

Refertilising Scotland (part 1)

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27 September 2010

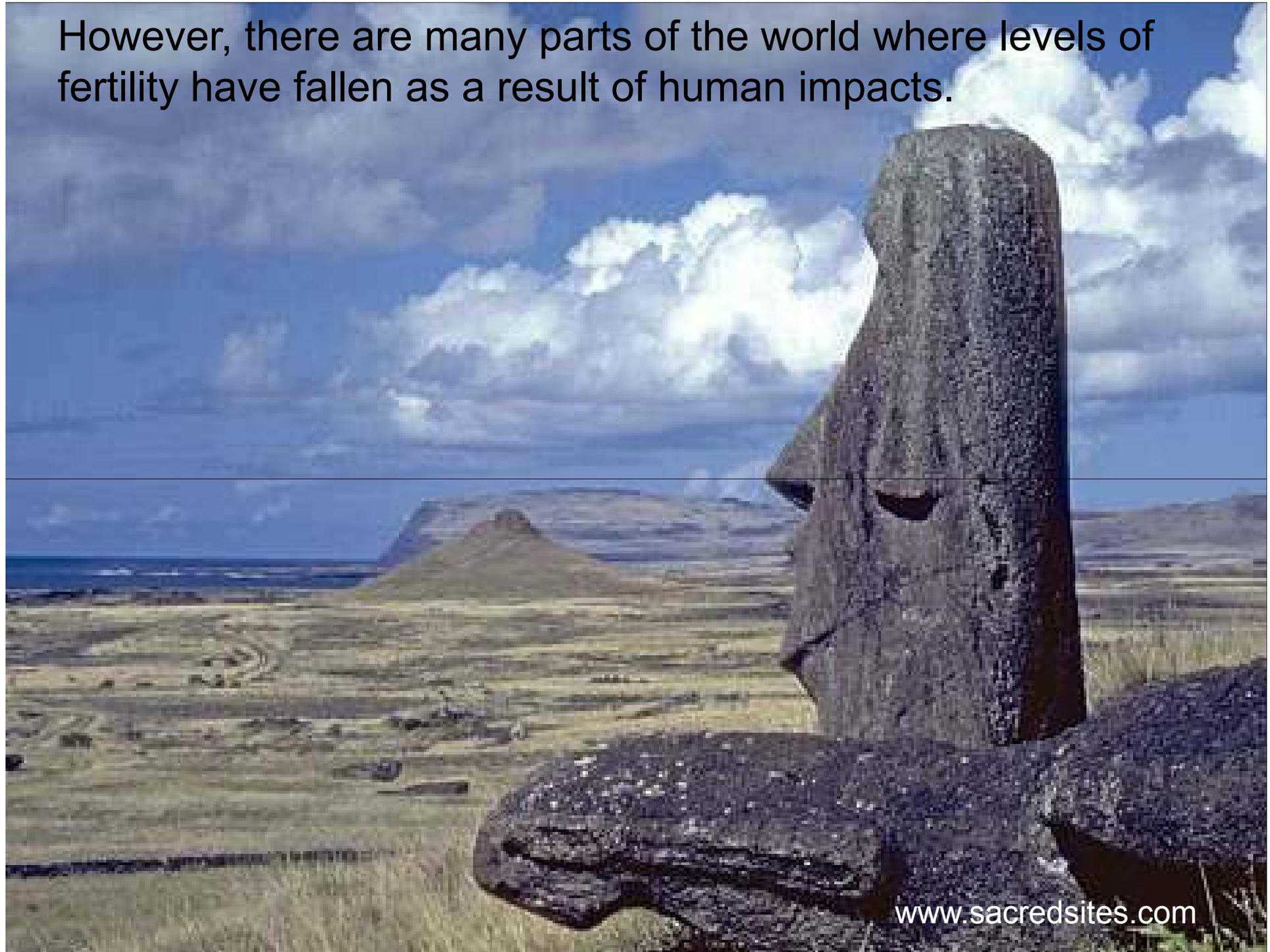
- for wildlife
- for fisheries
- for people

Beinn Eighe N'N'R from Meall Ghuibhais

One of our greatest government-led achievements for the environment, to date, has been the cleaning-up of 'eutrophied' waters.



However, there are many parts of the world where levels of fertility have fallen as a result of human impacts.



Deforested hills in Madagascar . . .



Is all of Scotland as fertile and naturally productive as she could be?



