Part 1 **Introduction**

1.1 Overview

Wild adult salmon and sea trout are of 'keystone' importance to the ecological health of Wester Ross. Salmon and sea trout transfer marine nutrients and energy to otherwise barren areas. Only a couple of hundred salmon generations ago there were bears, wolves, lynx and elk in Scotland. Elsewhere these animals are known to feed on salmon or on biota enriched by marine nutrients derived from spawning runs. In the same way, the breeding success of extant animals listed in EU directives as being of 'special conservation importance' including Black-throated diver, White-tailed eagle, Otter and Freshwater pearl mussel, relates to the health of wild fish populations and to the quality of the habitats in which fish live.

We can speculate from historic records on the productivity of the 'salmon systems' in Wester Ross at their peak. Within living memory there were many more adult fish than there are now. Wild fish populations were of vital importance to coastal communities. As elsewhere across much of the world, wild fisheries around Wester Ross have been in decline. Levels of employment in fisheries have fallen. Human activities have not only changed the landscape, trophic pathways have been disrupted. The demise of salmon and sea trout populations represents one more breaking linkage in an increasingly fragmented and dysfunctional life-support system. We disregard wild fish populations at our peril.

Can former levels of productivity be restored? This fisheries management plan aims to promote and to provoke some of the actions needed to support and strengthen wild fish populations, and to restore some of Scotland's most prolific wild freshwater fisheries. The plan is science-based. We have never had a better understanding of the potential for wild fisheries to sustain high yields. Proposed actions have been developed from the best available information. A holistic approach is adopted: all freshwater fish species are considered, including Arctic charr, European eel, lampreys and Three-spined stickleback. However, the plan focuses on those species which are of greatest importance to local fisheries and other wildlife: the Atlantic salmon and the Brown trout (including sea trout).

Fisheries management is about managing both *fish* populations and the natural systems that support them, and the way in which *people* interact with them. If you are an angler, a fishery manager, a wildlife enthusiast who lives within the area or visits Wester Ross regularly, we hope you will take an active interest in the future of wild fishes and fisheries of the area. We very much look forward to hearing from you and receiving any comments on this DRAFT fisheries management plan.

