About river banks and juvenile salmon production in Wester Ross



Peter Cunningham 5th February 2019 Summary
Wester Ross landscapes
Juvenile salmon production
Riparian woodlands
Catchment-scale restoration



Wester Ross

Land of glaciated mountains, lochs and short, swiftly flowing salmon rivers . . .

Barren mountains . . .

Beinn Eighe NNR: how natural?

Sparsely vegetated slopes

Beinn Damh forest: where are the trees?

Knoll and lochan landscapes...

Uninhabited 'wilderness' . . .

Fionn loch and Dubh loch from Beinn Airigh charr



Rainfall Amount (mm) Annual Average 1971 - 2000

Plenty of rain

(most of the time . . .)



Rainfall Amount (mm) 466 - 640 641 - 740 741 - 870 871 - 1060 1061 - 1290 1291 - 1690 1691 - 4577

Temperate rainforest . . .

[... or rain**wood** (Fenton, 2016)...]

. . . can still be found
around Loch Gairloch .
. . supporting a high
diversity of epiphytes.



But not so many trees along riverbanks . . .

Strath na Sealga, upper Gruinard: note alder woodland along floodplain

Trees cling to inaccessible ledges

Abhainn Dearg

Most of Wester Ross has been grazed by cattle, sheep and deer over hundreds of years.

Ben Rushbrooke

SEA

What limits juvenile salmon production in Wester Ross?



FRESHWATER

Find out about juvenile fish populations

WRFT electro-fishing survey

John Macpherson

Count and measure the catch...

How do the rivers compare?



River Broom tributary Allt a Mhuilinn 5th September 2016.

Stable habitat. Note green algae on streambed and overhanging vegetation.

54 trout + salmon fry in just9 minutes fishing!

(= stuffed with wee fish!)



Bruachaig River (River Ewe system) by Incherill, 2nd August 2019

•Highest salmon fry density of the year for NEPS sites (41 per 100m²) and good numbers of fat salmon parr.

•Healthy riparian woodland . . .

• (... & possibly a septic tank discharge ~200m upstream!)



Allt a' Cham Loin Mhoir (north burn) Loch Sguod system (by L. Ewe)

•Very high CPUE for both salmon fry and trout fry in some years.

- •Healthy riparian vegetation corridor.
- Dark peaty water
- Dead cow found in 3 years

•One of the most productive habitats for trout + salmon combined.

Growth and production of juvenile salmon depends upon food availability



Stonefly and Mayfly larvae



Gruinard River compared to Dundonnell River



Gruinard: Most juvenile salmon grow slowly in the headwaters streams



Gruinard: some of the highest wild salmon in Wester Ross? Allt Loch Ghuibsachain, 210m

9 September 2015



Gruinard main river: few riparian trees





Dundonnell River: many riparian trees 2019 survey: Moderate to high numbers of healthy parr Few salmon fry anywhere

•Unstable river: redds washed out?





and and a second s

Gruinard River

flows though deer grazed open moorland

Dundonnell River wooded riparian corridor



Length / frequency (numbers of fish / minute) of juvenile salmon caught at 4 sites in the Gruinard River, 26th August 2016





Numbers of fish per minute vs. length

2008

Gruinard River flows though deer grazed open

moorland



Lengui class (min)

Length / frequency (numbers of fish / minute) of juvenile salmon caught at 4 sites in the Gruinard River, 26th August 2016



2016



Dundonnell River

wooded riparian corridor







Estimated weight of fish per minute vs. length

2008



Gruinard River flows though deer grazed open moorland

Length / frequency (in grams of fish / minute) of juvenile salmon caught at 2 sites in the Gruinard River, 20th August 2008



Length / frequency (in grams of fish / minute) of juvenile salmon caught at 4 sites in the Gruinard River, 26th August 2016



Most of juvenile salmon biomass needs at least one more year in freshwater

Dundonnell River

wooded riparian corridor





Most of juvenile salmon biomass big enough to go to sea the following year

Benefits of riparian woodlands well known

Restoring and Managing Riparian Woodlands

Riparian woodland restoration scheme (WGS), Upper Kanaird River

(Langwell Estate)

Some estates have developed enclosed woodlands to stabilise streams and enhance food availability.

