sets for any river system in Scotland.

The adult trap below Orrin Dam catches returning salmon which are then released upstream of the Dam. This trap will be useful to monitor the success of efforts to restore the Upper Orrin as a salmon river.

PIT tagging

Since 1997 a PIT tagging programme on the Conon system has been developed in conjunction with FRS and SSE. This programme monitors marine survival of salmon smolts from the Bran as well as investigating a number of management issues.

9.2 Local Research priorities for the Cromarty Firth Region.

Status / monitoring of non-salmonid fish species.

Although there are fewer non-salmonid species present in the Cromarty Firth region than further south in Scotland, they can have either a high conservation status or in the case of introduced species a negative impact on native species. In both cases the monitoring of the distribution and status of non-salmonid species is required before appropriate management options can be employed. At present non-salmonid species are not commercially exploited in the region, although they have in the past. There is potential to develop recreational fisheries for some species and monitoring would be needed to ensure such fisheries are sustainable. Monitoring of eel stocks is important because of the rate of decline throughout its range. Monitoring of lamprey abundance is also important because of the threatened status of stocks and limited habitat availability in the region.

Status / monitoring of fish species in large rivers.

The status of fish stocks in large rivers is uncertain although they may be important in salmon smolt production, sea trout smolt production and over-wintering and for non-salmonid species. To develop models of fish production for the region the importance of large rivers needs to be better understood. Large rivers in lower catchments are subject to hydro, morphological and agricultural impacts. The scale of degradation resulting from these impacts needs to be understood before mitigations can be employed.

Status / monitoring of fish species in still waters / hill lochs

There is some scope for the development of new fisheries for brown trout and other species in the region. Collection of base line data and subsequent monitoring would be needed to ensure that such fishery development is sustainable.

Status of sea trout populations and habitats in the region.

Sea trout are important for biodiversity, economic and social reasons. They support accessible angling association fisheries in the lower reaches of rivers. Whilst salmon have been well researched in the region, sea trout have not enjoyed the same attention. The last significant work on sea trout in the region was by G H Nall in the 1930's. Sea trout stocks are concentrated in the lower reaches of large rivers in the region as well as coastal and lower catchment burns. Many of these areas are particularly impacted by agricultural siltation and channel modification. A 3-year Moray Firth wide project will start in 2008 to research sea trout stocks, habitats and management options.

Genetic structure of salmon populations.

The individual population is the logical unit of management for salmon stocks. At present we do not know the geographical boundaries of populations, the size and fragility of populations or the effects of long term hatchery operations.

Distribution / monitoring of alien species.

Alien species, both plant and animal are likely to impact on fish and fisheries. Invasive alien plant species displace native riparian species, reduce invertebrate production, destabilise banks and increase erosion. A map of the current extent and distribution is required to co-ordinate existing control activities more effectively and to instigate new works.
Alien animal species such as mink which are already present and American signal crayfish which are present in the Nairn catchment impact on fish stocks by predation. American signal crayfish also compete with fish for habitat. A control programme to contain and reduce the mink population should be instigated. A cordon of monitoring traps around the Moray Firth would give early warning of the spread of crayfish from the Nairn (or other sources).

Effects of predation on fish populations, predator populations, mitigations.

Returning adult salmon and sea trout are vulnerable to predation by bottle nosed dolphins in coastal waters and by grey and common seals both in coastal waters and mouths of rivers. Further work is required to assess the effectiveness of the Moray Firth Seal Management Plan in reducing seal predation. In rivers, otter predation can be significant, particularly when migratory fish are delayed and congregate below obstructions.
The early juvenile stages of most fish populations can withstand a degree of predation because of density dependent factors. However for salmon there are reducing compensatory mechanisms as the fish grow, so that by the pre-smolt and smolt stage predation will have a more direct effect on the number of returning adults in the spawning stock.
Pike, perch, brown trout and saw billed ducks are all significant predators on smolts and pre-smolts. Further research is needed to assess the effectiveness of methods of reducing predation and maximising smolt output.

Optimising fish passage at barriers to migration.

Further research is required to optimise fish passage at obstacles to migration. The effectiveness of downstream passage at obstacles can increase predation on smolts or as in the case of Luichart and Orrin prevent passage. The recent success in getting smolts out of Orrin Dam needs to be built on, so that conditions suitable to attract smolts into the fish lift can be reliably replicated every year.
Research into the effectiveness of upstream passage at individual obstacles to migration needs to be continued, so that the most appropriate structures and flow regimes can be maintained.

Monitor smolt production.

The success of freshwater management of salmon populations and habitats is finally judged by the number of smolts produced. Whilst juvenile electro-fishing surveys can show localised variation in habitat usage, the 'bottom line' of eventual smolt production shows trends which will be directly reflected in the number of returning adults.