Case study: Wester Ross

- Geology and landscape

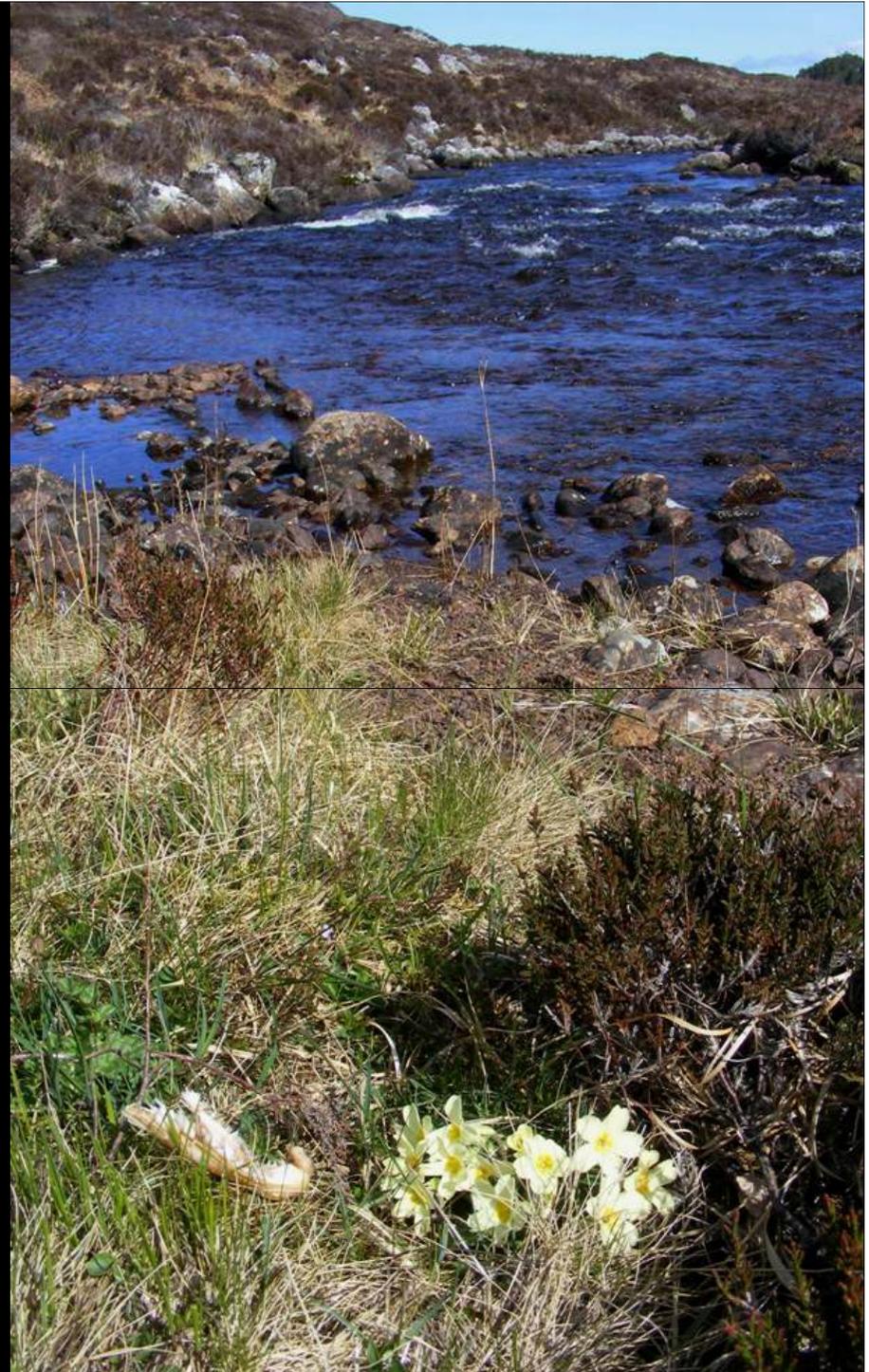
- Ecology and human influence

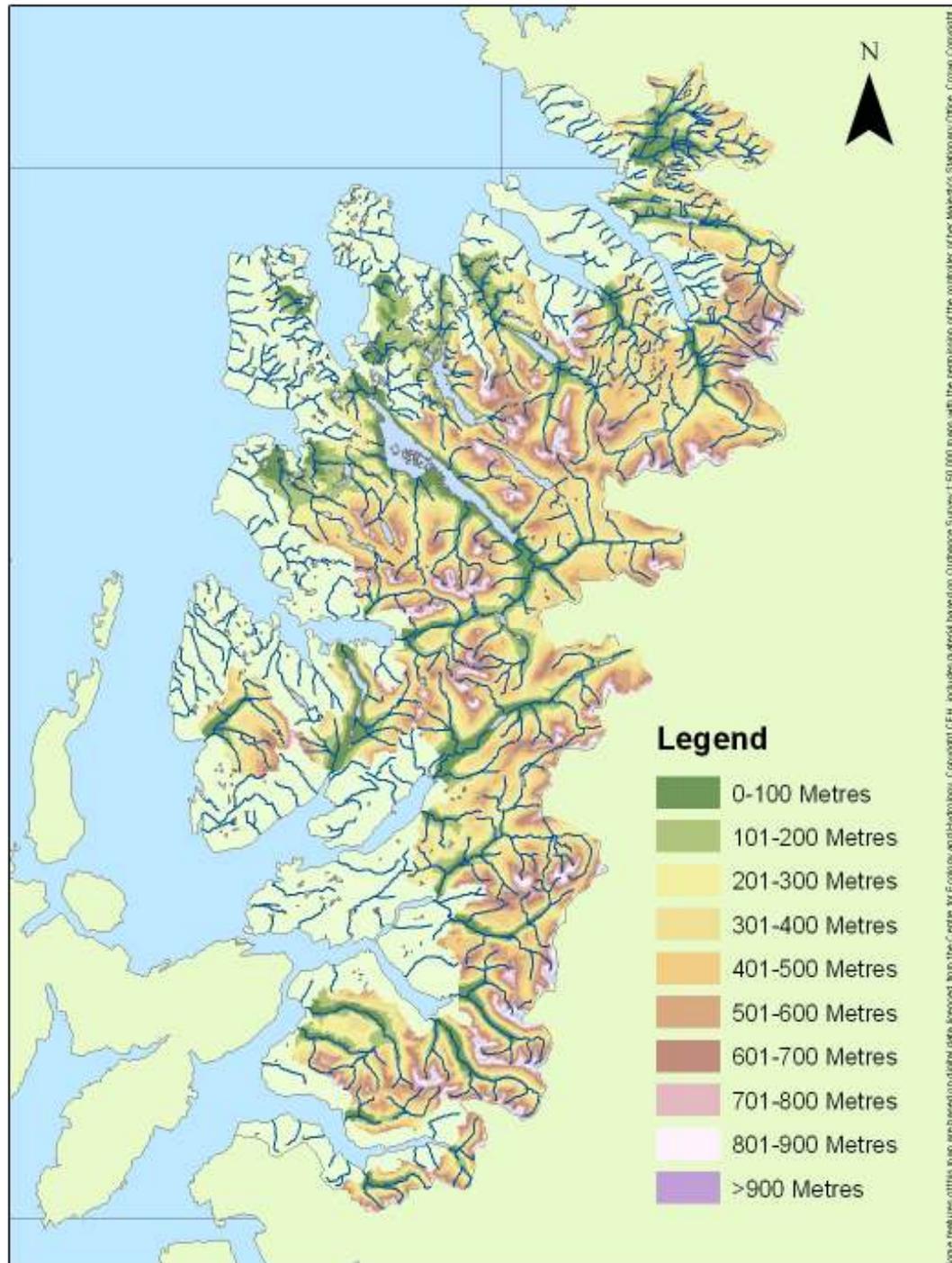
- break -

- Ecosystem fertility

- Revitalisation

*Salmon jaw and primroses, Little
Gruinard River , May 2010*



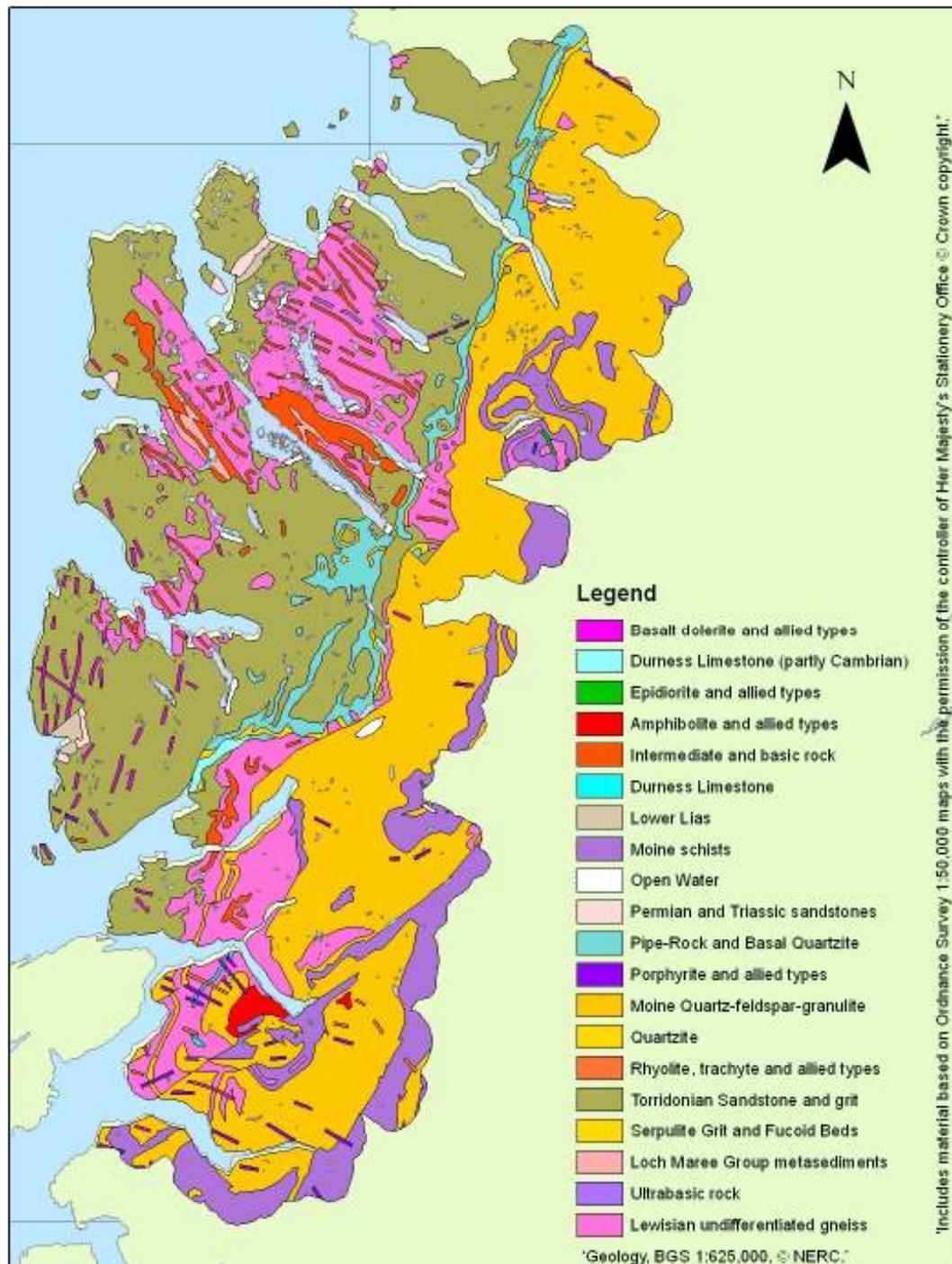


Wester Ross

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



Torridon and Liathach by Lulu Strader, Sept 2010

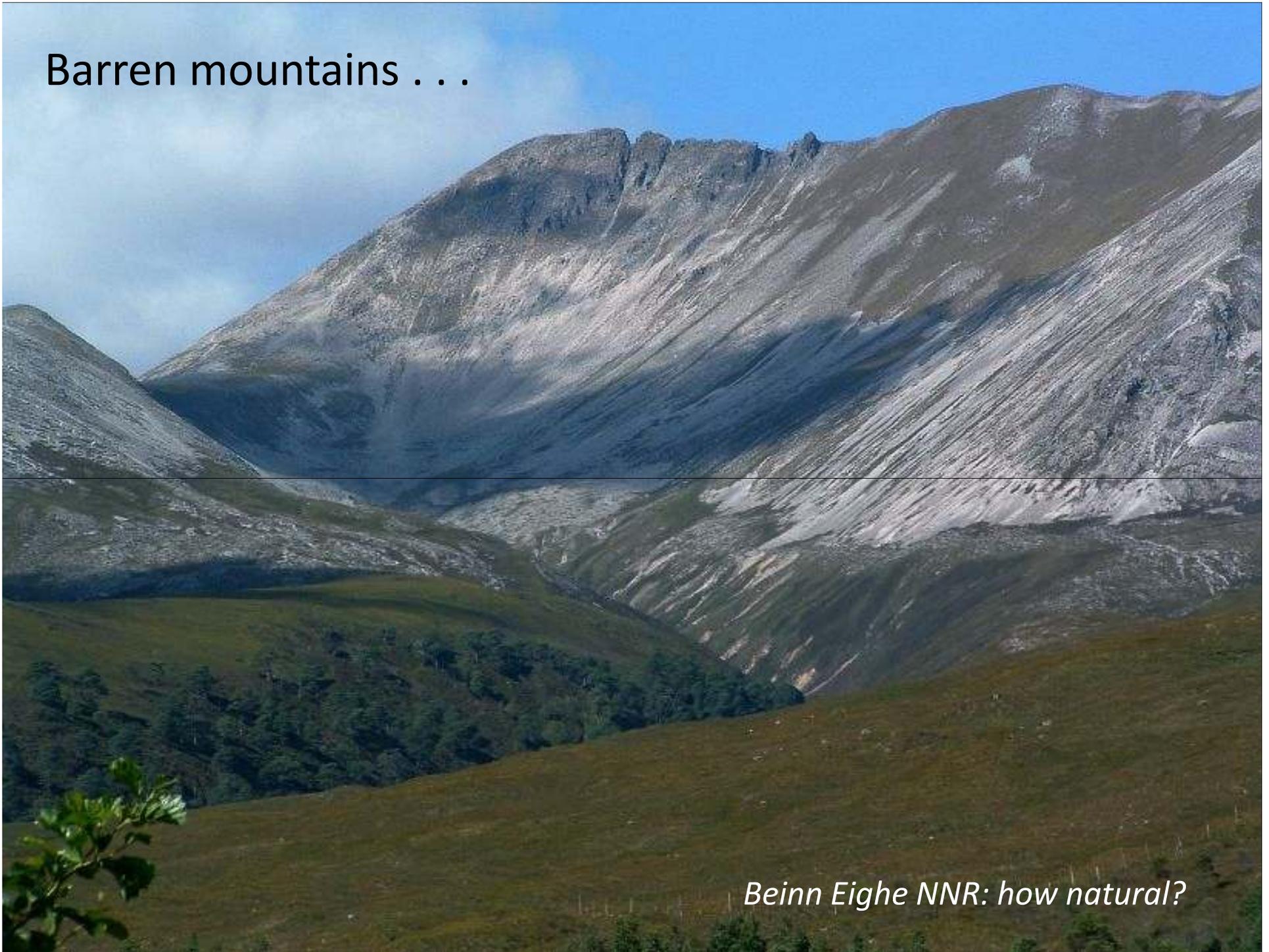


... underlain by
 Torridonian sandstone
 and Lewisian Gneiss.

Lewisian gneiss and Torridonian sandstone: hard, resistant to weathering, un-yielding rock.



Barren mountains . . .



Beinn Eighe NNR: how natural?



Sparsely vegetated slopes

Beinn Damh forest: where are the trees?



Trees cling to
inaccessible ledges

Abhainn Dearg

Unstable rivers



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

Uninhabited 'wilderness' . . .



*Fionn loch and Dubh loch
from Beinn Airigh charr*

with 'near pristine' oligotrophic lochs



Loch Maree . . .

Crofting townships around the coast

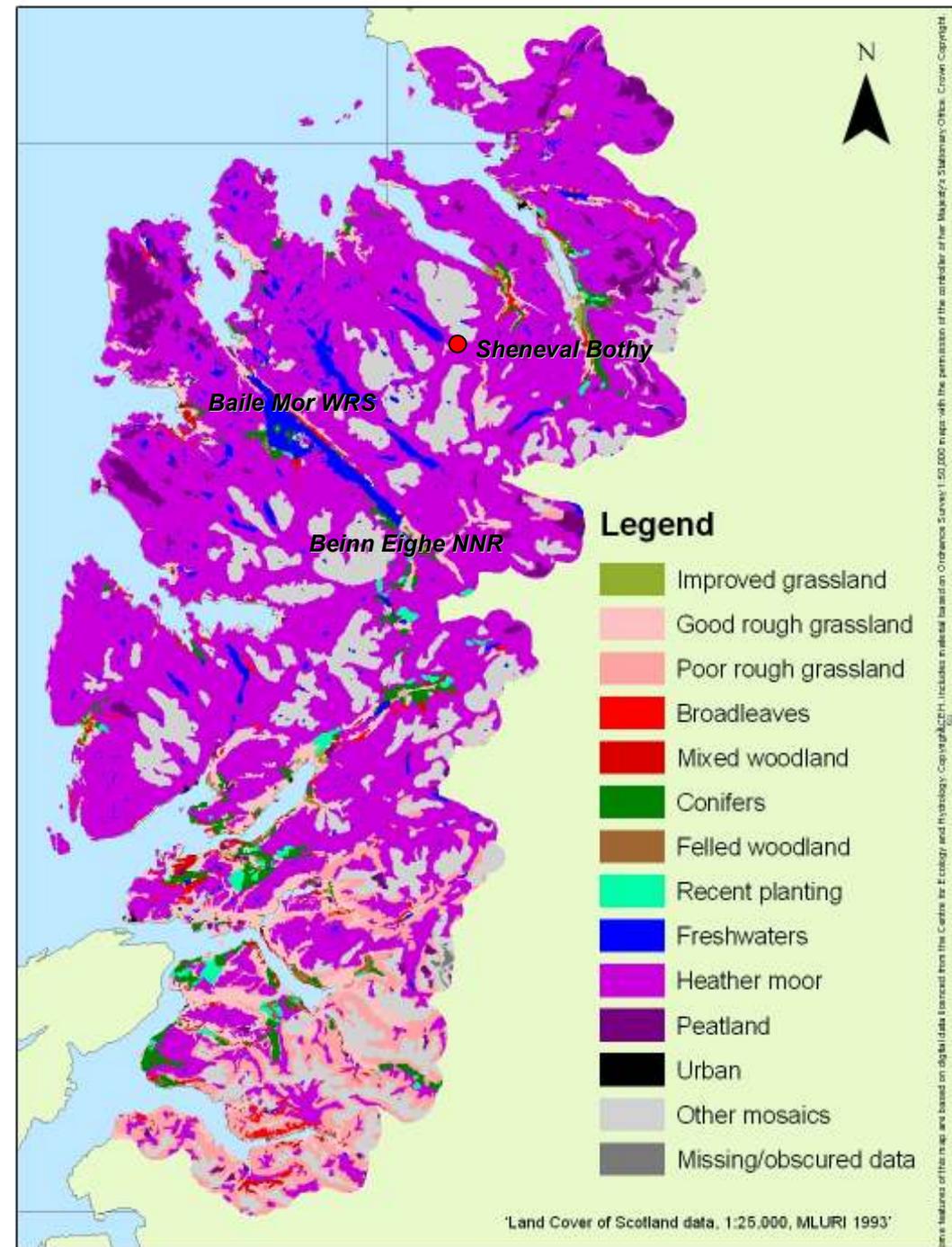


Melvaig and Alltgrishan in 2004

‘Heather moor’ and ‘other mosaics’ [50%+ unvegetated] are the dominant landcover.

There are relatively small areas of semi-natural woodland in valleys and around coast

Landcover map



Bog asphodel

Narthecium ossifragum

"bone breaker "