WGS enclosure, Coulin Estate (headwaters of River Ewe) ~2005

Coulin farmhouse burn: young woodland

WGS enclosure, Coulin Estate (headwaters of River Ewe) 2019

Planting trees along river bank

Gairloch High School S3 'Living Lochs' field trip to Coulin Estate

Coulin farmhouse burn: woodland scheme planted in 2004

(picture taken in October 2019)

Some of the trees are big now . . . ③

COULIN ESTATE NATIVE WOODLAND RESTORATION

PLEASE III

TREES FOR FISH

PROTICE THE WOODLAND BY CLOSING THE GATES BETUND YOU

TREES FOR FISH ...



To improve the habitat for fish, Coulin Estate with support from the Forestry Commission through the Woodland Grant Scheme (WGS) have established 2 enclosures to restore riparian (stream side) woodlands. This enclosure has been planted with alders, willows, birch, rowan and and other species.



By restoring more varied habitat, production of insects, earthworms and other small animals will increase. Leaf litter is also a food source for some of the aquatic insect larvae that are also important food items for young fish.

Tree roots, especially those of alder, help to stabilise river banks preventing erosion. Roots also provide additional cover (protection) for small fish, which can hide from larger fish and other predators.

Between June and September each year many thousands of adult salmon and sea trout return from the sea underneath the road bridge at Poolewe and swim up the River Ewe into Loch Maree where the fishery for sea trout was once world famous. By October, many fish have continued their journey back towards their natal streams, some heading up the Kinlochewe and A'Ghairbhe Rivers to Loch Clair and on into Loch Coulin.

This stream, known locally as the 'Farmhouse burn', is one of the most important spawning areas for sea trout, which lay their eggs in river gravels in late October or November. The eggs slowly develop during the cold winter months and little trout fry swim up from between the stones in April or early May in search of food.





Stonefly (2 tails) and mayfly larvae (3 tails) are food for juvenile trout (above) and salmon (below)

Native woodlands also provide habitat for many birds – including Stonechat, warblers and other small song birds. Look for dipper, grey and pied wagtails which also feed on insects along the stream.



Otter, and Blackthroated diver, which attempt to breed on several lochs in the area also benefit from healthy populations of trout and salmon.







Coulin Estate is committed to the restoration of healthy and productive fisheries for wild sea trout, salmon and other special wildlife. If you meet the keeper, ask him about some of the other projects on the estate.

Wester Ross Fisheries Trust, 2004 tel: 01445 712 899 info@wrft.org.uk

Inside Woodland Grant Scheme, Tournaig . . .



Gruinard headwaters, Abhainn Gleann na Muice

Why are there not more riparian trees?


HOME SPECIES RED DEER

view all Species

RED DEER CERVUS ELAPHUS

management priority

Our largest deer, males have large, branching antlers, increasing in size as they get older. During the autumnal breeding season, known as the 'rut', males bellow to proclaim their territory and will fight over the females, sometimes injuring each other with their sharp antlers. Red Deer live on moorland and mountainsides, as well as grasslands near to woodland. They can be seen in deer parks throughout the country.

COMMON NAME

Red Deer



(left) Live alder trees

roots support river bank.
fertile riparian corridor with green grass.
many places for parr to hide in roots.

(right) Dead alder trees

- roots rot away and bank collapses.
- •fertile riparian corridor eroded away.
- •stream becomes wider and shallower.



Gruinard headwaters: trees can grow quite well if fenced off . . .



Some ideas proposed . . .