Monitor marine survival

Monitoring trends in marine survival can be used to support decisions on exploitation control. At very low levels of marine survival strict conservation measures may be required to ensure sufficient spawning escapement. Whilst an upturn in marine survival might allow an increase in exploitation to be sustainable.

Developing models of stocks.

Developing better models of stocks could be used to predict the effects of management interventions, changes in predator numbers, changes in climate and land-use.

Estimate pre-fishery abundance.

An estimate of pre-fishery abundance would allow decisions to be made on the sustainable level of exploitation which could be maintained. This would be difficult to achieve but more effective stock modelling, combining an estimate of smolt production with trends in marine survival could be used to establish limits to exploitation.
The estimation of pre-fishery abundance would be important in assessing the sustainability of the development of new fisheries. The development of a ferox fishery may need to be linked to an effective catch and release policy, whilst some hill loch brown trout populations may withstand a high level of exploitation.

Establish required spawning escapements for individual populations.

This would allow decisions to be made about the adequacy of spawning escapement (particularly on rivers with fish counters) and the level of management intervention required to restore or maintain egg deposition.

Establishing carrying capacities for habitats.

By establishing carrying capacities for a variety of habitat types at different altitudes, the health of existing fish populations could be assessed. The extent of deviation from a typical carrying capacity could be used to decide the types and level of management interventions which might be considered.

Monitoring habitat change – developing new survey techniques.

There is scope to develop the existing SFCC habitat survey technique to integrate new methods of aerial habitat survey. These new methods link high definition digital photography with 3-D computer analysis to survey large sections of river, quickly and in a way which can be replicated to record changes in habitat over time.

Investigate methods and effects of sediment restoration and other habitat manipulations.

In order to assess the effectiveness of gravel restoration below hydro dams and other management interventions such as riparian habitat restoration and agricultural sediment control, pre and post works studies should be conducted. These should include; habitat survey, photography and electro-fishing in order to record and quantify changes and benefits arising from the interventions.

Investigate nutrient restoration in upper catchments

Initial research indicates that an anthropogenic change in the nutrient status of upper catchment streams may limit fish production. Further research is required to establish restoration techniques which can restore carrying capacity to these areas, without adversely influencing the conservation status of waterbodies downstream.

Develop international research projects

The Strategic Framework for Freshwater Fisheries identified the need for increased international collaboration in fisheries research and management. In recent years we have developed useful links with researchers in the United States and Norway. A project to monitor changes in climate and effects on fisheries, linking rivers from Scotland with rivers in the south and perhaps north of the Atlantic salmon's range could be developed.

9.3 Local data collection required (methods, sites etc) to achieve research priorities identified above.

Status / monitoring of salmonids.

Continue collection of rod catch and net catch data for region.

Continue collection of fish counter and trap count data.

Investigate installation of new fish counters particularly on the Alness.

Develop existing network of electro-fishing monitoring sites into a rolling programme. Seek advice from FRS on site selection, so as to give an improved geographical and habitat type coverage.

Status / monitoring of non-salmonid fish species.

Continue collection of non-salmonid data at electro-fishing sites selected for salmonid monitoring.

Set up rolling programme of electro-fishing monitoring sites for eels and lampreys. Seek advice from FRS on site selection.

Status / monitoring of fish species in large rivers.

Work with SFCC / FRS to agree national protocols for monitoring fish species in larger rivers and incorporate into monitoring programme.

Status / monitoring of fish species in still waters / hill lochs

Set up a group of volunteers from local angling clubs to collect base line data from hill lochs. Use a combination of catch log book, photography, biometric and scale collection from captured fish. Seek advice from FRS on data collection and site selection strategy.

Status of sea trout populations and habitats in the region.

Contribute to Moray Firth Sea Trout project. Facilitate liaison between Project Officer and local sea trout interests.

Genetic structure of salmon populations.

In the medium to longer term work with FRS / RAFTS / SFCC to develop a national salmon genetic mapping programme.

In the shorter term liaise with FRS to start the collection and storage of appropriate genetic material during existing electro-fishing and trapping works.
Distribution / monitoring of alien species.

Start invasive plant species mapping project in summer 2008. Liaise with SFCC / RAFTS / SNH to ensure data is collected and stored in a format which will allow the development of a national database.

Liaise with neighbouring Boards / Trusts and SNH on mink trapping and monitoring project.

Liaise with neighbouring Boards / Trusts and SNH on American signal crayfish trapping and monitoring project.

Effects of predation on fish populations, predator populations, mitigations.

Continue support for SMRU research programme as part of the Moray Firth Seal Management Plan.

Continue sawbill counts. Develop Moray Firth Sawbill Management Plan in partnership with neighbouring Boards / Trusts, SNH and Scottish Govt.