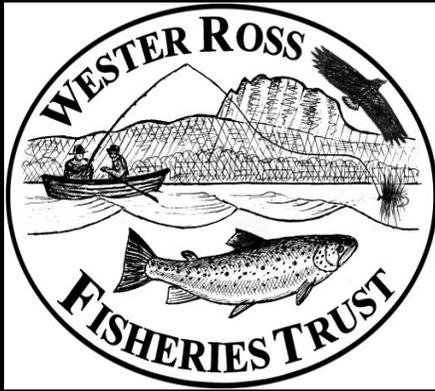
Sundew



I work for Wester Ross Fisheries Trust

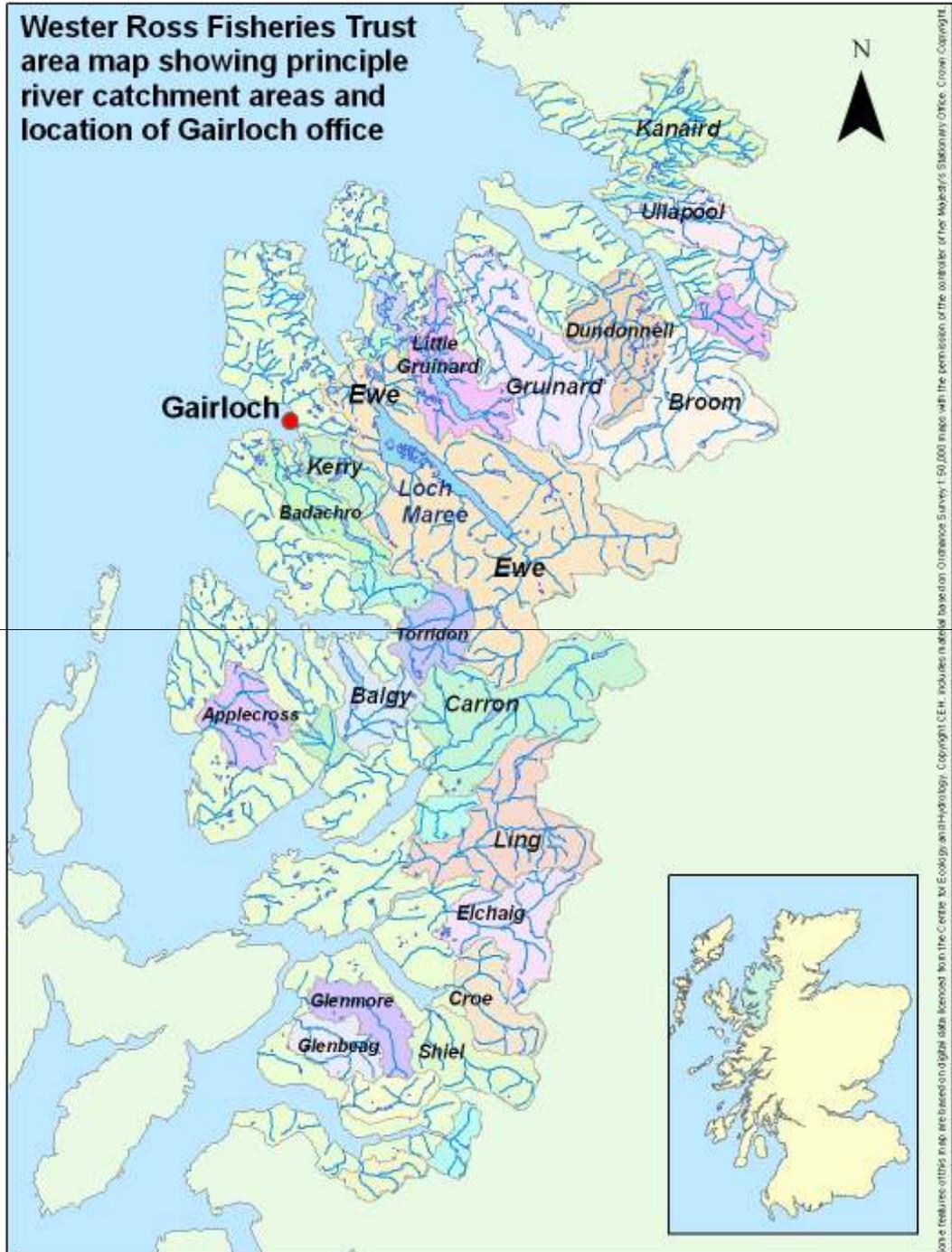


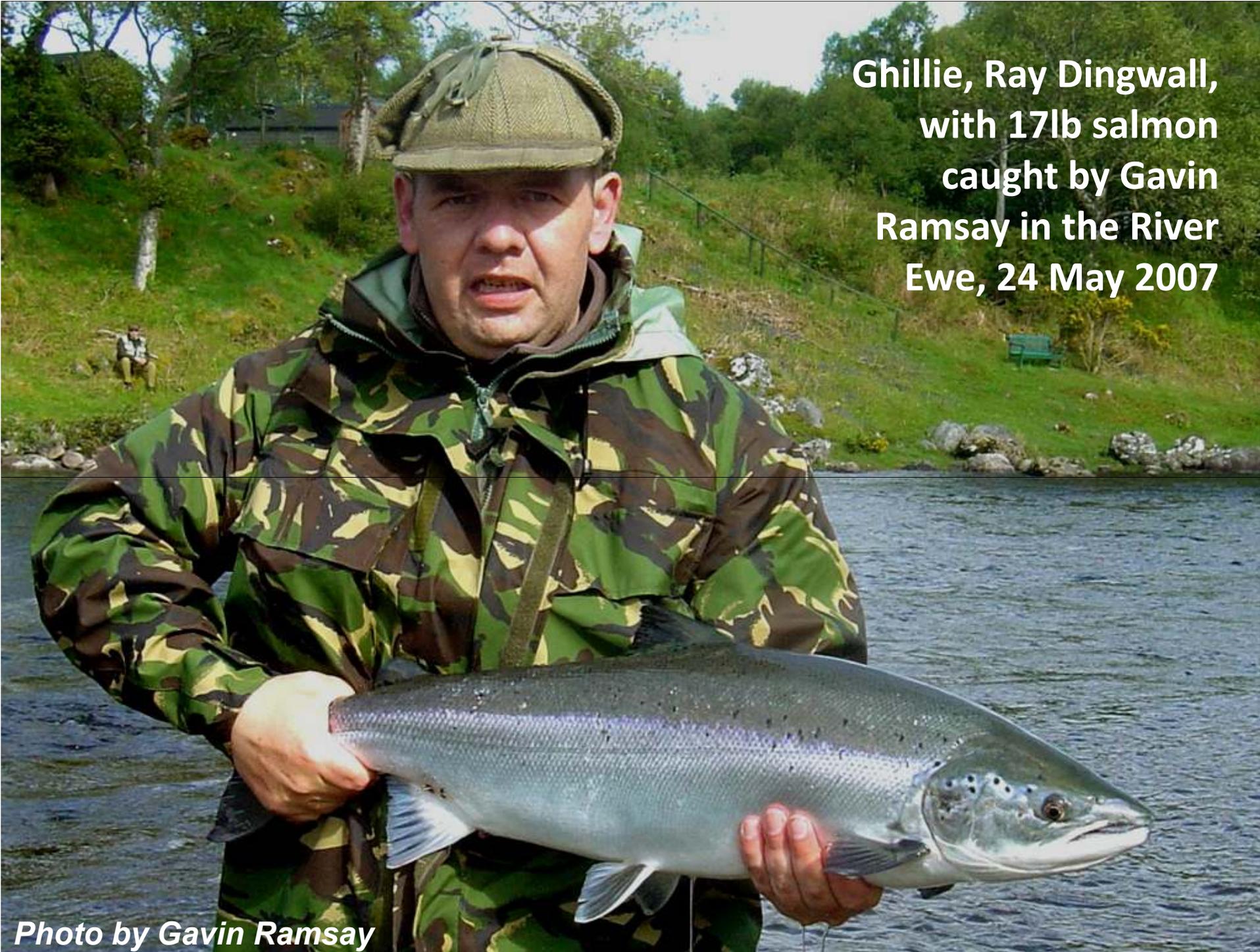
Sweep net catch, Flowerdale estuary, 1st February 2010



The overall Purpose of the Wester Ross Fisheries Trust is:

To maximise and sustain the natural productivity of wild salmonid fisheries in the rivers and lochs of Wester Ross.

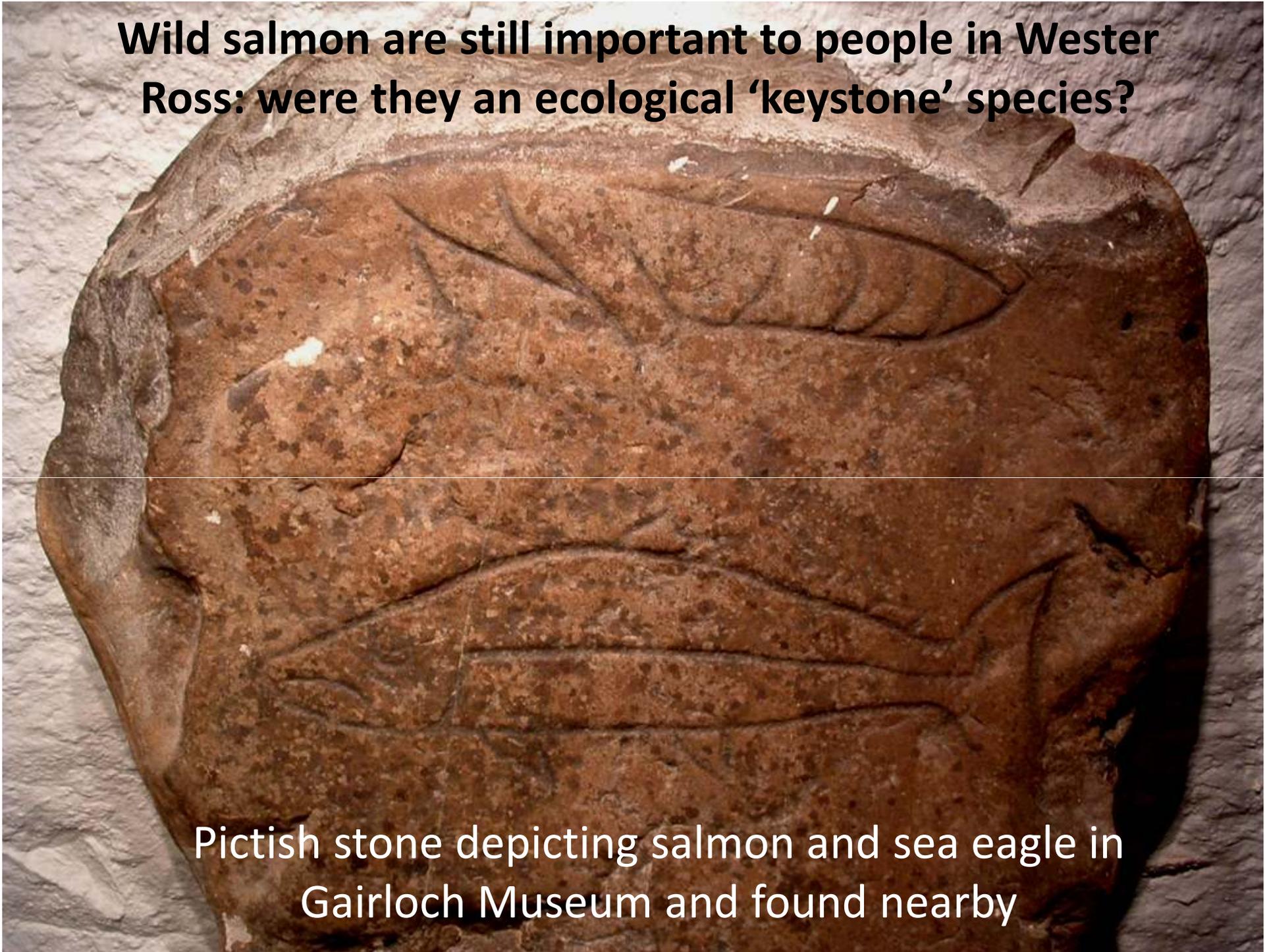


A man wearing a green tweed cap and a camouflage jacket is holding a large salmon. He is standing on a grassy bank next to a river. The background shows a lush green landscape with trees and a fence. The text is overlaid in the top right corner.

**Ghillie, Ray Dingwall,
with 17lb salmon
caught by Gavin
Ramsay in the River
Ewe, 24 May 2007**

Photo by Gavin Ramsay

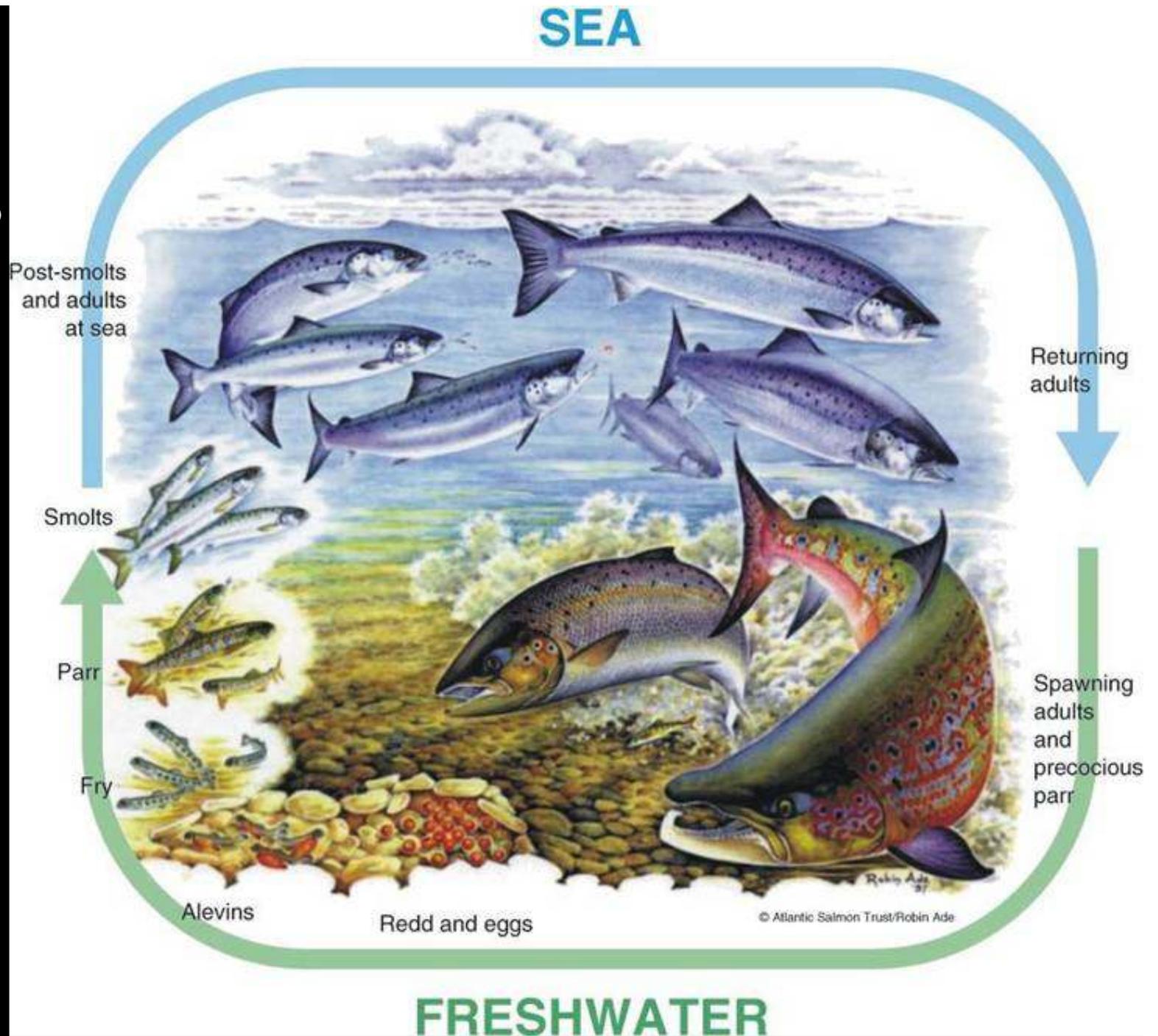
Wild salmon are still important to people in Wester Ross: were they an ecological 'keystone' species?



Pictish stone depicting salmon and sea eagle in Gairloch Museum and found nearby

What limits salmon production?

Are the waters of Wester Ross producing as many adult fish as they should be?