5.3 Riparian habitat protection and restoration

5.3.1 Abhiann Gleann na Muice

Butler (2001) discusses the need to protect riparian habitats. Since then, there has been much reappraisal of options and discussion both on and off the record particularly with regard to the Abhainn Gleann na Muice. These have focussed on two issues (1) the rate at which riparian habitat is degrading, and (2) the practicalities and potential costs of taking action to protect and restore riparian habitat (including concerns for passage of red deer within respective areas and access to grazing habitat).



En route to electro-fishing sites in 2207, 2010 and 2011 the WRFT biologist took note of the state of riparian habitats. Here are some pictures from section upstream the from the confluence with the Abhainn Gleann na Muice Beag. All photos taken 1" on were November 2011 by Ben Rushbrooke, except the dead tree (right), which was taken on 23' September 2009.











Figure 12. Proposed riparian habitat protection and restoration scheme for Abhainn Gleann na Muice.

This scheme ('Scheme A') proposes the establishment of a riparian enclosure to protect remaining alder trees and the soils they support, and to allow regeneration of trees along the Abhainn Gleann na Muice. The existing riparian alder trees are slowly dying off, and there is virtually no regeneration above the confluence with the Abhainn Gleann na Muice Beag. This is potentially one of the most important headwater streams for production of early running 2SW salmon, arguably the most desirable salmon in the Gruinard River system.



from WRFT fish survey report

Maintaining water gates in remote area an issue...

Possible solution where red deer are the management priority?



https://www.deepartnership.org/pearls-in-pearl-project.asp

Even where riparian woodlands are healthy some rivers are unstable

Dundonnell River (August 2019) •healthy riparian woodland corridor •but river still very unstable?

Rhidorroch River (Ullapool River headwaters) 2nd September2015

Hurricane Bertha spate damage

> Just 8 salmon fry and 4 salmon parr caught in 16 minutes e-fishing

Much of the Rhidorroch River is very unstable...

0/08/2002

East Rhidorroch River (Ullapool River catchment)

December 2005

August 2006



August 2019

Unstable because of rapid run off, bank erosion and collapse and large amounts of sediment transported from upper catchment area (Glen Douchary)...



(Same view as photo at bottom of previous page)

Problems originate in the upper river catchment



WESTER ROSS FISHERIES TRUST

ULLAPOOL RIVER FISHERIES MANAGEMENT PLAN 2016-2010

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NEPS sites 2019, Rhidorroch River (Ullapool River headwaters)

Very low densities of salmon fry and trout fry
Low densities of salmon parr
Juvenile salmon, invertebrates . . . washed out!

Trout eat juvenile salmon.

Juvenile salmon need somewhere safe to hide!

2nd September 2015

17 Aug 2005

34

Practical River Works

a best practice design and build event

23-24 September 2019

The Scottish Natural Heritage Headquarters

Great Glen House, Leachkin Rd, Inverness, IV3 8NW

Tickets: £75

Delivering sustainable river engineering works: client and regulator requirements for concept development, design and construction that consider natural processes.

Topics to be covered include:

- solving river engineering problems using natural processes
- stable design in steep channels.
- · engineering with trees
- adding natural process/ form into SUDS

SEPA

- cost benefit
- environmental austainability
- licensing and consents

Engineering works are often required where built intrastructure outh as reads, railwags, pipelinet, cables, and buildings interact with rivers and their floodplains. While such works must deliver a practical concome, there is an increasing requirement that they are mittaecubic in the longer term and sensitive to the natural environment.

The event will describe the background to such an approach to river works, the advantages of its application, the regulatory/ legislative context and provide examples of design? construction methods (including case studies, both nuccessful and unsuccessful). A significant part of the event will be site write to rome of the case studies to help with visualisation and understanding.



Such objectives are best achieved by working with river processes, producing solutions that aim to reproduce/ reinstate the natural form and, function of stable shannel-floodplain systems. This approach is now at the heart of decision making by regulatory bodies.