Optimising fish passage at barriers to migration.

Install rotary screw trap below Orrin Dam to monitor smolt production from the Upper Orrin.

Monitor fish pass counts at Tor Achilty, Meig and Luichart.

Monitor adult trap counts at Orrin Dam.

Monitor smolt production.

Install rotary screw trap in Blackwater to complete smolt production estimates for all Conon tributaries.

Investigate installation of rotary screw traps in Alness, Allt Graad and Balnagown.

Set up rolling programme of smolt production estimation.

Monitor marine survival

Continue long term PIT tagging monitoring on the Bran. Develop PIT tagging projects on Meig and Blackwater.

Developing models of stocks.

Develop better models of stocks with FRS. Incorporate smolt production estimates, areas of habitat used, marine survival, predation / migration mortality.

Estimate pre-fishery abundance.

Use improved stock models to predict pre-fishery abundance.

Use mark / recapture or other methods to estimate pre-fishery abundance as part of the development of new fisheries.

Establish required spawning escapements for individual populations.

Derive from improved stock modelling.

Apply precautionary principle.

Establishing carrying capacities for habitats.

Either as part of a national project with SFCC / FRS / RAFTS, or as a regional pilot project.

Would require a variety of habitat types at different altitudes to be stocked to saturation and the resulting juvenile populations monitoring by electro-fishing.

Monitoring habitat change – developing new survey techniques.

Work with SSE / APEM on aerial survey projects on the Orrin and Glascarnoch.

Adapt SFCC habitat survey protocols to include new survey methods as GIS layers. This would allow a phased approach to habitat data collection and linkage of different methods.

Investigate methods and effects of sediment restoration and other habitat manipulations.

Work with SSE / SEPA on options to restore sediment transfer and spawning habitat to the Lower Orrin.

Incorporate pre and post works surveys into electro-fishing programme.

Investigate nutrient restoration in upper catchments

Work with FRS / US Forest Service to develop research programme.

Develop international research projects

Continue collaboration with US and Norwegian researchers.

Through RAFTS, investigate EU funding for a climate change / fisheries project with potential partners in the Asturias region of Northern Spain.

9.4 Assessment of options for collecting required data with full consideration of the legislative framework (e.g. Animal Scientific Procedures Act, health and safety requirements) governing research.

At the design stage of each project identify and record whether the project will deliver outcomes which will be used for local fishery management. If there is a clear management outcome from the project then it is exempt from the Animal Scientific Procedures Act.

Where research projects do not have a clear local management outcome, then the work must be covered by a Home Office Licence under the Animal Scientific Procedures Act. This should be applied for by a university partner or FRS and the work carried out under the terms of the licence.

All projects should be conducted in compliance with the Cromarty Firth Fisheries Board's Health and Safety Policy. An appropriate risk assessment should be carried out and recorded before commencing works.

Staff should be trained to SFCC / SVQ standards in electro-fishing.

Staff should be trained to SFCC standards in survey techniques and data entry.

Where appropriate papers should be produced and submitted for peer reviewed publications.

Regular liaison should take place with FRS / SFCC to ensure best practice is applied.

The Board and Trust will carry out an annual review of compliance with the agreed ASFB / RAFTS Guide to Best Practice protocols described below and make a formal response to ASFB / RAFTS as to the level of compliance with the Guide. We are at present compliant with all significant sections of the Guide and are working towards full compliance. In particular the Board has a Health and Safety Policy and a standardised method of conducting Risk Assessments prior to conducting tasks. All Board Staff are required to complete the IFM Bailiff Certificate qualification before being warranted. This qualification includes training on job specific health and safety and child protection issues. All staff are also required to carry out First Aid training which has industry specific elements and 3 yearly refresher courses.
The Board also has an equal opportunities policy to meet the requirements of the Sex Discrimination Act 1975, The Race Relations Act 1976 and the Disability Discrimination Act 1995.

A GUIDE TO BEST PRACTICE

FOR

SCOTTISH FRESHWATER FISHERIES MANAGEMENT ORGANISATIONS

CONTENTS

"In addition to their economic importance, Scotland's freshwater fish have significant natural heritage value. This includes their nature conservation importance, which is recognised through formal designations, their contribution to Scotland's biodiversity and freshwater ecosystem function, and their role as environmental indicators. Scotland's legislative and management structures for fisheries in fresh water must therefore seek to achieve a situation in which fish thrive, fishery owners and operators achieve an acceptable financial return, and anglers enjoy their sport. Effective measures must operate throughout Scotland to ensure the appropriate conservation of all fish species, regardless of their commercial or sporting interest, and a scientifically-based approach to fishery management which seeks to achieve the sustainable exploitation of fish as a sporting resource and maintain the biodiversity of fresh water habitat".

(Scotland's freshwater fish and fisheries: Securing their future.