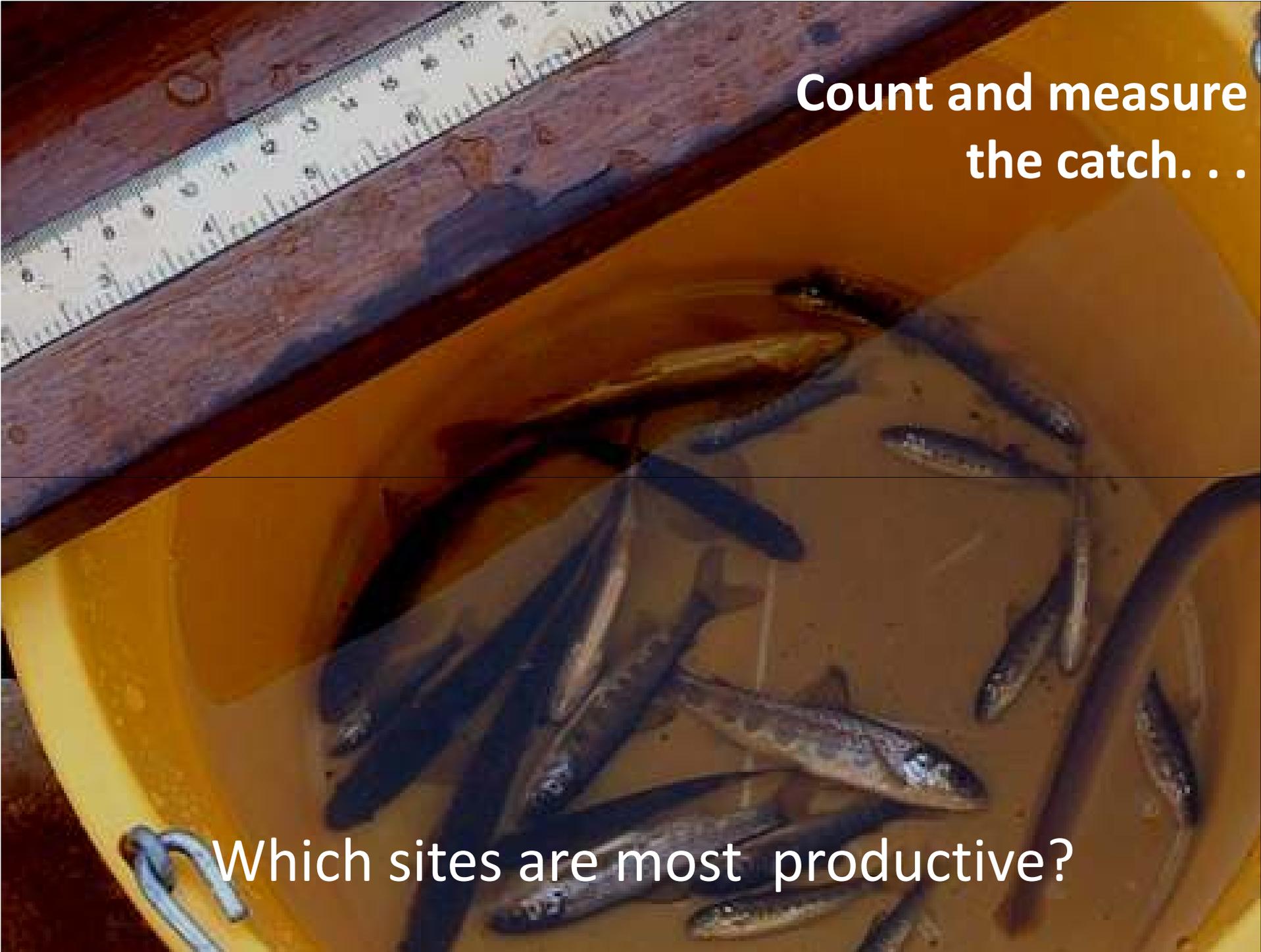


Juvenile fish surveys

Aims

1. To determine the distribution of wild juvenile salmon (trout and eels).
2. To assess the abundance of juvenile fish
3. To inform fisheries proprietors and managers

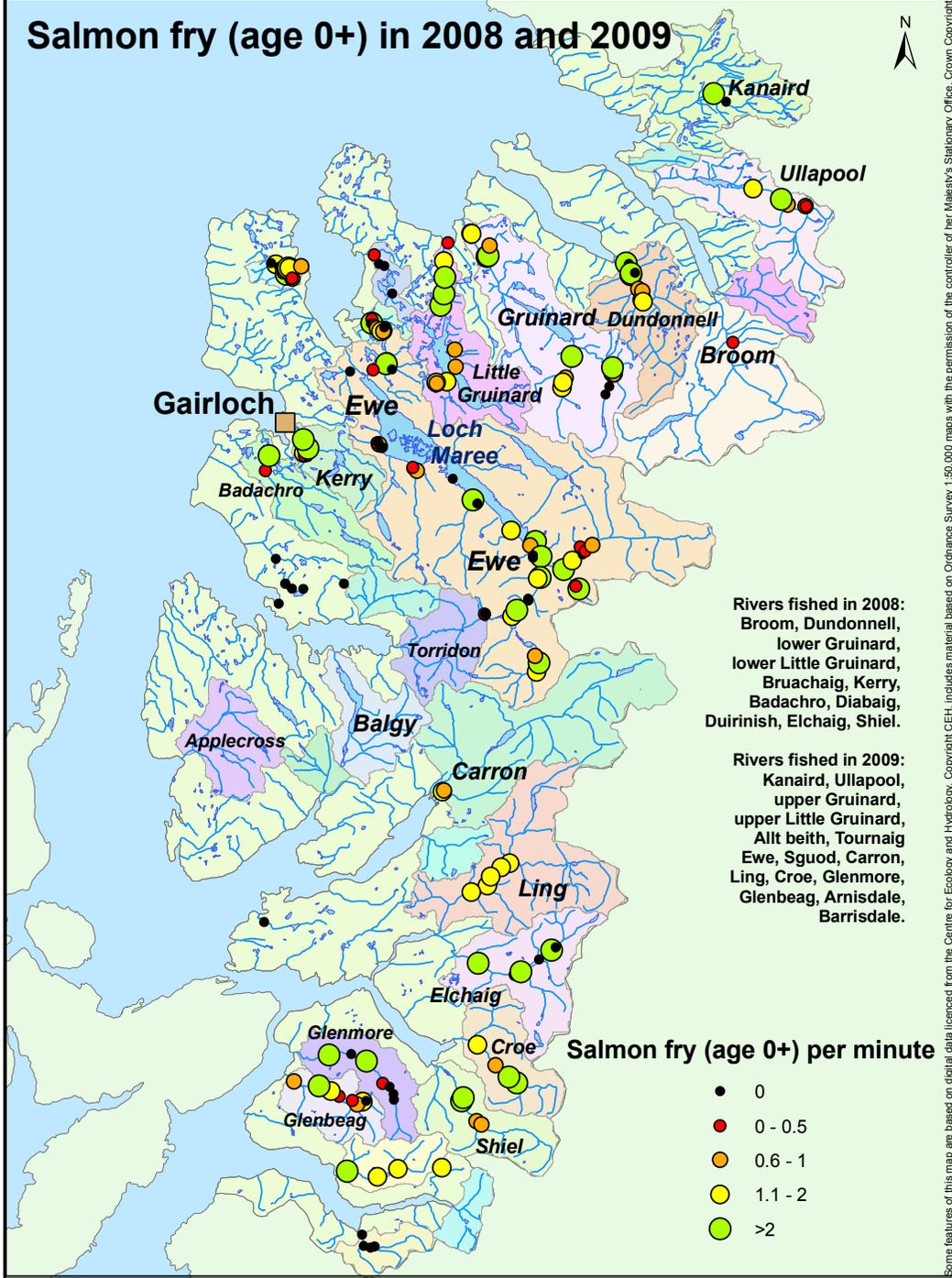




Count and measure
the catch. . .

Which sites are most productive?

Salmon fry (age 0+) in 2008 and 2009



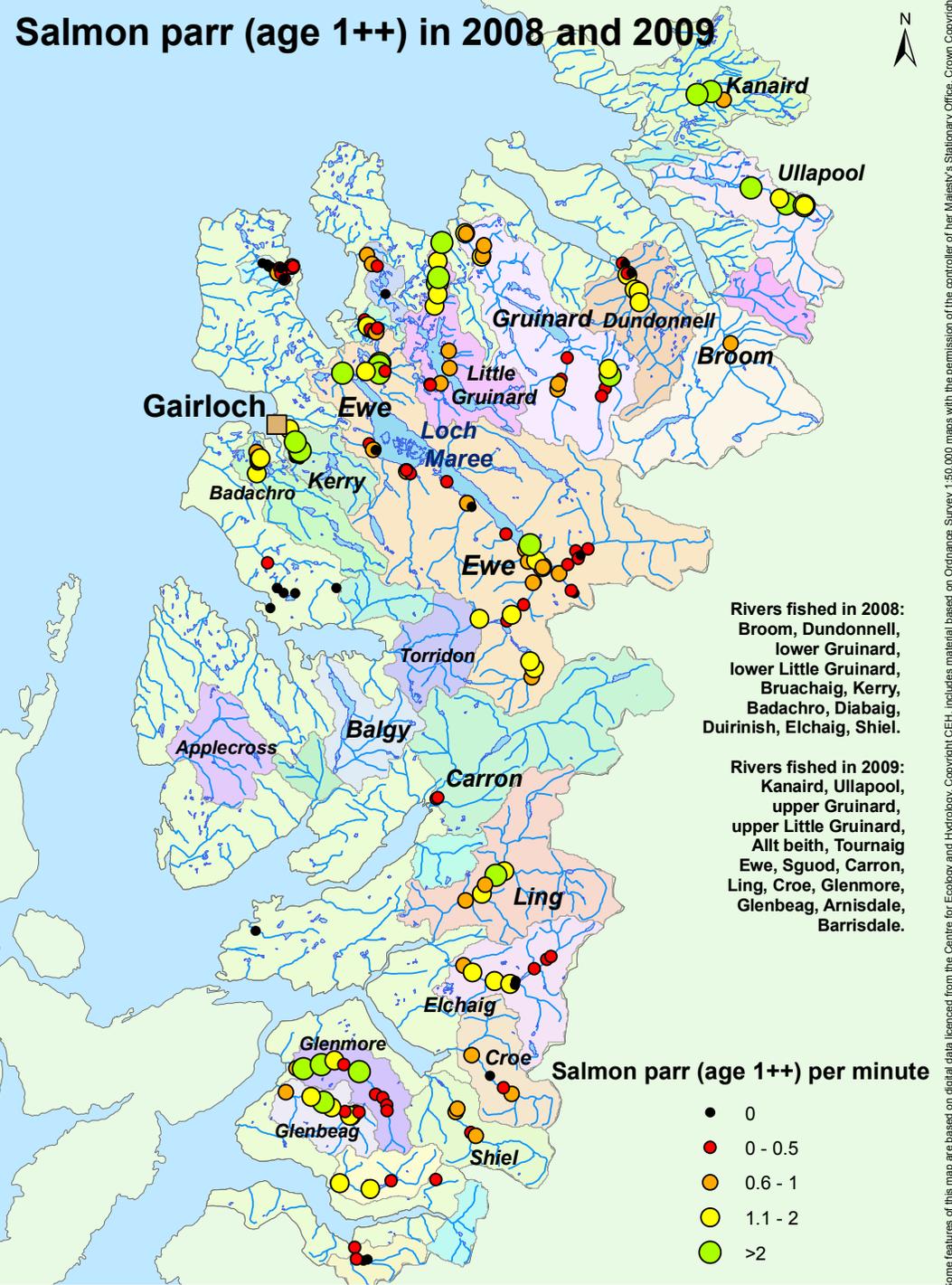
Some features of this map are based on digital data licensed from the Centre for Ecology and Hydrology. Copyright CEH. Includes material based on Ordnance Survey 1:50,000 maps with the permission of the controller of her Majesty's Stationary Office. Crown Copyright.

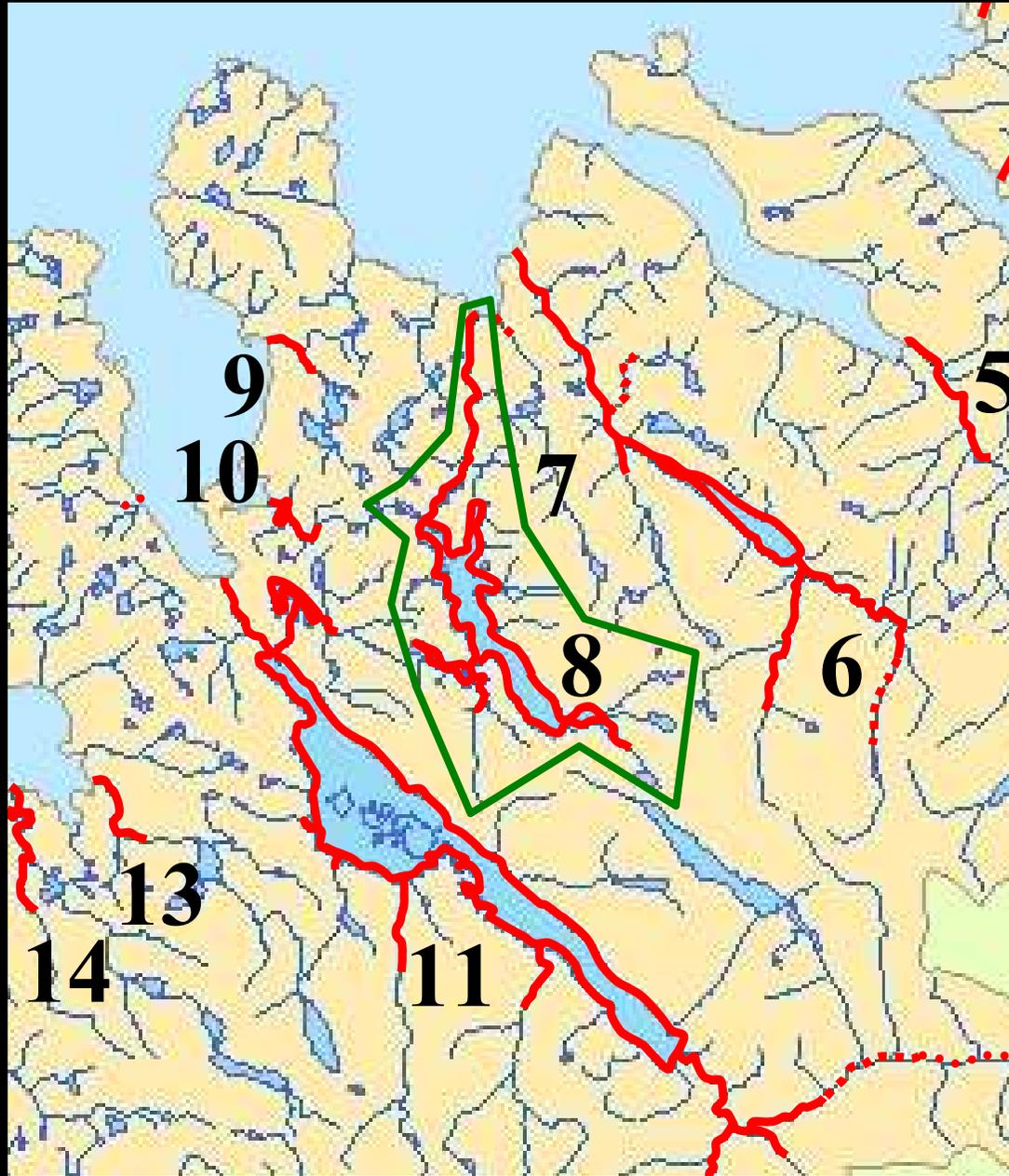


Distribution of salmon fry (age 0+ years)