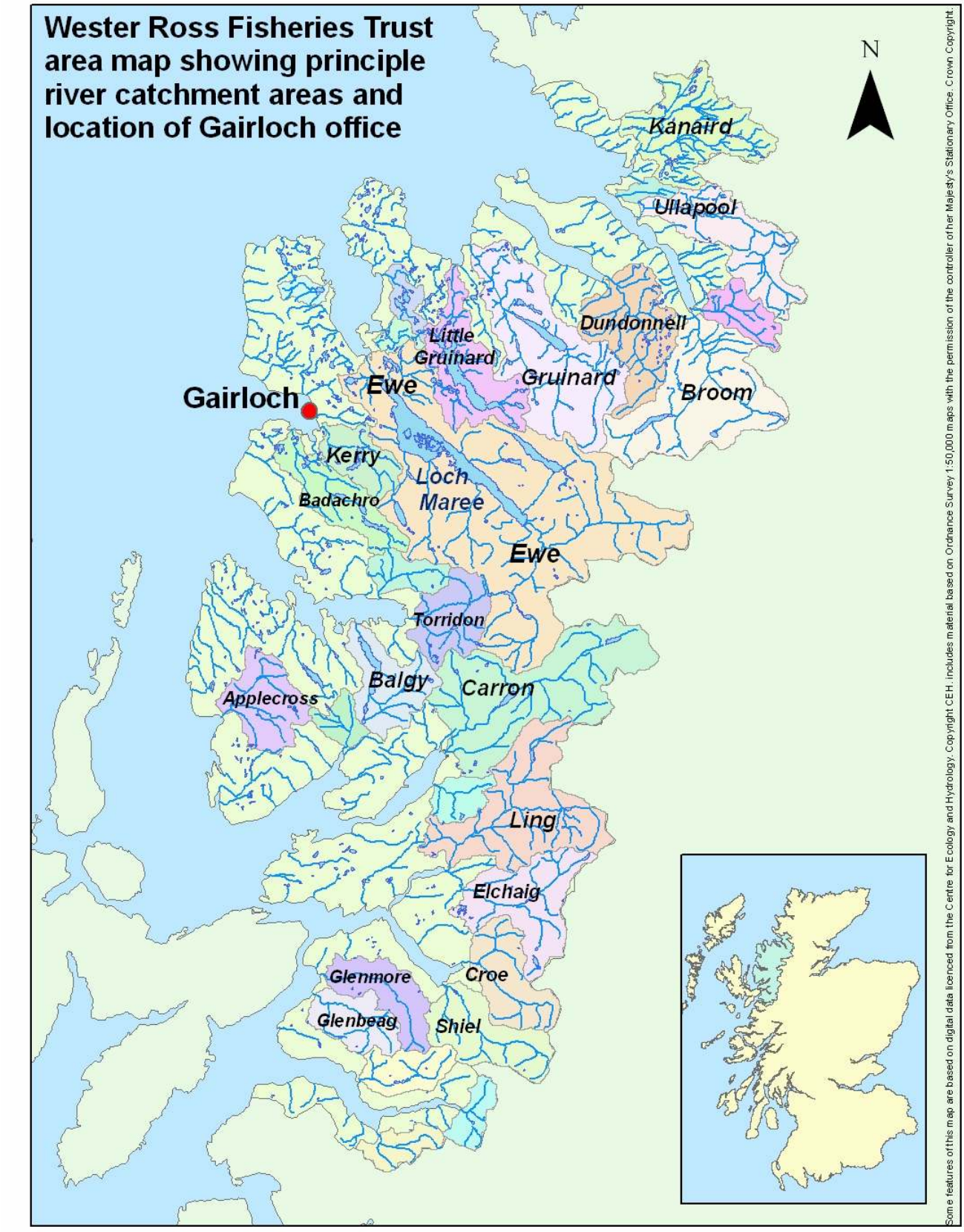
Subsequent sections of this DRAFT have been organised as follows and can be downloaded as separate PDF files:

Part 2 Wester Ross land of rivers, lochs and denuded mountains
Part 3 Freshwater fishes and fish production in Wester Ross
Part 4 Factors affecting fish production in WRFT area
Part 5 Fisheries Management in Wester Ross: actions past and present
Part 6 Proposed Fisheries Management Actions for WRFT area

Definition:

Fishery: the business of *catching fish*; a place for *catching fish*: right of fishing [Chambers 20th Century Dictionary, 1983]

Figure 1.1 *Wester Ross Fisheries Trust area considered within this Fishery Management Plan*



1.2 Wester Ross Fisheries Trust

Until the late 1980s the rivers and lochs of Wester Ross were still well known for prolific salmon and sea trout fisheries. During the 1990s stocks around northwest Scotland declined to their lowest levels. WRFT was set up in 1996 in response to the need for solutions to fisheries problems and to improve the management of wild fisheries. The Trust was set up by local salmon fisheries boards concerned about the collapse of fish catches together with representatives from the local council, the salmon faming industry and angling clubs.

The overall **Purpose** of the Trust is to ***maximise and sustain the productivity of salmonid fisheries*** in the rivers and lochs of Wester Ross. Wherever possible, the Trust works with other organisations and individuals to improve understanding of the wider environmental issues that impinge upon the health of Wester Ross aquatic ecosystems, and contributes to the promotion of awareness and understanding of issues and benefits. Achievement of the WRFT Purpose will, in fact, contribute to a wider goal of ***enhancing and sustaining the productivity and biodiversity of freshwater ecosystems for present and future generations***. This goal will, however, rely on the collaboration of a range of policy makers and implementing agencies both within and outside the fisheries sector.