Rhona Brankin, Scottish Executive, 2001)

"It is estimated that anglers spend a total of £113 million on angling in Scotland, with salmon and sea trout anglers accounting for over 65% (£73 million) of this total".
(Scottish Executive, 2004)

Introduction

This Guide to Best Practice sets a benchmark against which District Salmon Fishery Boards and Fishery Trusts may assess their operations. In following this guide, regulators, funders, managers, customers, and the general public will have greater confidence in the ability of these organisations to manage fish stocks and fisheries effectively, at both a local and national level.

This Guide sets out principles and national standards for the governance of organisations that are responsible for the effective conservation, management and development of freshwater fish species and management and development of freshwater fisheries, with due respect to the ecosystem and biodiversity. The Guide recognises the economic, social, environmental and cultural importance of fisheries and the interests of all those concerned with the fishery sector. The Guide takes into account the biological characteristics of the resources and their environment and the interests of consumers and other users.

This guide relates to the corporate governance and management of fisheries organisations. Issues of scientifically based procedures for fisheries management and procedures for sound practice will be dealt with in further documents developed by fisheries biologists and managers operating within these organisations.

Certain parts of this Guide relate to legislation and assists subscribers in meeting the requirements of wider legislation.

The Guide provides principles and standards, which could be applied to the conservation, management and development of all fisheries.

Why have a Guide to Best Practice?

The guide will demonstrate to other organisations that fisheries will be managed in a credible, transparent and consist way. Properly managed fisheries can have great benefits in a number of areas including:

- National and local economy
- Tourism
- Recreation
- Biodiversity
- Sustainable fish stocks and habitats
- Community and social inclusion
- Environmental education

A Guide that is followed and complied with can influence policy makers in Government departments in developing future fisheries policy and provides a route map for good fisheries management at a local level.

Compliance with an agreed Guide to Best Practice will provide evidence of good fisheries management practices which will help secure confidence and encourage greater public and private investment in the sector.

This Guide will enable subscribers to identify good practice for their own areas of operation.

This is a working document, which may be revised and up-dated to take account of newly identified good practice and changing regulatory conditions and working environments.

The Objectives of the Guide are to ensure that fisheries management organisations:

a) Establish principles, in accordance with the relevant legislation, for responsible fish and fishery management, and promotion, taking into account all their relevant biological, technological, economic, social, environmental and commercial aspects.
b) Establish principles and criteria for the elaboration and implementation of consistent local and national policies for responsible conservation of fish and fisheries resources and fish and fisheries management and development.
c) Serve as an instrument of reference to help Government and public agencies establish and improve the legal and institutional framework required for the exercise of sustainable fisheries and in the formulation and implementation of appropriate measures.
d) Facilitate and promote technical, financial and other cooperation in conservation of fish and fisheries resources and fish and fisheries management and development.
e) Promote protection of living aquatic resources and their environments and coastal areas.
f) Promote research on fish and fisheries as well as on associated ecosystems and relevant environmental factors.
g) Provide standards of conduct for all persons involved in the fisheries sector.

What will the Guide cover?

- **Corporate governance of Boards and Trusts**
- **Relationships between Boards and Trusts**
- **Relationship between ASFB and RAFTS**
- **Engagement with other sectors and organisations**
- **Compliance with GtBP and auditing**

Definitions

'Fisheries Management'
Within this Guide *fisheries management* refers to the management of freshwater fish stocks, fisheries and habitat within Scotland.

'Sustainable development'
Development that meets the need of the present without compromising the ability of future generations to meet their own needs.

'District Salmon Fishery Boards' ('DSFBs')
Are the statutory management bodies for migratory salmonid fish stocks.

'Fisheries Trusts'

Refers to Fisheries and Rivers Trusts and Foundations, which have a remit to conserve and enhance all native freshwater fish and their environments.

'Association of Salmon Fishery Boards' ('ASFB')
Is the representative organisation for the above DSFBs.

'Rivers and Fisheries Trusts Scotland' ('RAFTS')
Is the representative organisation for the above Fisheries Trusts.

'Scottish Fisheries Co-ordination Centre' ('SFCC')
A public private partnership organisation which produces protocols and training for the collection of fisheries data including electro fishing and habitat data, and which holds the national databases for fisheries data.

'Must'
Where a recommendation in this Guide is expressed using the word '**must'**, it is re-stating an existing legal obligation for the organisation, who therefore have to be compliant with the appropriate provision as a matter of law.

'Should'
Where a recommendation in this Guide is expressed using the word **'should'** it is implicit that signatories to the Guide are obliged to follow the recommendation if they wish to remain compliant with the provisions of this Guide.