10.00 0.000

To express interest for this event, please send an email to workshop@cbecoeng.co.uk or call 01463 718 831

Practical River Works

hast practice design and build event

Ha<mark>mish M</mark>oir (CBEC) Alasdair Matheson (SEPA)

Engineering works are often required where built stractructure soft as roads, railways, pipelines, tables and buildings interact with rivers

AND AND ADDRESS OF



In objectives are best achieved by working th river processes, producing solutions that in to reproduce/ reinstate the natural form of function of stable channel-floodplain istems. This approach is now at the heart of color making by regulatory bodies.









Practical River Works

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Upper River Nairn river habitat restoration project (~£250k...)

erarder

B85



Sign in

Flichity

Not all problems resolved . . .

Loch Ruthven

East Croachy

Much sediment (including boulders and cobbles) is transported from upper catchment area

Abersky

Thank you very much for organising an excellent workshop and field excursion to the upper River Nairn yesterday. Sorry I couldn't stay for today – too far behind with other things!

However yesterday's excursion to upper River Nairn very thought provoking and raises issues some of which are similar to those I see in some unstable rivers in parts of Wester Ross.

I'm very interested in catchment management approaches to reduce the input of sediment into rivers. So I've looked at google map photos of upper River Nairn catchment to see if sources of so sediment deposited above and below the road bridge can be identified.

Please find attached some pictures from google map and bing maps. The google map photos show active landslips. The tracks also appear to be quite new – have they exacerbated the landslip problem increasing input of sediment?

Are there any projects or other work occurring in the Highlands to address the issue of landslipping at the catchment scale? Rapid runoff and associated erosion is a big problem in parts of Wester Ross affecting fish habitat in several rivers. SEPA advice on how to minimise landslip problem and protect hillsides would be much appreciated.

If some of this was covered on today's field excursions, my apologies for asking about this.

If there is any supplementary information from the workshop I'll be very interested in receiving it.

Many thanks to everyone for organising the meeting.

Best wishes,

Peter Cunningham



@frogenvironmental.co.uk; RRC; Lucio.Marcello.ic@uhi.ac.uk; David Holland; julie.tuck@sse.com Subject: Workshop thanks and landslips in upper river Nairn

Hi Peter,

Thank you for your email and our sincere apologies for the lengthy delay responding to it.

We are glad that you enjoyed the workshop and pleased that there was a lot of positive feedback from other delegates too. The River Nairn site in particular prompted a lot of discussion. It was a real shame we didn't have time to take the group to the upper catchment to see the source of all the sediment.

As part of the preparatory work for the restoration project both SEPA and Cbec surveyed the upper catchment. Attached are a couple of survey photos which show what it looks like and emphasises the scale of processes at work. The combination of discharge, slope and erodible material makes it inevitable that the river is very dynamic and generates a large amount of sediment input. The relatively soft slope material means that any connection between river and valley side will result in mass valley side failure. Scars all along the valley sides suggest that valley side failure has occurred frequently here through recent history at least



Picture by Alasdair Matheson SEPA

Picture by Alasdair Matheson SEPA



x

google.com/maps/@57.278741,-4.2507737,2006m/data=I3m1!1e3

Is the amount of sediment that comes down the river associated with upland management practices?

Dunmaglass

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Sign in

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Muirburn and wildfire in Wester Ross

•There were nine separate cases affecting designated areas in WR covering the period 2011-2014. We do not have data post 2014.