The Trust has worked with fisheries managers, landowners, Scottish Natural Heritage [SNH], The Highland Council, The Wester Ross Area Salmon Fishery Board [WRASFB], the Scottish Government's Fisheries Research Services [FRS] and a range of other individuals and organisations; and currently employs one full-time biologist and several part-time assistants. Wester Ross Fisheries Trust is now one over 20 fisheries trusts and foundations in Scotland, and is supported by the umbrella organisation **'Rivers and Fisheries Trusts of Scotland'** www.rafts.org.uk.

WRFT is also a founder member of the '**The Scottish Fisheries Coordination Centre'** www.sfcc.co.uk which aims to support its members in collecting, using and providing information on salmon and freshwater fish, their habitats and fisheries, in an effective and co-operative way. To these ends the SFCC provides a mechanism for local fisheries managers and biologists to standardise aspects of data collection and storage. Specialist software development is co-ordinated in a cost-effective way and members are supplied with spatial data relevant to the freshwater environment. The SFCC also provides a facility for balanced scientific analysis of available information and encourages informed discussion of fisheries issues for both local management and national policy decisions.

The Wester Ross Fisheries Trust area encompasses many small river systems (see Figure 1.1). At least 30 of these, from the River Kanaird in the north to the River Barrisdale (Knoydart) in the south, have supported juvenile Atlantic salmon. In addition, there are at least 400 lochs of area 0.5 Ha or more within the area. Many of these support Brown trout and/or Arctic charr. Some have no fishes but are nevertheless of great interest for the diversity of other wildlife that they support.

Over the past 10 years, the Trust has carried out baseline surveys of juvenile fish populations and habitats along many of the river systems that enter the sea between Loch Broom and Loch Hourn (inclusive). Results have been reported in Fisheries Management Plans [FMPs]. Each 'five year plan' presented recommendations for actions to restore fish production. FMPs have been produced for the rivers Kanaird, Broom, Dundonnell, Gruinard, Ewe (including Loch Maree), Balgy, Ling and Carron. The Trust has also produced short reports presenting the results of research, surveys and monitoring, with the primary aim of providing useful advice to those directly involved with fisheries management. An inventory of trust publications and reports is presented in Appendix 1. The Wester Ross Fisheries Trust website provides an overview of current activities: please visit www.wrft.org.uk.

1.3 Proposed aims and objectives

This fisheries management plan addresses major problems that affect wild fish populations in the WRFT area. The aims of the fisheries management plan are as follows:

Aim 1. To conserve the genetic diversity and structure of wild fish populations and the habitats that support them within the WRFT area. The main species of fisheries importance are Atlantic salmon and Brown trout (including sea trout). Some river systems support several discrete populations of salmon or trout. Wester Ross is also a stronghold for arctic charr with at least 20 poorly known populations within the WRFT area.

Returning an electro-fishing survey sample of juvenile salmon and trout to the Torridon River.

Aim 2: To promote the sustainable management of fisheries. Fisheries management is primarily about maximising fish production without in any way compromising the long-term health of the fish population or its ability to sustain a yield in the future. There is a need to ensure that stocks are not exploited to levels at which there are inadequate numbers of spawning fish. The 'catch and release' policy is a means of minimising mortality, and has been recommended and adopted by many salmon and sea trout fisheries and some brown trout fisheries in the area.

Aim 3: To foster wider benefits for other wildlife, biodiversity, ecology and the amenity of the area. Many other special animals, including Otter, Black-throated diver, White-tailed eagle, Osprey, many smaller birds, and insects (including carrion beetles, and in-stream invertebrates) will benefit from increasing returns of salmon and sea trout. Habitat restoration activities and possible trials to restore stream fertility should also support other vulnerable species, such as Freshwater pearl mussels.

Objectives

To achieve the aims outlined above, ten 'objectives' are presented together with a string of actions considered to be of 'high' priority to achieve the stated objectives (see Part 6). The core objectives are Objectives 1-4. Many 'actions' are on-going WRFT activities, and include juvenile fish surveys, sea lice monitoring, management projects, education and awareness raising events; others 'actions' are aspirations and depend upon the availability of future support and funding.