'Recommend'
Where a recommendation in this Guide is expressed using the word **'recommend'**, it is implicit that the signatories are expected to undertake the recommendation if they wish to remain compliant with this particular provision of the Guide, but it is acknowledged that some signatories may not be able to comply due to unique circumstances. The 'recommendation' remains a goal to which organisations should aspire.

Important

Compliance with this Guide does not relieve you of your responsibilities to meet the requirements of the law. Although we refer specifically to some pieces of legislation in the Guide, we have not attempted to include every piece of legislation that may affect your organisations activities.

ASFB – RAFTS Relationship

Working together

Boards and Trusts have a wide range of common objectives and therefore will benefit of working together to prioritise actions, allocate responsibilities, reduce duplication and utilise resources fully. It is necessary to maintain independent identities as required by the statutory and charity obligations of each organisation.

Responding to consultations

- Where possible RAFTS & ASFB **should** make joint responses to consultations.
- Where conflicts of opinion or policy occur RAFTS and ASFB **should** make separate responses.
- Conflicts of opinion or policy identified by the Directors **should** be brought to the attention of the Executive Committees.

Representation at meetings

- Where possible RAFTS & ASFB **should** share representation at meetings.
- Where conflicts of opinion or policy occur RAFTS and ASFB **should** make separate representation.
- Conflicts of opinion or policy identified by the Directors **should** be brought to the attention of the Executive Committees.

Identifying conflicts of opinion

- Where conflicts of opinion or policy are identified the Directors in the Executive Committees of each organisation **should** ask for representation from both organisations.
- Where no conflict of opinion or policy is identified and where there are efficiencies to be had from joint services it is **recommended** that the two organisations work together e.g. secretarial, legal, administrative, accountancy

DSFB GUIDE TO BEST PRACTICE

This Guide sets out key governing principles to which District Salmon Fishery Boards (DSFB) should be expected to work, covering best practice in management actions, public accountability and sound corporate governance.

It will demonstrate what level of service other stakeholders, including public agencies, non governmental organisations and the general public may reasonably expect from a DSFB in the above areas, as well as providing a basic framework within which DSFB members and employees will have a clear understanding of what is expected of them in the broadest sense, both from the perspective of an employer and employee.

By DSFBs adhering to the terms of this guide, stakeholders will have greater confidence in the ability of the DSFBs to discharge their statutory powers and duties in a way which is clearly understood by all.

Any functions discharged by a DSFB **must** be in compliance with Scottish, UK or International law. Such legislation may range from local regulations specific to a fishery district, (for example local annual close time regulations), to national regulations (for example Controlled Activities Regulations governing river works) right through to international legislation such as the Habitats Directive which governs the protection of species designated within Special Areas of Conservation. **The onus is on the Board to ensure compliance with the relevant legislation – if in doubt, contact the ASFB.**

Membership

- DSFB membership procedures **must** comply with existing fisheries legislation.
- DSFB's **must** comply with the law of election of proprietors, angler representatives and tenant netsmen.
- DSFBs **should** invite representation from local stakeholders such as SNH, SEPA, coarse fishermen where coarse fisheries are significant in the catchment and their Local Authority onto their Boards in an invitee capacity, recognising the limitations of the Act.
- DSFBs **should** have an angler representative chosen through consultation with the angling associations.
- DSFBs **should** ensure good representation on their Board from any Fisheries Trust/Foundation operating in their area.

Code of Conduct for Board Members

- All Board members **must** act in the interest of the Board's overall interest first and foremost. Any personal or professional conflict of interest **must** be declared at the outset.
- *See appendix Members Code of Conduct and Standing Orders*

Management

- All DSFBs **should** have a personnel manual including policies for the following issues:
    - Pensions

- Disclosure
- Line management
- Disciplinary procedures
- Personal performance and remunerations reviews
- Equal opportunities

- DSFBs **must** comply with appropriate Health & Safety legislation (see appendix for Health & Safety and COSSH).
- DSFBs **should** ensure that all staff dealing with children have been through the appropriate disclosure procedures.
- All DSFBs **must** ensure that all staff involved in predation control have appropriate certificates to comply with the law.
- Employer liability and third party insurance **must** be obtained by each DSFB.
- Data Protection Act notification **must** be registered where applicable.

Training

- All scientific staff **should** be trained to SFCC standards.
- All bailiff and enforcement staff **must** be trained to the IFM/SVQ level 2-bailiff course. Bailiff warrant cards **must** only be issued to trained personnel.
- It is **recommended** that DSFBs consider appropriate training for Board members.
- DSFBs employing staff using boats **should** provide them with appropriate training in boat handling
- Training in fish diseases and identification **should** be supplied to DSFB staff (Marine Lab course).