Distribution of salmon parr (age 1++ years)



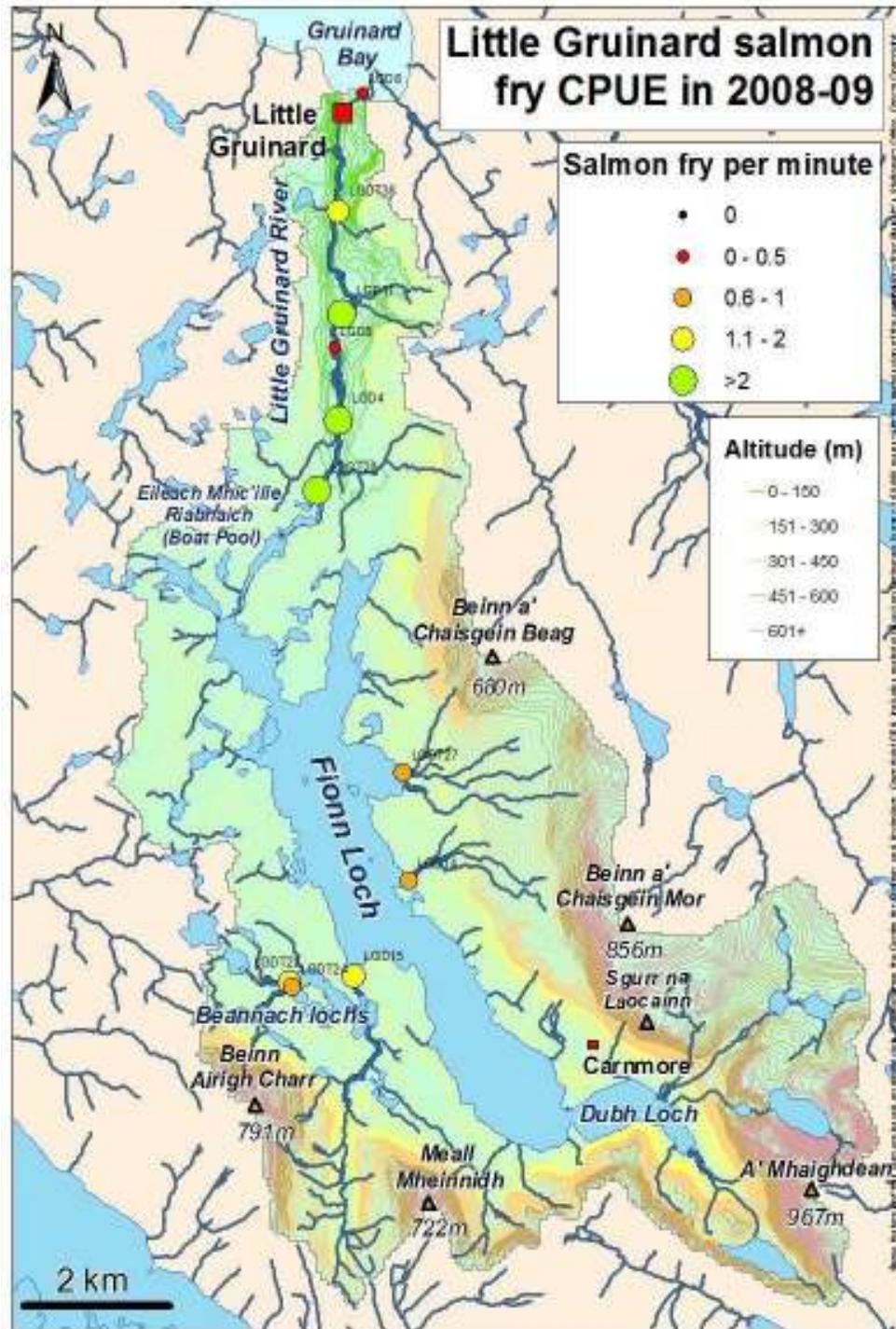


The Little Gruinard River

Special Area of Conservation (SAC) for the Atlantic salmon.



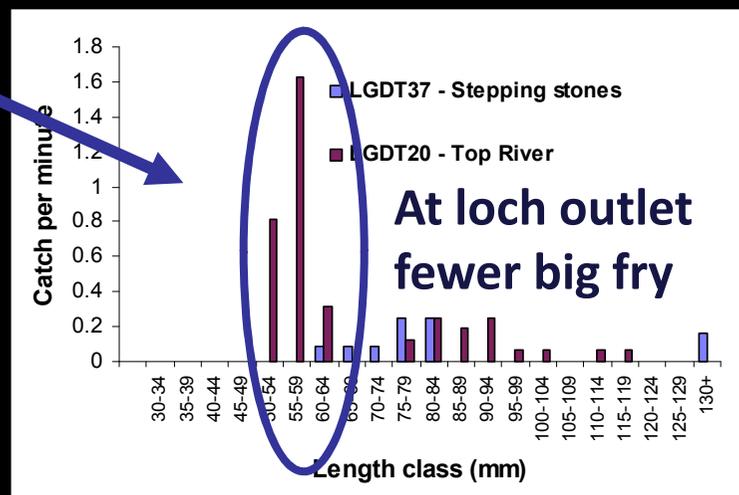
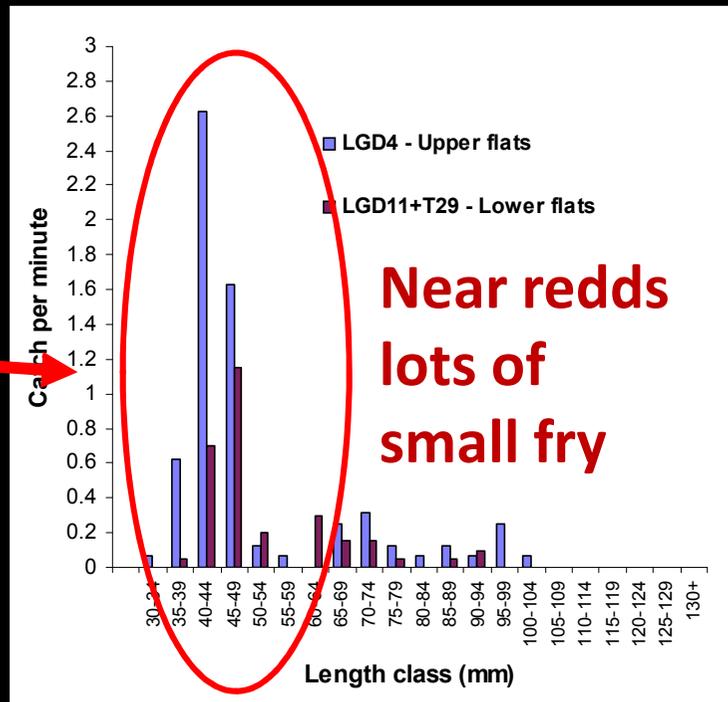
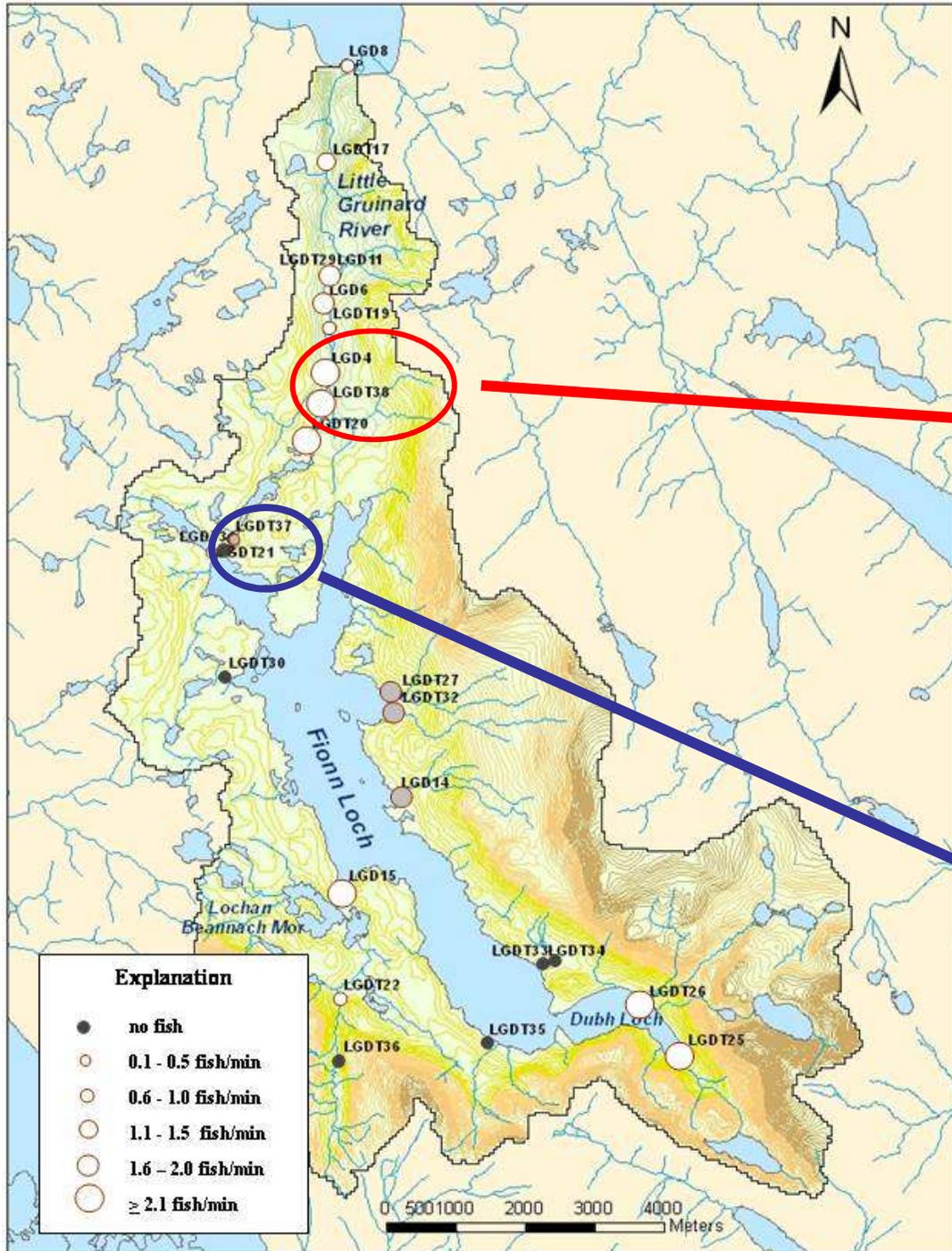
Fionn Loch from Beinn Airigh charr



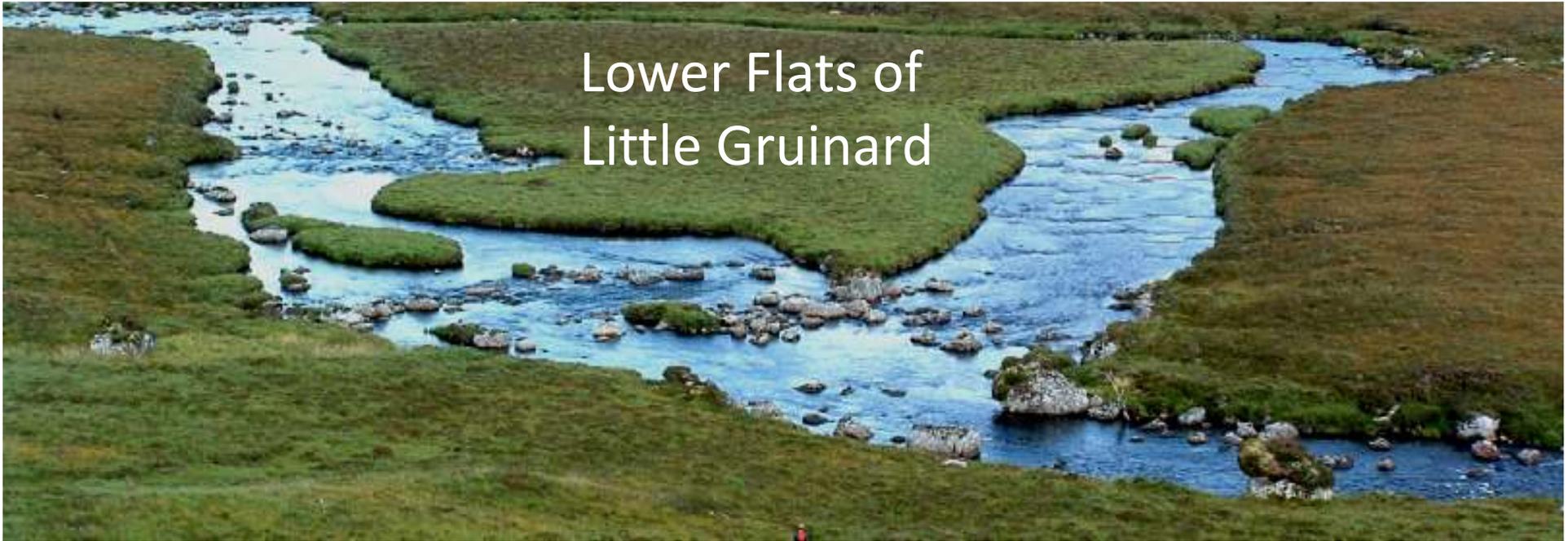
Densities of juvenile salmon are consistently high in the main river . . .