Objective 1: **Conserve wild salmon populations**
Wild, locally adapted, salmon populations are the fundamental genetic units upon which the salmon fisheries of the WRFT are based. To maximise the likelihood of populations surviving and remaining productive (i.e. able to produce a harvestable surplus), population units should be identified for management purposes. This means genetic screening. If particularly vulnerable (i.e. small) populations are identified, they should be given special protection.

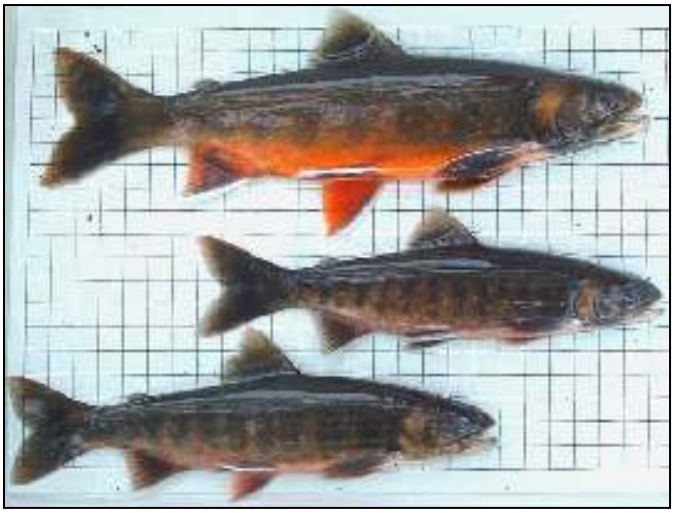
Objective 2: **Restore the Loch Maree Sea trout population and fishery**
The Loch Maree sea trout fishery was and remains potentially the most important freshwater fishery within the WRFT area. Restoration of the sea trout population(s) would be of greater benefit to the local economy and wildlife (Loch Maree is an SPA for breeding Black-throated diver) than restoration of any other fishery.

Objective 3: **Restore & enhance wild salmon production in areas where stocks have been lost to support fisheries**

Juvenile salmon populations have been lost from the accessible headwaters of some river systems. In parts of other rivers, juvenile salmon densities and growth rates are low. Actions aimed at restoring salmon production within the WRFT area are currently required for the following rivers (in order of priority): upper Bruachaig (Ewe), upper Gruinard, upper Glenmore River, Glenbeag River, Rhidorroch River (Ullapool), Balgy River, River Elchaig. These may include both habitat restoration and supplementary stocking.

Objective 4: **Restore sea trout production to support fisheries**

There are many rivers where sea trout production could be enhanced. These include the following river systems: Kanaird, Broom, Gruinard, Second Coast, Slaggan Burn, Allt Beith, Tournaig, other parts of the Ewe system, Sguod, Strath mill (Gairloch), Torridon, Balgy, Shieldaig, Cuaig, Applecross, Carron, Elchaig, Croe, Shiel, Glenmore and Glenbeag.'



Male Arctic charr from a stream spawning site in the River Ewe catchment area. There are historic records of net fisheries for charr in Loch Maree and Loch Kernsary.

Objective 5: **Develop opportunities for sustainable wildlife-friendly wild trout fishing**

A series of recommendations were presented in the 'The Wester Ross Wild Trout Project Report for 2006 – 2007'. These remain valid for the purposes of the current FMP (see WRFT Review, May 2007).

Objective 6: **Assess options for developing a sustainable Arctic charr fishery**

Before Arctic charr can responsibly be promoted as a species of fisheries interest within the WRFT area, information about the size and status of charr populations within the area is required.

Objective 7: **Lamprey and eel conservation**

Of the other freshwater fishes in the WRFT area, only eels are known to have been exploited in the past. Actions in Wester Ross should contribute to wider efforts to conserve these species.