•We also have the coarser mapping from the European Forest Fire Information Service (EFFIS). The screenshot shows fires in

2019 in red

2018 in green

Thank you to Ben Leyshon, SNH



Woodland Grant Scheme, Flowerdale (Gairloch Estate)



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	BBOS - Try to avoid using BBOs, but If you do please make sure livey are located away from vegetation such as neather, gorse or grass, and are not in crintact with the ground. The metal underside of those disposable BBOs.	Sport Knoronninn
		Gairloch and Loch Ewe Action Forum ···· (GALE) - 28 June 2018 · 🚱
		Hello everyone! Hope you are all enjoying this amazing weather!
		Please see below for some info about fire risks. As we have recently seen several wildfires roar across our beautiful land devastating flora, fauna and wildlife we thought it would be a good idea to reiterate how important it is to be careful when out and about during this current heatwave.
	and the state of the second	I have made a wee document if anyone would like it for printing, just send a message with your email address and i'll fire it across.
		Many rural and remote communities are hugely impacted by wildfires, which can cause significant environmental and economic damage.
		You can help us protect our land by reading and

sharing the following advice...

Campfires - It would be considered highly

f you are planning a trip to the Highlands then look no further, Wester Ross has it all! Spectacular mountain and coastal

Wester Ross Biosphere -Highland Environment Forum

Wildfire conference & workshop

Kinlochewe Village Hall

Friday 6th March 2020

Details on HEF website and eventbrite tickets

Wildfire ?

Each year accidental wildfires destroy upland and woodland, releasing large amounts of carbon dioxide into the air.

A conference

6th March Kinlochewe Village Hall 09.30 - 16.00

Preventing Wildfires: Learning from experience

We'll be learning from past experience and good management practice to avoid out of control burning.

The programme will include presentations and practical workshops.

Find out more and book at https://wildfireconference.eventbrite.com





Highland Environment Forum Scottish Natural Heritage Dualchas Nàdair na h-Alba

Peatland ACTION Restoring Scotland's Peatlands Ath-stèidheachadh talamh mònach na h-Alba

Peatland and Carbon



Scotush Natural mentage Dualchas Natair na h-Alba



Peatland Action - How to apply

Continuing Scotland-wide peatland restoration in 2019 - 2020

Change section

Peatland ACTION Funding

The funding round for 2019-20 closed on Friday 17 May 2019.

Applicants will be informed if their application has been successful from July 2019.

In limited circumstances we may consider further applications where delivery of all on-site activity before 28 February 2020 can be assured. To make an initial enquiry please complete the Expression of Interest form. We will review your form after which we may invite you to submit a full application.

To request advice on your proposed Peatland ACTION project or Feasibility Study contact us at peatlandaction@nature.scot ^{L2}

The Management of Wild Deer in Scotland

Report of the Deer Working Group





Deer Management Report January 2020: New deer management legislation proposed

Picture by Sue Holland
Conclusions

•Juvenile salmon production depends upon food availability in most rivers in Wester Ross.

•Many of the more productive sites for juvenile salmon are associated with riparian woodland.

•Riparian woodlands are not regenerating in some areas because of grazing pressure and fire.

•Catchment-scale restoration initiatives may be helpful where headwater areas are very unstable, especially given more intensive rainfall events. Carrier Wildwood - Hore x + - □

Donate / Buy the book



About Carrifran Wildwood

with our help...

Carrifran Wildwood

An inspirational story of ecological recovery of a barren 650 hectare valley in the Scottish Borders



Life returns to Carrifran as planted woodland regenerates naturally. Photo by John Savory/Borders Forest Trust

https://www.rewildingbritain.org.uk/rewildin g/rewilding-projects/carrifran-wildwood





Thank you www.wrft.org.uk









Soils, ecosystem fertility & salmon smolt production in Wester Ross

1. Much of **Wester Ross** is underlain by hard, insoluble Lewisian gneiss, Torridonian sandstone or Moine granulite, yielding very **little nutrients**.

5. Historically there were **bears and wolves**. Wolves eat deer, ingesting bone and recycling phosphates.

6. **Peat** has formed where sphagnum moss smothers the ground, acidifying the soil and preventing aerobic decomposition. 7. Look for wee green knolls in the peatlands where birds and mammals have enriched the soil: note the increased plant growth and biodiversity.