. . . but many of them are very small . . .

Juvenile salmon 2006



Lower Flats of
Little Gruinard



Small fry and small parr



Below Fionn Loch outlet



Big, faster growing, one year old parr

- Where juvenile salmon densities are high, growth tends to be slower.
- Where juvenile salmon densities are low, growth tends to be faster.



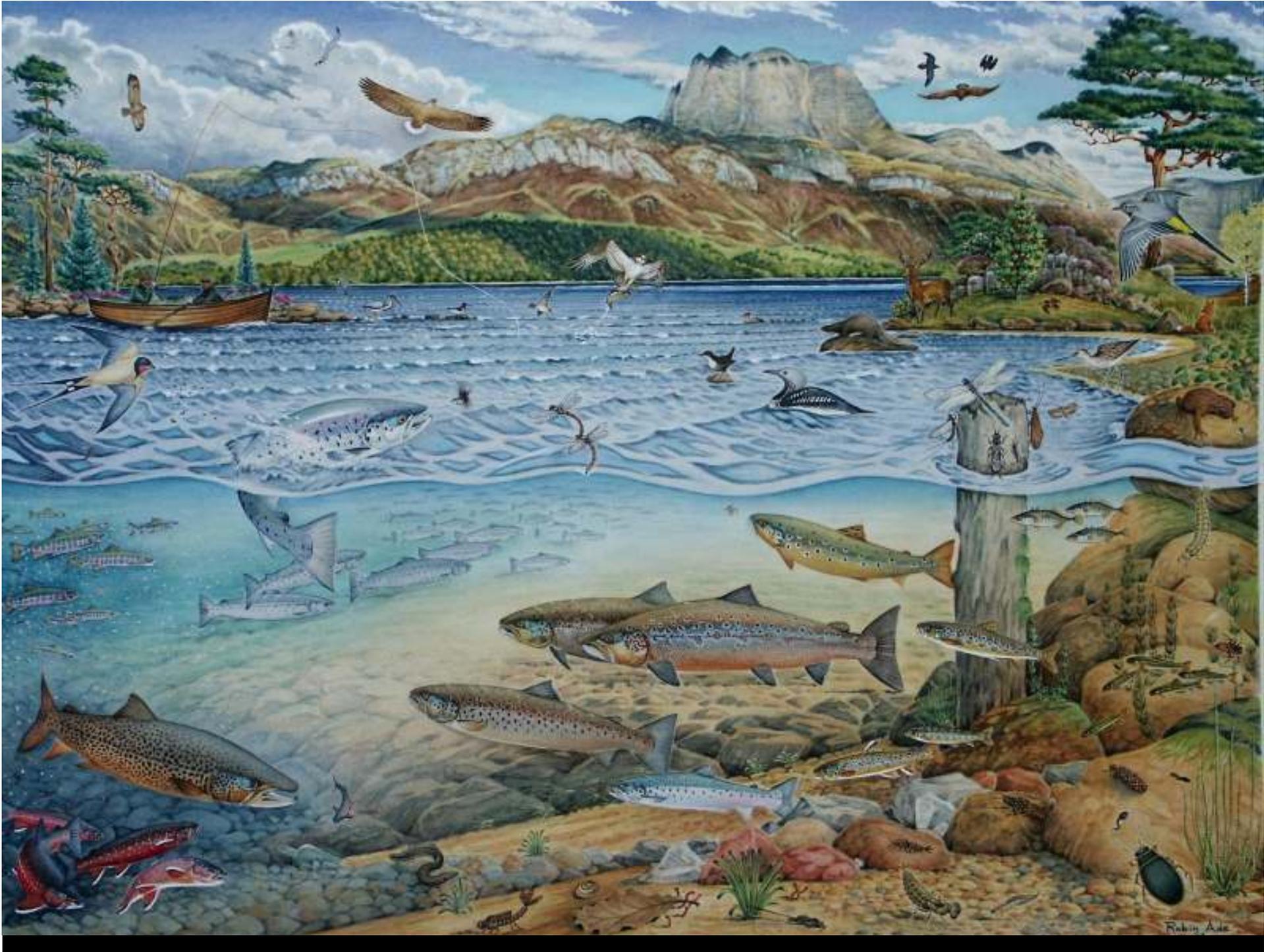
- Juvenile salmon production is determined by habitat area, food availability and stream fertility



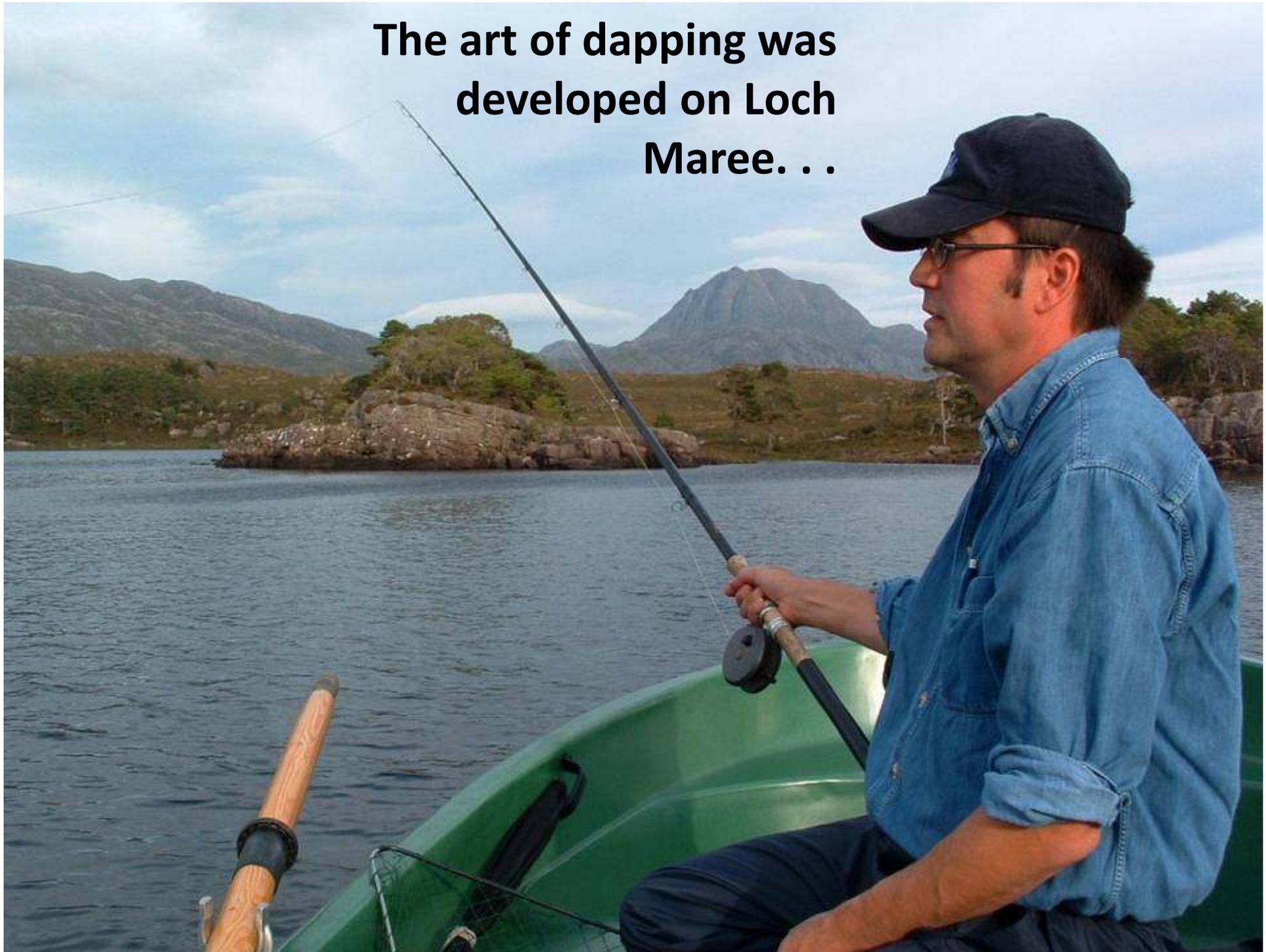
Loch Maree Sea trout Fishery

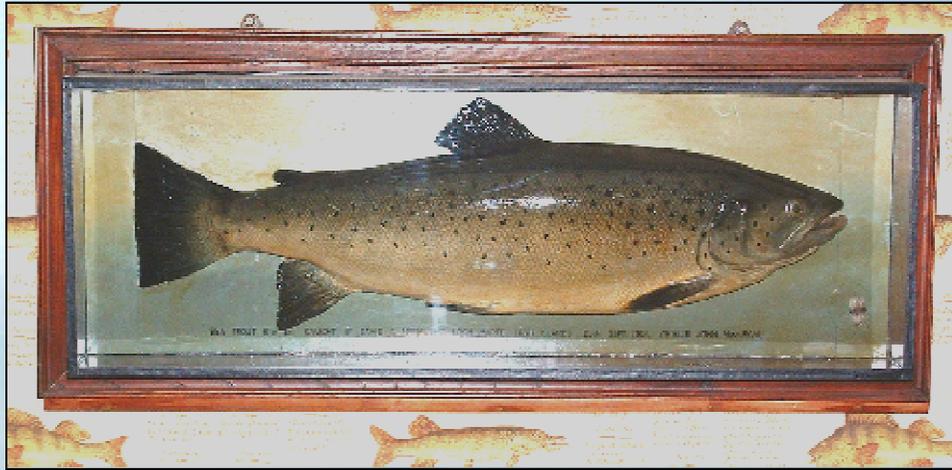
formerly 15+ boats from early July until mid October





**The art of dapping was
developed on Loch
Maree. . .**



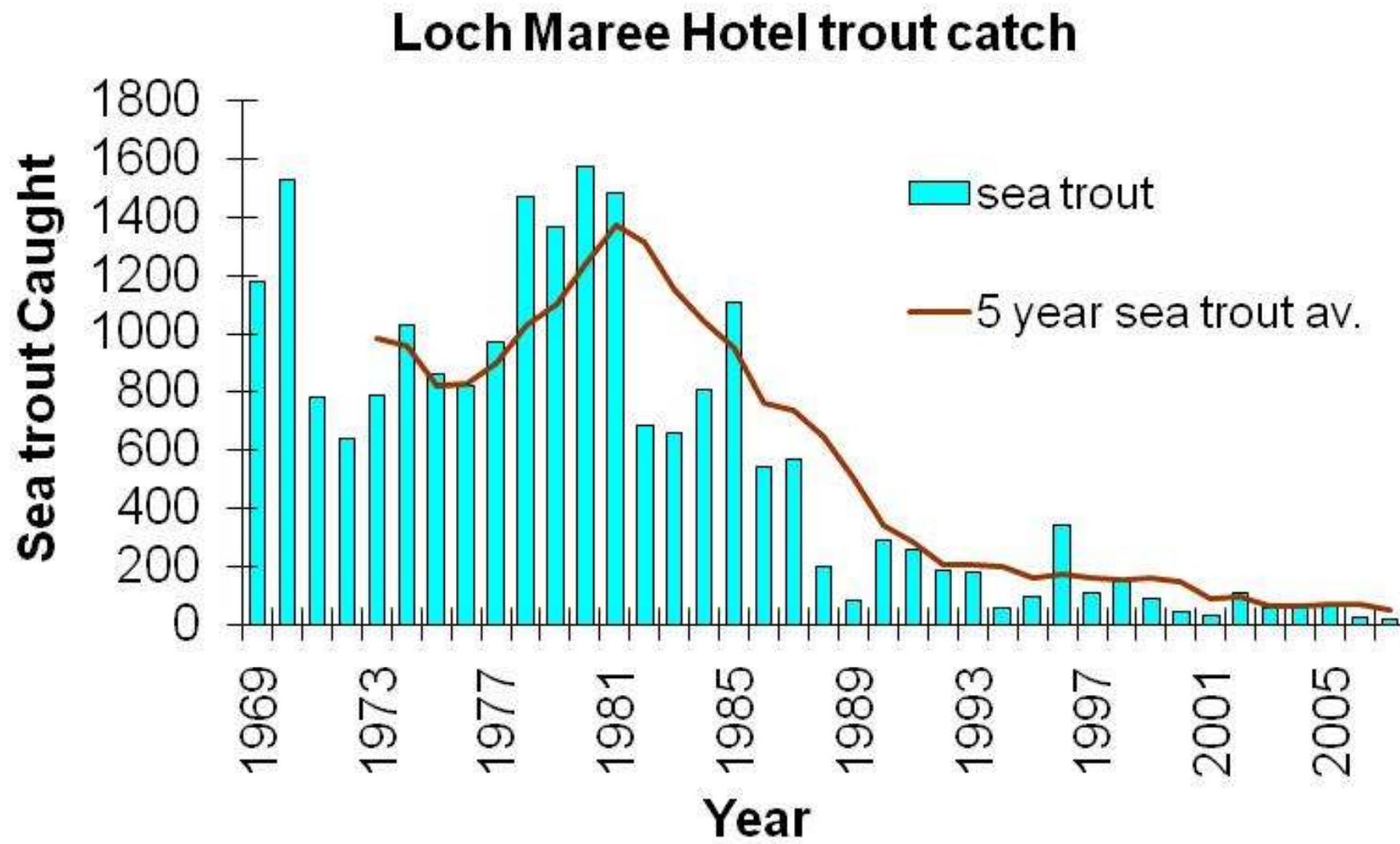


Former British record rod caught sea trout





The fishery collapsed at the end of the 1980s



Problems for sea trout in the marine environment include sea lice infection and food availability . . .



Sea trout and the seas around Wester Ross

White-tailed (sea) eagle

Trawling: Rising fuel prices provide additional incentives for the further development of alternative, more selective, fishing methods.

Gannet

Sea birds:

The 'catastrophic and unprecedented breeding failure' around the West of Scotland in 2005 has been attributed to a shortage of sandeels (RSPB).

Seals: Populations of both harbour and grey seals are near recorded highs. There are few natural predators in local waters (rare Orca sightings). Formerly culled by salmon netmen.