Objective 8: **Sea fish monitoring**

Monitoring of sea fish is normally out with the remit of WRFT. However, for many inshore fish species of local interest, there is little other monitoring. Salmon and sea trout require a healthy marine environment with abundant food items (including juvenile herring, sandeels, and other fish). With an office located at Gairloch Harbour adjacent to wildlife tour operators, WRFT is in a good position to offer support to other local groups or agencies that also wish to gather information on the status of locally important fish stocks.

Objective 9: **Raise awareness of wild fisheries and their management needs**

WRFT has just launched its new website www.wrft.org.uk where newsletters, reports and the annual review can be found. WRFT also attends public open days to extend awareness of wild fish populations, the problems they face and opportunities for restorative action.

Objective 10: **Monitor and review progress**

The status of fish populations and problems that they face are constantly changing. Fisheries management is as much about being able to respond to unforeseen events and opportunities as sticking rigidly to preconceived work programmes. WRFT will continue to support fisheries managers and provide management guidance based upon the latest available information and best available scientific advice.

Part 2 **Wester Ross: land of rivers, lochs and denuded mountains**

2.1 Physical characteristics of Wester Ross

2.1.1 Topography

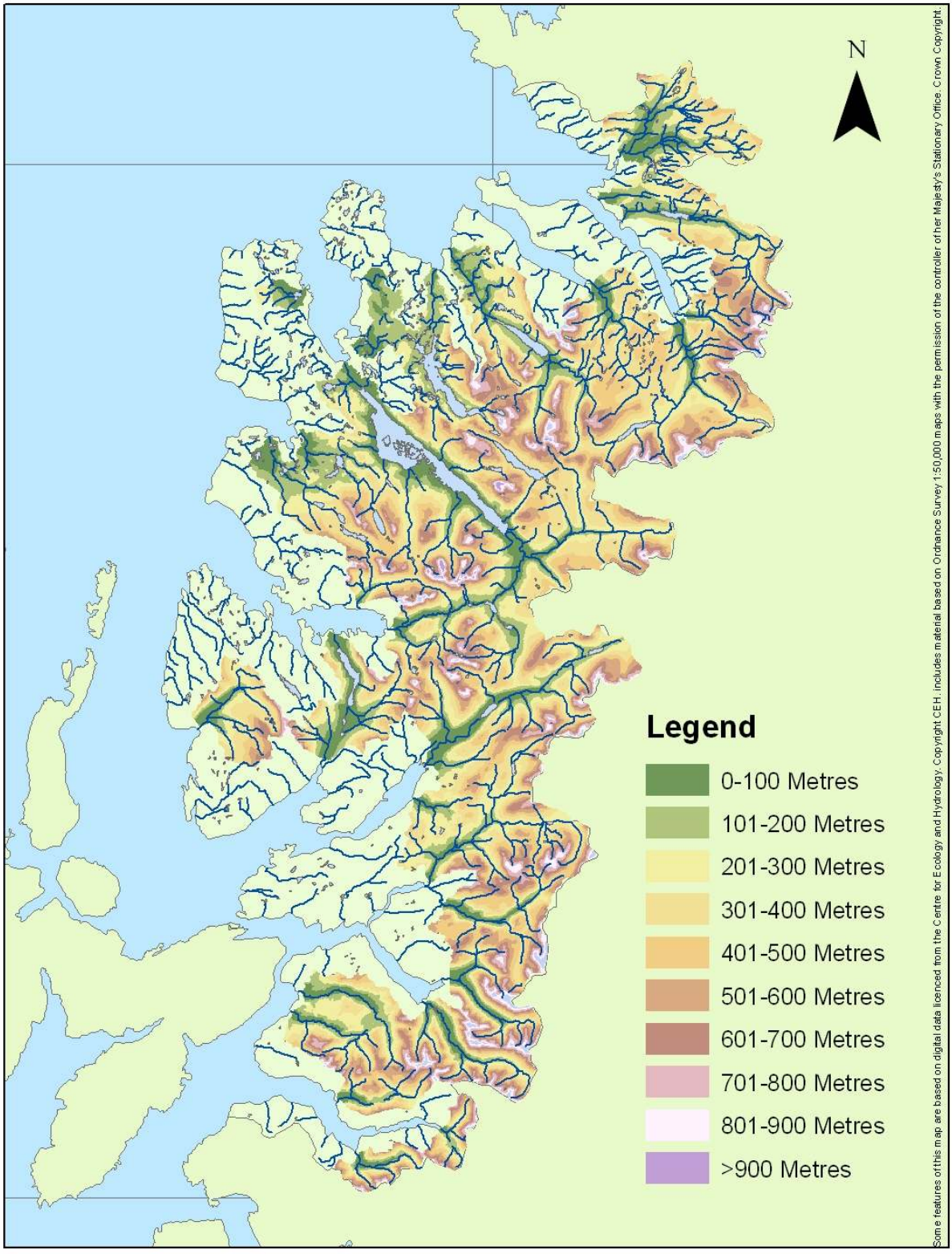
The river systems of Wester Ross drain some of the most spectacularly rugged mountainous terrain within the British Isles. The area is rocky, peaty (especially between 10m and 500m altitude), and has relatively small areas of fertile soil in the river valleys. Notable peaks with drainage into the WRFT area include Beinn Dearg [Inverleal forest] (1084m), An Teallach (1060m), Mullach Coire Mhic fearchair (1019m), Slioch (980m), Beinn Eighe (1010m), Liathach (1054m), Sgurr nan Ceathreamhnan (1151m), the Five Sisters of Kintail (including Sgurr Fhuran, 1067m) and Beinn Sgritheall (928m). Scotland's largest 'National Scenic Area' [NSA] is the Wester Ross NSA, with an area of 145,300Ha.