Relationships with other Bodies

a. Trusts and Boards (see Section 5)

b. Regulatory Bodies

- DSFBs **should** agree with its immediate Trust and other local Trusts and DSFBs to appropriate representation on SEPA's Area Advisory Groups for the Water Framework Directive (WFD).
- DSFBs **should** participate where appropriate in Area Management Groups.
- Where there are Special Areas of Conservation (SACs), DSFBs **must** comply with SAC management plans.
- DSFBs **should** contribute to and be aware of their Local Biodiversity Action Plans (LBAPs).
- DSFBs **should** liaise closely with local authorities and other regulatory authorities.

c. Stakeholders

- It is **recommended** that DSFBs should consult with all other fish and fishery interests.
- It is **recommended** that DSFB attempt to communicate where possible with other relevant interests within their catchments.

Communications

- Once stakeholders have been identified they **should** be communicated with and receive information from the DSFB through the following mediums: -
- DSFBs **should** use a website on which the following information will be available:
    - Most recent published accounts
    - Annual catch statistics since 1952
    - Membership of Board
    - Annual reports
    - Other reports/newsletters
    - Minutes of meetings
    - List of qualified proprietors
- DSFBs **should** produce a newsletter/e-letter for distribution to the general public.
- DSFBs **must** hold an AGM and should consider holding an annual public meeting that is publicly advertised and open to all members of the general public to promote the work of the Board.
- It is **recommended** that DSFBs take all available opportunity to use media to broadcast their work to the general public.
- It is **recommended** that DSFBs use and/or co-ordinate their media actions with the ASFB/RAFTS PR/Media adviser.
- It is **recommended** that DSFBs attempt to liaise with their local Fisheries Trusts when engaging in media activity.

Operations

- DSFBs **must** comply with relevant CAR regulations.
- DSFBs **should**, with their associated Fisheries Trust, agree, produce and implement catchment based fisheries management plans based on protocols developed by SFCC (see section 4.8).
- It is **recommended** that Boards ensure such plans are aligned with WFD objectives and operate on a similar six-year cycle. Such plans should be discussed with the Area Advisory Groups.
- DSFBs with Fisheries Trusts **should** produce an inventory of fisheries and fish stocks in their districts.
- All fisheries management operations **should** be based on the best available scientific information and advice as supplied by the Fishery Trusts or elsewhere.
- Where agreement cannot be reached, independent advice **should** be sought from the Fisheries Research Services.
- DSFBs and Trusts **should** consider where possible managing day-to-day business through a joint working group, consisting of active representatives from each organisation.
- Applications for licences to control predators **must** be prepared in accordance with the SEERAD latest application procedure, and **should** be co-coordinated with other Boards where applicable.

- Where advice is required on relevant legislation and regulation the DSFBs **should** consult with the ASFB.
- DSFBs **should** adopt the Regulation Application Protocol (see appendix) before applying to the Scottish Executive for any regulations.
- Where there is a logical reason for a Board amalgamation it is **recommended** that DSFBs actively consider them.
- DSFBs **should** adopt a strict policy that ensures that live fish are not moved between catchments in their district, unless with suitable permission.
- Permission **must** be sought from the relevant DSFB before salmon (fish or eggs) are stocked within the district.
- DSFBs **should** pursue a policy of closure or curtailment of any mixed stock fisheries in their district in accordance with the ASFB policy on exploitation of salmon.
- All fisheries management technical decisions **should** comply with best practice and reference to fisheries management plans.

Fisheries Promotion

- Fisheries **should** be promoted in a sustainable way; environmentally, socially and economically.
- Information **should** be gathered to inform decisions relating to angling promotion.
- It is **recommended** that DSFBs encourage proprietors to make information on fishing opportunities more publicly available.

Audit

- DSFBs **should** conduct an annual audit of this Guide and submit to the ASFB at the end of each calendar year.
- All Boards **should** submit a brief annual return to the ASFB, outlining income, expenditure, personnel, rateable value, membership and any other details as may be deemed useful for promoting the wider interest of salmon fisheries.

Trust Guide to Best Practice

This Guide sets out key governing principles to which Fishery Trusts should be expected to work, covering best practice in management actions, public accountability and sound corporate governance.

It will demonstrate what level of service other stakeholders, including public agencies, non governmental organisations and the general public may reasonably expect from a Fishery Trust. As well as providing a basic framework within which Trusts and their employees will have a clear understanding of what is expected of them in the broadest sense, both from the perspective of an employer and employee.

By Trusts adhering to the terms of this guide, stakeholders will have greater confidence in their charitable function and duties in a way that is clearly understood by all.