Phytoplankton: Production depends upon sunlight and dissolved nutrient concentrations, and reaches a peak in early summer.

Zooplankton: Changes in the relative abundance of important *Calanus* species may be related to global climatic change.

Minke whale and porpoise:

Target sandeels in the early summer, then sprat and herring from mid-summer onwards. Whales were less common in 2005 than in 2004.

Otter:

Widespread and abundant around the coastline. Feeds on small fishes and crabs. Diet is unlikely to include healthy sea trout in the sea.

Herring and sprat: Herring stocks around the west of Scotland were lower in 2005 than in 2004, with particularly few fish in the Minch (ICES).

Small gadoids: Pollack, Saithe, Whiting, etc.

Sandeels: of vital importance for sea birds, marine mammals and many fish species. ICES advise that the current status of West Coast sandeels is 'unknown'.

Jellyfish: Dense aggregations of moon jellyfish formed in local sea lochs during summer 2005. Jellyfish may out-compete juvenile fin-fish for zooplankton.

Sea trout: Kelts, over-wintered finnock and smolts may be particularly vulnerable when water temperatures are still cold in spring, especially if health is compromised (e.g. by sea lice infection).

Common prawn: Other small crustaceans are also of importance as food for sea trout.

Pollack: Large pollack may be significant predators of small sea trout. Gadoids (including Pollack) are important food for seals.

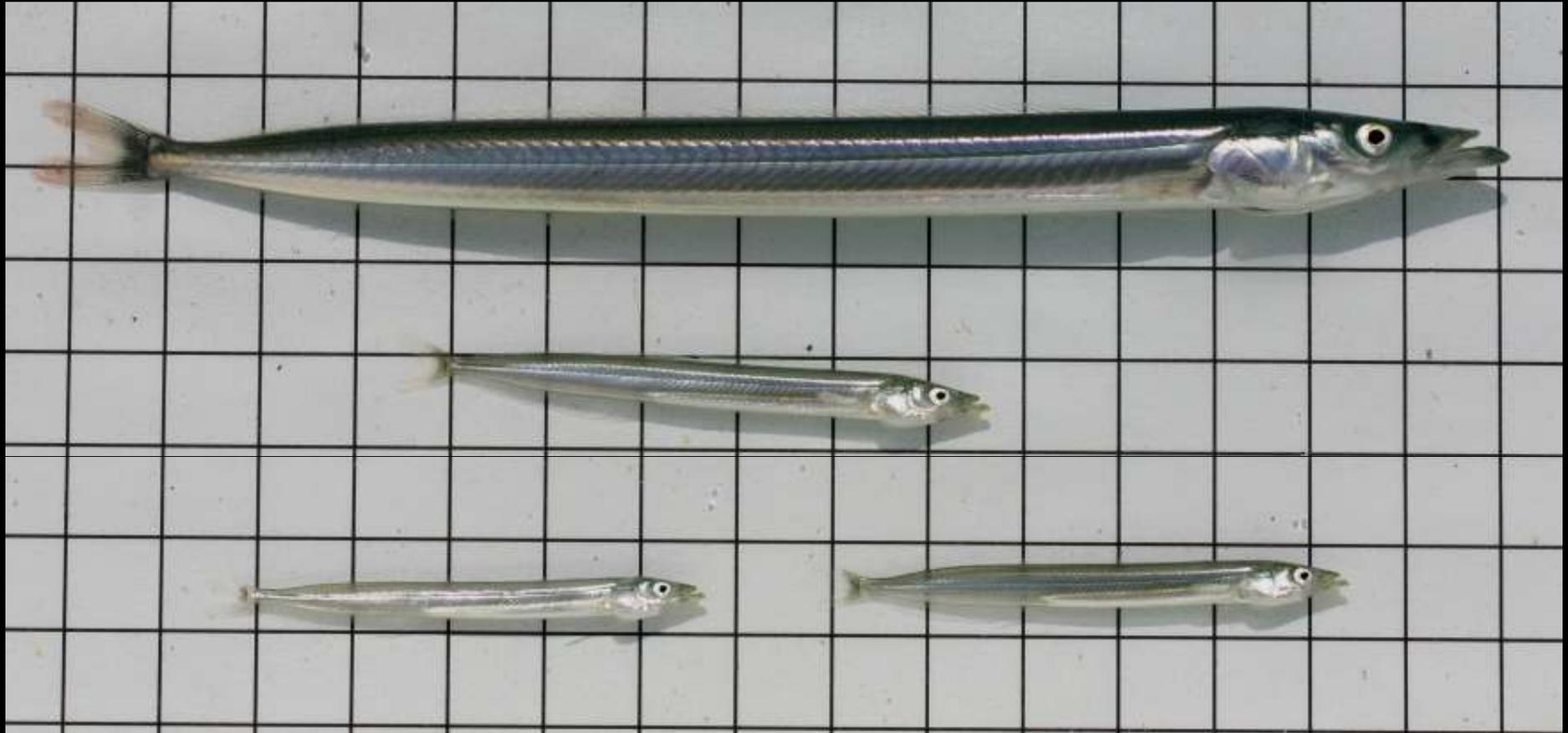
Cod, Haddock and Whiting: Taken as bycatch by *nephrops* trawlers. Cod and whiting stocks are near historic low levels; haddock at sustainable levels.

Common shrimp: Emerges from sand to feed at night. An important food for many fish species.

Nephrops: Live in burrows in deeper water. Fishermen in Loch Torridon catch only larger *nephrops* by using creels with 'hatches' that allow smaller *nephrops* to escape (MSC 'Sustainable Fishery').

PDC Apr 06

Sandeels . . .



Sandeel glut, summer 2009

Herrings

W2356

W2354

Thanks to Roddy MacIver



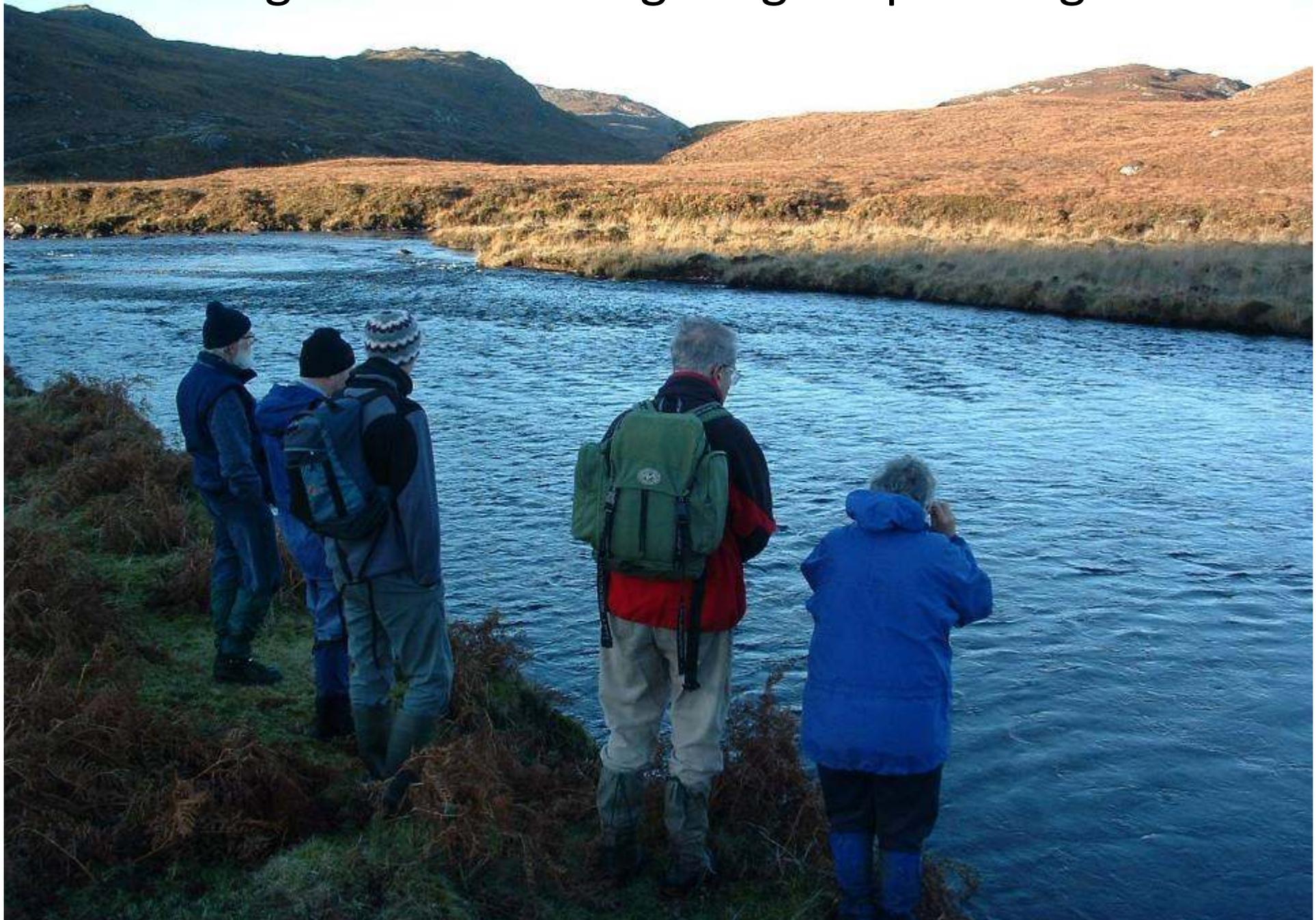
Salmon also bring back marine nutrients from the ocean . . .



Gruinard River, late November . . .



watching cock salmon fighting at spawning time



Wild salmon are an important food source for other wildlife



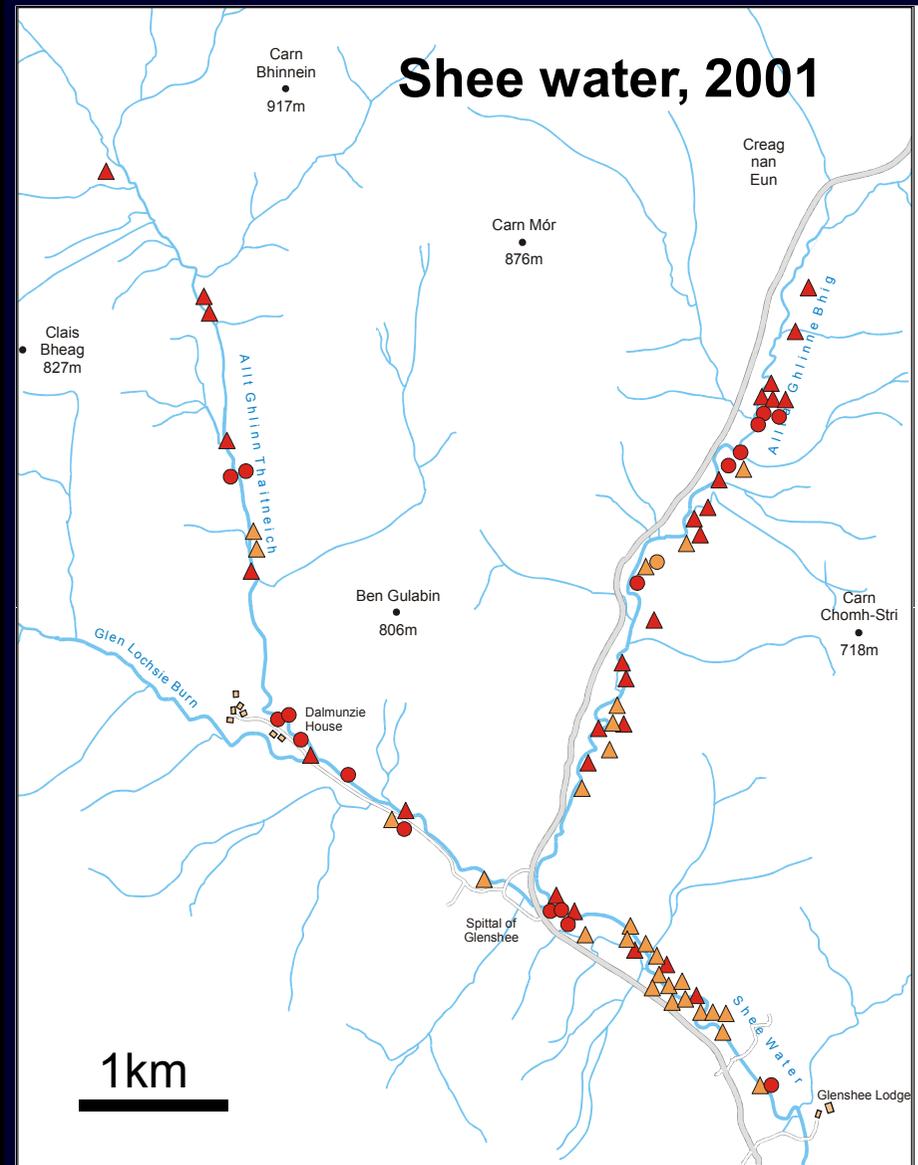
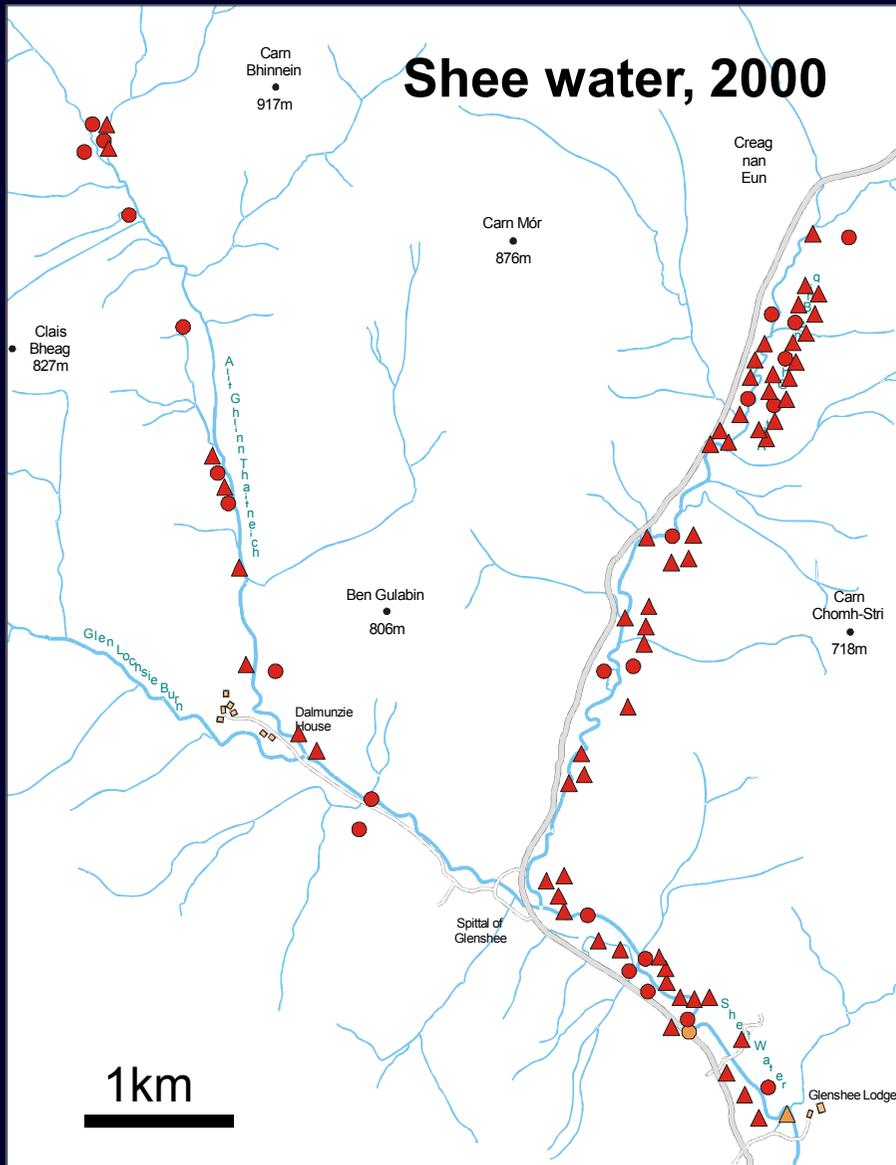
Andrew Harwood