Most rivers descend steeply from headwater streams, plunging over waterfalls or rapids, before entering lower gradient stretches accessible to adult salmon and sea trout. River forms vary from cascades hidden deep within steep-sided rocky gorges to more open glide-run-riffle sections that meander through alluvial plains.

Lochs that are accessible to salmon and / or sea trout are present within the following river systems: Ullapool, Gruinard, Little Gruinard, Tournaig, Ewe, Sguod, Badachro, Torridon, Balgy, Shieldaig, Carron, Elchaig and Shiel. The largest freshwater loch is Loch Maree. Several smaller systems also have lochs that are accessible to sea trout. However, there are many more lochs that are inaccessible to salmon and sea trout above waterfalls. These include Loch a' Bhraoin (River Broom catchment area), Lochan Fada (River Ewe catchment area), Loch a Bheallach (Badachro River), Loch Lundie (Inverbain River), and hundreds of smaller waters.

Riparian alder trees with the sparsely vegetated slopes of Beinn Eighe behind.

Figure 2.1 *Topographic map of the WRFT area*



2.1.2 Geology

Wester Ross has some of the oldest and most resistant (to chemical and physical erosion) rocks in the British Isles. Hard, base-poor metamorphic and sedimentary rocks of low solubility underlie the river catchment areas of all the major river systems. These rocks are overlain by glacial deposits carved from the underlying rock, and transported by ice. Glacial erratics are found on many of the hill tops, sometimes transported from sources many km away. In the ice sculpted valleys, glacial sediments have been reworked by rivers. Fluvio-glacial and alluvial sediments underlie the more fertile farmland of the area, and have a major influence on the character of rivers and lochs.