Any functions discharged by a Trust must be in compliance with Scottish, UK or International law. Such legislation may range from local regulations specific to a fishery district, to national regulations (for example Controlled Activities Regulations governing river works) right through to international legislation such as the Habitats Directive which governs the protection of species designated with Special Areas of Conservation. Trusts must also comply with charities legislation. **The onus is on the Trust to ensure compliance with the relevant legislation – if in doubt, contact RAFTS.**

Membership

- Trusts **must** comply with relevant Charities legislation.
- Trustees **should** be selected for their interests and skills in the objectives of the charity.
- Trust **should** have in place a rotation policy for Trustees.
- It is **recommended** that the position of Trustee be not held for more than three terms of three years.
- Trustees whilst serving in their capacity as a Trustee of the charity **must** be acting solely for the benefit of the Trust and declare any vested interests.
- In Scotland any individual, of any nationality, aged 16 or over can be a Charity Trustee, unless they are legally disqualified from being or continuing to be a Trustee.
- Section 69 of the Charities and Trustee Investment (Scotland) Act 2005 (CTI(S) Act) lists those who cannot be Charity Trustees, namely anyone who is:
  - Convicted of an offence involving dishonesty (unless the conviction is spent;
  - Convicted of an offence under the CTI(S) Act;
  - An undischarged bankrupt;
  - Removed from being concerned in the management or control of any charity by the Court of Session;
  - Removed from the office of charity trustee by the Charity Commissioners for England and Wales or by the High Court of Justice in England;
  - Disqualified by the Court from acting as a company director by virtue of the Company Directors Disqualification Act 1986.
- New Trusts **should** consider limiting public liability by setting up as a Company Limited by Guarantee.
- Trusts **should** invite membership from a wide range of stakeholder interests who support the objectives of the Trust.

- Bodies can be defined that nominate individuals for the membership:
  - Nominating Bodies **should** be organisations supportive of the Mission and Objectives of the Trust. A list of Nominating Bodies **should** be held at the Registered Office of the Trust. The Trust Board should approve the list of Nominating Bodies.
- It is **recommended** that Trust governing documents stipulate the election and rotation policy for Trustees or Board of Directors.

Code of Conduct for Trustees

- All Trustees **must** act in the interest of the Trusts overall interest first and foremost. Any personal or professional conflict of interest **must** be declared at the outset.

Management

- Trusts **should** have a policy on whether or not housing is provided.
- All Trusts **should** have a personnel manual including policies for the following issues:
  - Pensions
  - Disclosure
  - Line management
  - Disciplinary procures
  - Personal performance and remunerations reviews
  - Equal opportunities
- All Trusts **should** have appropriate Health & Safety policies and if a Trust has more than five employees they **must** have a Health & Safety policy.
- Trusts **must** ensure that all staff dealing with children have been through the appropriate disclosure procedures.
- Trusts **must** ensure that any staff involved in fish catching operations including electro fishing and gill netting have the appropriate licenses and permissions to comply with the law.
- Permission **must** be sought from the relevant DSFB before salmon (fish or eggs) are stocked within the district.
- Employer liability and third party insurance **should** be obtained by each Trust.
- Under charity regulations the Charity **must** be registered with the Office of the Scottish Charity Regulator (OSCR).
- Accounts **must** be approved in accordance with the CTI(S) Act.
- Approved accounts and annual reports **must** be submitted, as requested, to the OSCR annually.

Training

- All scientific staff **should** be trained to SFCC standards.
- It is **recommended** that Trusts consider appropriate training for Trust Board members.

- Trusts employing staff using boats **should** provide them with appropriate training in Boat handling.
- All fisheries management technical decisions **should** comply with accompanying guide to best practice.
- Fish Disease training **should** be supplied to Trust staff (Marine Lab course).
- Trust staff involved in school education projects e.g. salmon in the classroom **should** have appropriate child protection training.
- Staff **should** have First Aid Training.

Interaction with other Bodies

a. Trusts and Boards (see Section 5)

b. Regulatory Bodies

- Trusts **should** agree with the Board to appropriate representation on SEPA's Area Advisory Groups.
- Trusts **should** participate where appropriate in Area Management Groups.
- Where there are SACs Trusts **must** comply with and contribute to SAC management plans.
- Trusts **should** contribute and be aware of their Local Biodiversity Action Plans (LBAPs).
- Trusts **should** prepare relevant fishery management plans (see section 3.8.).

c. Stakeholders

- Trusts **should** interact with all other fish and stakeholder interests within their catchments.
- Trusts **should** identify, where appropriate, the other river users within the catchment e.g. canoeists.

Communications

- Once stakeholders have been identified they **should** be communicated with and receive information from the Trusts.
- Trusts **should** use a website on which the following information will be available:
  - Most recent published accounts
  - List of Trustees
  - Membership of Trust
  - Annual reports
  - Other reports/newsletters
- Trusts **should** produce a newsletter/e-letter to be made available to the general public.
- Trusts **should** hold an AGM and **should** consider holding an annual public meeting that is publicly advertised and open to all members and the general public to promote the work of the Trust.
- It is **recommended** that Trusts consider whether some of the above forms of communication could be co-coordinated with the relevant DSFB and other relevant stakeholders or agencies.