Otter kill, Shee Water, 2001

(Andrew Harwood)

Salmon carcasses found in two week study period in late October early November



Explanation

- | | |
|------------------------|-------------------------------|
| Salmon killed by otter | Salmon died non-violent death |
| ▲ male | ▲ male |
| ● female | ● female |

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- | | |
|------------------------|-------------------------------|
| Salmon killed by otter | Salmon died non-violent death |
| ▲ male | ▲ male |
| ● female | ● female |



Otter

Kills salmon and
removes carcasses
onto river banks

Pine marten

scavenges
carcasses

(self portraits)



This partly digested grisle was regurgitated by a cormorant at Kinlochewe



photo by Ben Rushbrooke

This little trout had 11 salmon eggs in its stomach.
Possibly its best meal of the year!



photo by Ben Rushrooke

Why is this rock green?

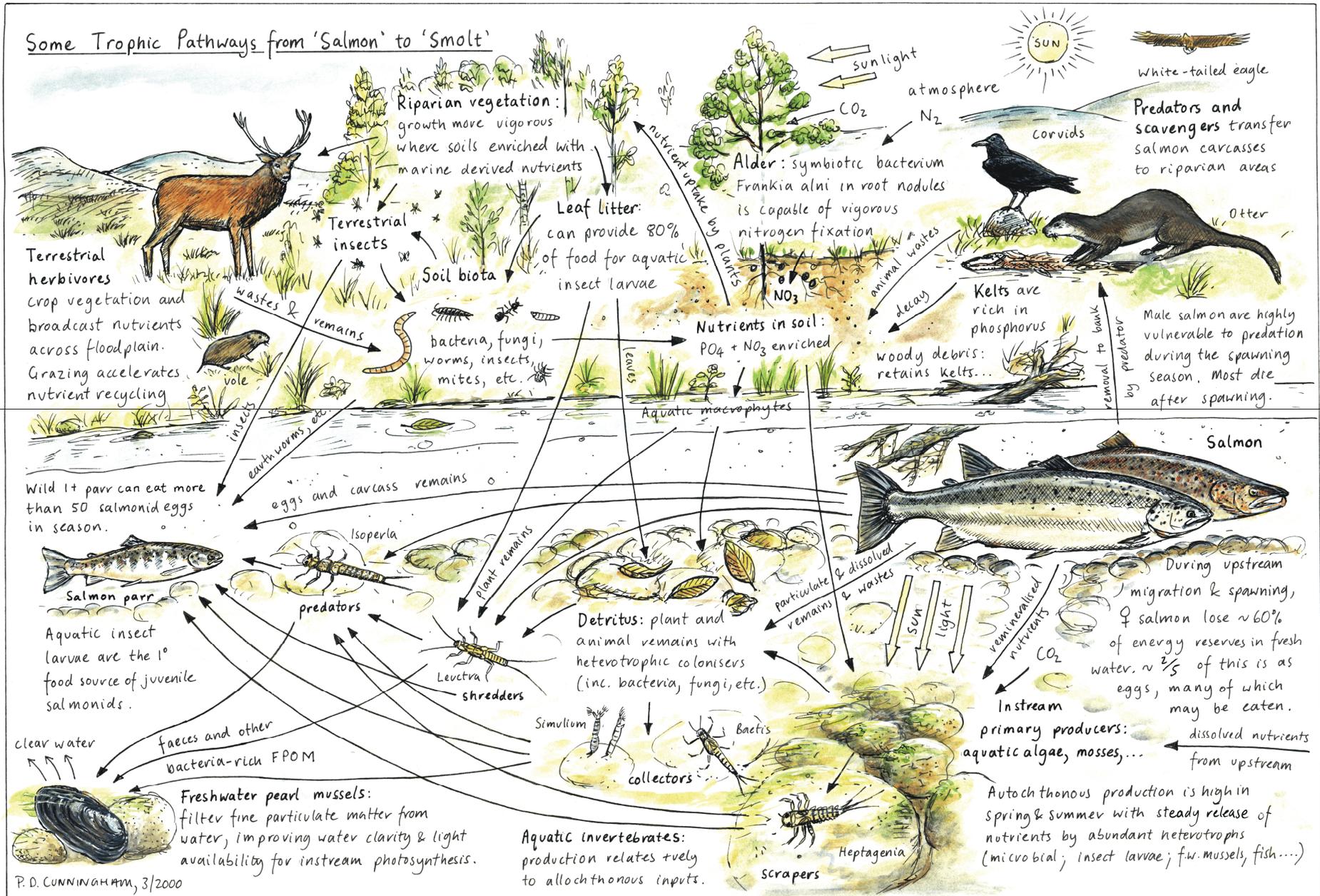




Otter spraint with fish bones.



Adult salmon provide food for juvenile salmon



In North America adult Pacific salmon return to spawning streams in the forests of Alaska, British Columbia, Washington, Oregon



All the salmon die . . .



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. . . providing food for wildlife and nutrients for riparian forest soils . . .

ARKIVE
www.arkive.org



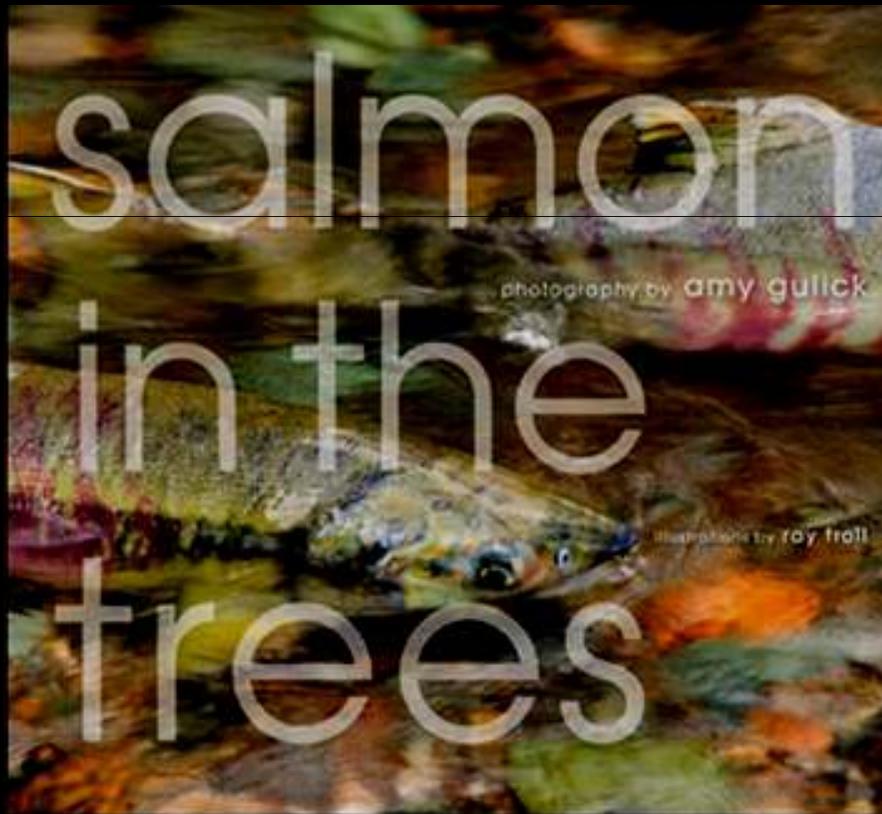
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johncastor.com

"...what if I told you that the trees are here, in part, because of salmon? That the trees that shelter and feed the fish, that help build the fish, are themselves built by the fish?"

*-- Carl Safina, essayist for **Salmon in the Trees***



photos by Amy Gulick



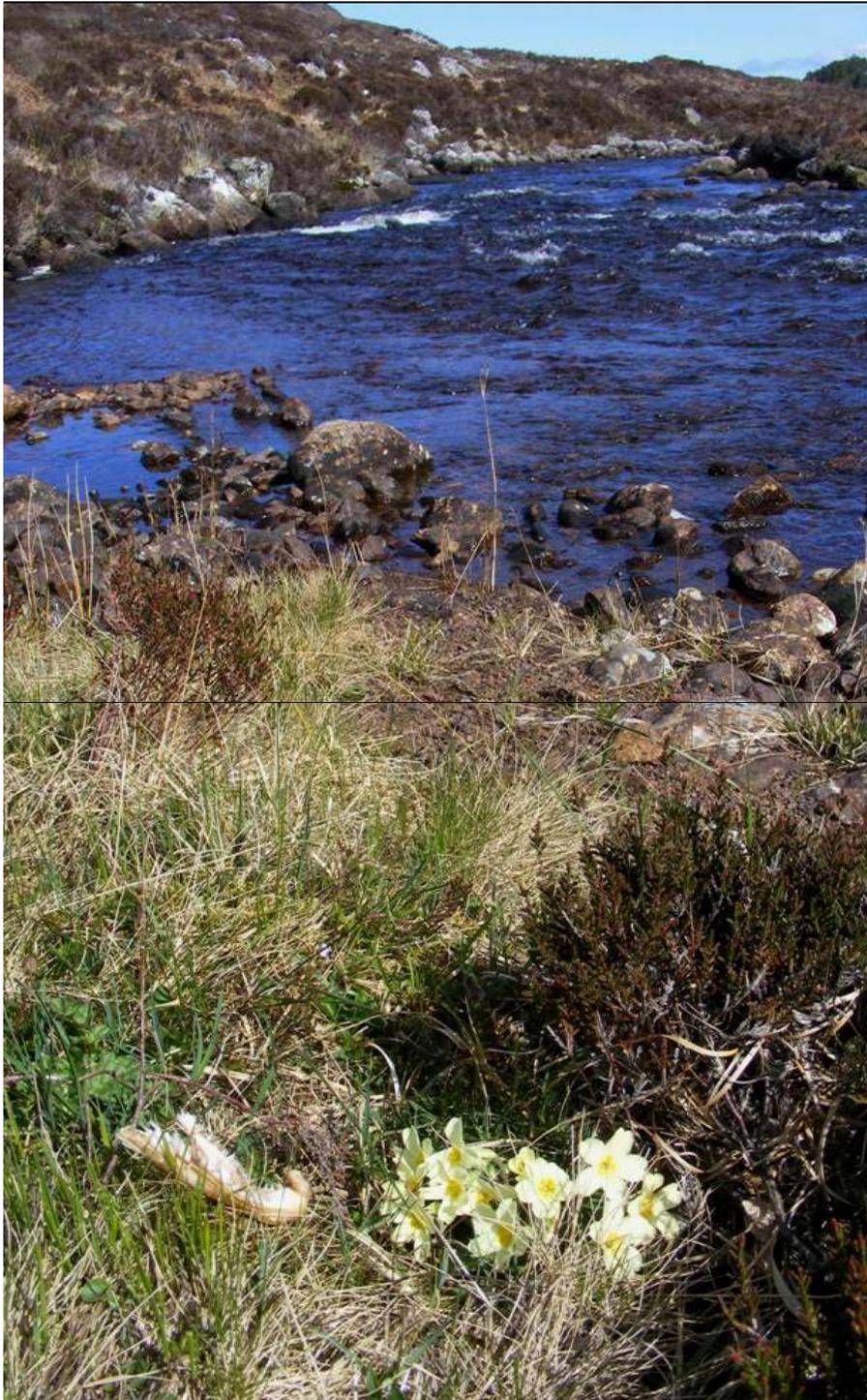
Not all Atlantic salmon die after spawning (though most do) and spawning densities are generally lower than for Pacific salmon rivers, in recent years at least.



Little Gruinard River

*Salmon jaw and primroses,
as found, May 2010*





In the past, many more salmon returned to Scottish rivers from the sea each year.

How much marine nutrient was transferred to terrestrial ecosystems in Scotland in the past?

Upper Gruinard catchment Gleann na Muice



Alder tree
Gleann na Muice



Dead alder tree
Gleann na Muice



Break – any questions ?