Solid geology

The rocks that outcrop within the WRFT area are sub-divided by the Moine Thrust Zone [MTZ] which runs north-south through the area. To the west of the MTZ, the oldest 'basement' rocks are Lewisian gneiss and amphibolites. Achaean 'Lewisian' gneiss and meta-sedimentary rocks of the Loch Maree Series outcrop between Gairloch and Gruinard Bay and in a few other areas. These form rugged hills near Gairloch and Gruinard bay. The mountains of Torridon are of Precambrian Torridonian sandstone and Cambrian sediments. To the east of the MTZ, underlying rocks comprise a complex assortment of hard, generally base poor metamorphic rocks, predominately granulite, schists and gneisses.

'Drift'

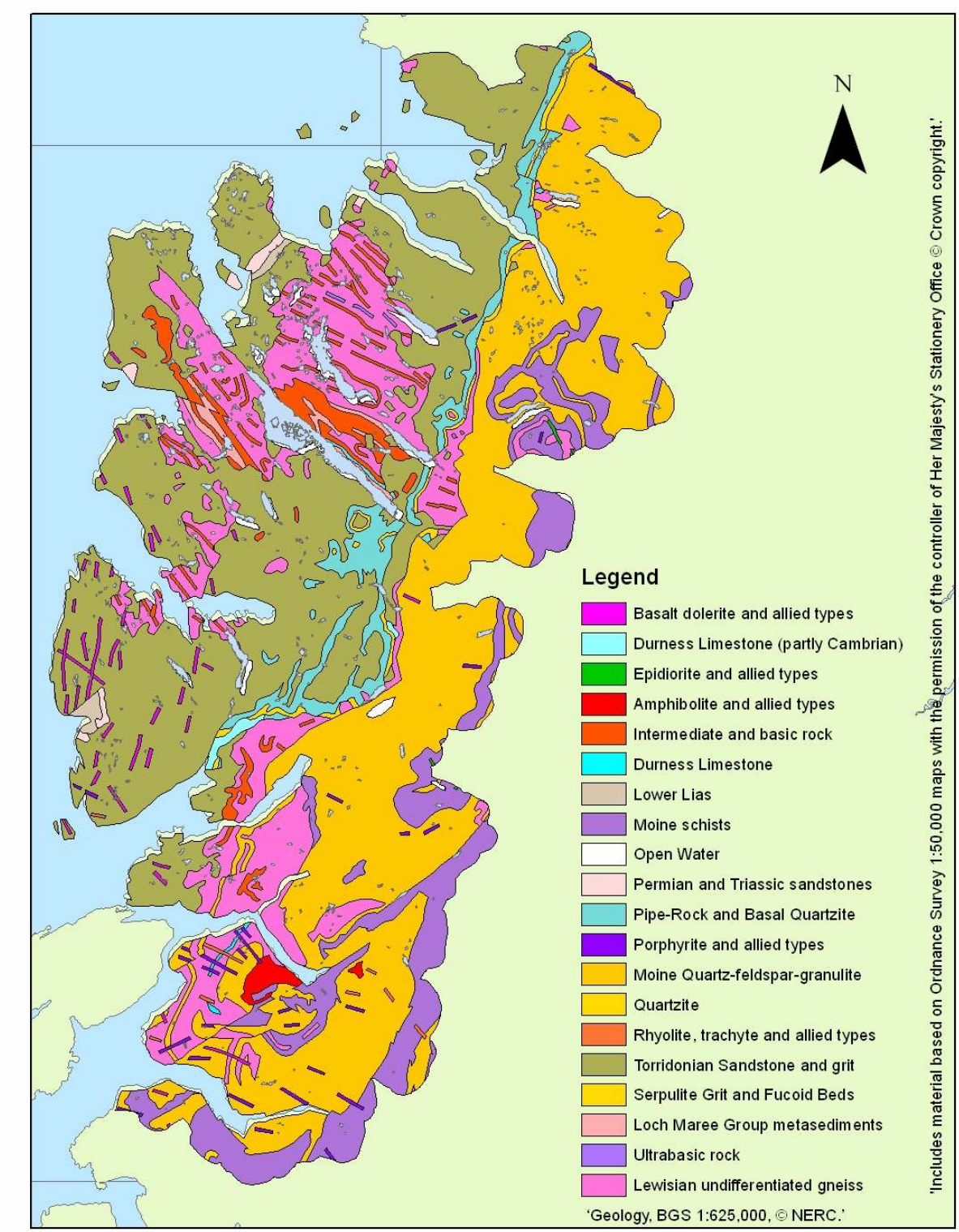
Glacial deposits underlie many of the rivers and lochs of the area. Some of the larger lochs are located in glaciated hollows, others lochs are located where glacial moraines have dammed a valley. Rates of erosion and redeposition in some catchments are possibly as high now as at any time within the last few thousand years. In some places in-stream sediment features have been modified by spawning salmon and trout; good examples of 'ancestral redds' can be seen in the Gruinard and Little Gruinard rivers and in the Loch Bharranch burn. These features remain of particular value to spawning fish.