- It is **recommended** that Trusts take all available opportunity to use media to broadcast their work to the general public.
- It is **recommended** that Trust use and/or co-ordinate their media actions with the ASFB/RAFTS PR/Media adviser.
- It is **recommended** that Trusts attempt to liaise with their local DSFB when engaging in media activity.

Fisheries Promotion

- The economic development of fisheries inevitably imposes pressures on fisheries, which could be detrimental to fish stocks. Fisheries Trusts **should** ensure that fisheries are promoted in a sustainable way; environmentally, socially and economically.
- Information **should** be gathered to inform decisions relating to angling access and promotion.

Transparency

- The Trust **must** be transparent in accordance with Charities Law.
- The Trust **must** provide information on request to OSCR.
- The Trust **must** provide members of the public with a copy of the charity's constitution and its latest statement of accounts on request.
- Trusts **must** comply with the Charities and Trustee Investment (Scotland) Act 2005 and supervision and potential investigation there under by OSCR.

Education

- Trusts **should** be involved in education initiatives with both children and adults.

Monitoring

- Data **should** be collected to SFCC standards and submitted to the national database annually.
- Management decisions **should** be based on relevant best practice.

Trading Subsidiaries

- Trusts **must** create a separate trading subsidiary, if there is to be any non-charitable work, with additional costs involved.
- Charity's funds **must** be used for its stated Charitable Purposes only.
- To determine whether funds are being used correctly it is helpful to ask three essential questions:
    1. What are the charity's Charitable Purposes?
    2. Is the proposed course of action going to further its Charitable Purposes?
    3. Is the proposed course of action in the best interests of the charity and its Charitable Purposes?

- Whenever a charity wishes to conduct activities out with its Charitable Purposes ("non-charitable trading"), it will be necessary to create a separate trading subsidiary.

Fisheries Management Plans

- The Fisheries Management plans **should** be produced in a common format consistent with the SFCC template, which will enable it to contribute to Catchment Management Plans and the WFD River Basin Area Management Plans that will be produced by the Area Advisory Groups being established by SEPA.
- There **should** be Fisheries Management Plans for all significant river catchments in Scotland.
- Where there are no Fisheries Management Plans, they **should** be produced for all significant catchments within an agreed timetable for completion and implementation.
- Where appropriate these plans **should** be produced in co-ordination with/input from the DSFB.
- Completed Fisheries Management Plan **should** produce a series of objectives for implementation.
- A plan for resourcing the implementation of Fisheries Management Plans **should** be produced.
- The progress of implementation **should** be assessed and reported on an annual basis.

Audit

- Trusts **should** conduct an annual audit of this Guide and submit to the RAFTS at the end of each calendar year.
- All Trusts **should** submit a brief annual return to the RAFTS, outlining income, expenditure, personnel, membership and any other details as may be deemed useful for promoting the interests of Fisheries Trusts and fundraising.

Relationships between Trusts and Boards

- It is **recommended** that DSFBs and Trusts form a joint working group to co-ordinate activities of staff and projects.
- Representatives on the joint working group **should** sufficiently represent the differing interests within the catchment.
- The all species remit of the Trust **should** be recognised by the interests of the salmon and sea trout fisheries.
- To avoid duplication of effort Trusts and Boards **should** co-ordinate representation on the various groups and committees within their catchments.
- The information collected by the Trusts **should** be made available to the District Salmon Fishery Boards to assist management decisions.
- It is **recommended** that Boards and Trusts liaise with each other on media activity.
- Consideration **should** be given to the short to medium requirements of the Trust to ensure continuity of funding.

11.3 Describe the infrastructure and expenditure (e.g. libraries, laboratories, visiting groups, consultancy fees) required to facilitate proposed management actions in your area.

Regular use of the FRS library facilities will continue to be made as will consultation with FRS staff for advice in their specialist fields. Issues where further consultation with FRS staff will be required to achieve the aims of this plan are listed below;

- Research into genetic structuring of salmon and sea trout populations.
- Development of salmonid electro-fishing programme
- Development of eel monitoring programme.
- Development of lamprey monitoring programme.
- Sampling fish populations in large waterbodies.
- Development of Hill loch research.
- Carrying capacity research.
- Nutrient restoration research.
- Modelling of stocks.

The development of international links and hosting of visiting groups would require additional resources although the refurbishment of the Board's bothy at Pitglassie near Dingwall will provide some accommodation.

Where specialist consultancy has been required (engineering design at Dunglass Island and fish pass design at Corriefeol) this has been sourced and built into project costs.

Advice from the River Restoration Centre is also available through SNH for projects which meet their criteria.