8. Similar green patches are found along river banks where otters defecate. In the autumn, these **otter 'spraint sites'** may contain salmon bones. 2. **Soil fertility** is therefore dependent upon the retention and cycling of nutrients, particularly phosphate, through the **ecosystem**. 14. Increasingly heavy rain leaches nutrients from soils and washes away ash from fires. Spates erode away the richest riparian soils notably where alder trees have died back.

3. Unlike many rivers in the east of Scotland, there is **little human habitation** within the catchments of local rivers so little added nutrient from human sources.

10. Given sufficient phosphate (e.g. bone meal in mammal faeces), Alder trees grow in symbiosis with symbiotic nitrogenfixing bacteria, further enriching riparian soil fertility. 13. Heather burning is carried out to convert woody matter to ash, thereby releasing nutrients to promote the growth of grasses and other leafy matter for grazing deer or livestock.

4. In the past there were more people living in river catchment areas. Without modern sanitation, they contributed to nutrient recycling.

11. Most plants develop **mycorhyza networks** with symbiotic fungi which deliver phosphate to plant roots in exchange for carbohydrate.

15. Growth of **periphyton** is faster where the streambed is stabile and stream fertility is naturally high.

17. **Salmon parr** growth rates are highest where the food supply is richest. Over-winter survival and smolt production may depend upon the supply of mayfly and caddisfly larvae

18. **Well-nourished smolts** are better prepared for life at sea than emaciated smolts. d supply is urvival and depend upon and caddisfly filter orga

16. Flat-headed 'Heptageniid' **mayfly larvae** scrape periphyton from the streambed. Other mayfly and **caddisfly larvae** gather or filter organic detritus including leaf and periphyton fragments. 12. Earthworms help to recycle and retain organic matter and increase the porosity of riparian soils. In some areas invasive New Zealand flatworms have reduced earthworm populations, displacing moles with adverse consequences for soils.

9. Adult salmon deliver nutrients of marine origin to headwater streams especially if their carcasses are scavenged by other animals

Ecosystem nutrition in Wester Ross: conserving & replenishing phosphorus Woodlands on higher dont burns Graze schbird ground provide shelter for Islands during deer and contribute to composted food westes winter months. retention of Pindroppings. from schools, hotels be deer Return bones from droppings tim restaurants can be used= deer carcasses to the Discovege dear & as soil enhancer. hill to be recycled. domestic livestock from Bannie grezing river banks to (2 Sta pritert viparian trees. Keep domestic animals ** ** 7 F. 400 & deer off land where maxp. soils are broken, fragile Ash from incinerated Byres or polytunnels for or water logged. farm salmon carchises (chies ? Overwintering livestock privide / Intitling Sheep shelten is rich in phosphorus. P-vich manuve for use as ((() R dry beds nutrichits from share dung bectles fertiliser in the opening. canfly ... septic tank Sheep which eat seawced SOAKAWAY Keep deer, with Scheep Alder roots & course can be overwintered along CATCAS run off off the best grazing arcs woody debris in streams the shore as they'll help at night where possible. can help snay & retain to transfer nutrients to P-rich organic matter. managed constal grasslands. Nell_ wetland nutrient Spraint trup Weenypond otters follow salman o sivice to control water level sea troot & salmon deliver marine nutrients to head water streams. Huts with compost move bird Apples grow well toilets can replenish 1.50 teeders every where soils are P in surounding areas. ten weeks. enviched. Feed youry frees each year with small amounts Return wood ash to of Parich fertiliser. woodland soils to store. restore fertility. Schoolchildren enjoy outdoor learning and Fruit bushes grow well contribute diverting to along trails where dogs closystem fertility. look after raspherries are regularly walked ... earthworms DRAFT 1 Pick up or dig in solid wastes! PDC November ZU16

See https://www.wrft.org.uk/files/Ecosystem%20nutrition%20in%20Wester%20Ross%20poster%20and%20explanation.pdf