Peat deposits are usually at their thickest (5m or more) at altitudes of between 10m and 400m above sea level. River catchments with large areas of peat and particularly peaty water include the Kanaird, Broom, Badachro, Sguod and Torridon rivers.

Soils

Soils are thin, eroded or poorly developed over much of the area, especially the higher ground. Peaty gleys, peat and peaty podsols predominate. Soils have become compacted in some areas, particularly where earthworm populations have collapsed. New Zealand flatworms have been found at Rhidorroch, Second Coast, Tournaig, Poolewe, Flowerdale (by Gairloch), Kerrysdale and Talladale (by the Loch Maree Hotel). WRFT investigations are ongoing. Moles are absent from areas around Loch Ewe (including, Poolewe, Inverasdale) except Drumchork, and from the alluvial fields by the River Kerry. Other wildlife, including song birds, wading birds and badgers may have also been affected by the reduction in earthworm abundance.

Figure 2.3 *Geology (solid) map of the WRFT area*



2.2 A temperate rainforest climate

2.2.1 Climate statistics

Wester Ross has a moist maritime climate. Weather patterns are dominated by a westerly, Atlantic air stream. Climate varies locally according to proximity to the sea, the mountains and with altitude. Weather records for the National Trust for Scotland's Inverewe Garden, Poolewe show a 20 year average annual maximum temperature of 12.1°C, and average rainfall of 1,734mm (max 2,314mm; min 1,430mm). At the opposite end of Ewe system, Met Office statistics for Kinlochewe (1971 – 2000) indicate an average annual rainfall of just over 2,200mm. The wettest months are November and December, the driest month May.

Weather patterns vary considerably from year to year. For example, between November 1999 and March 2000, 1,746mm of rain was recorded by Letterewe Estate at Kinlochewe. In contrast only 688mm of rain was recorded for the same period in 2000 – 2001. More detailed climate statistics are available from the Met Office.

2.2.2 Flow characteristics

River levels in Wester Ross are highly variable, rising and falling in response to rainfall. This is especially so for headwater streams and rivers without the large lochs that moderate spate flows. Successive low pressure systems may bring near daily rainfall. The heaviest and most frequent downpours are over higher ground. When the wind swings to the east the sun usually shines, the ground dries out, and river levels fall. Streams which were deep enough to allow unobstructed passage for an adult salmon may become so shallow, with flows of less than 1% peak discharge, that even the smallest trout are confined to little pools between the stones. Periods with frequent heavy rain – or drought - can last for many weeks or months. No two years are alike: successful plants and animals have to be able to adapt as conditions change.

SEPA monitoring stations are located on the River Broom (Inverbroom), River Ewe (Poolewe) and River Carron (Strathcarron). The River Ewe has the highest discharge of any river system in the WRFT area, with an average flow of 29.57 $m^3 s^{-1}$. The response of the River Ewe following rainfall is delayed due to the time it takes for water levels in Loch Maree to rise. The flow peaks at over 150 $m^3 s^{-1}$. The Q10 flow is 63 m^3s^{-1} and the Q95 flow is 5.95 m^3s^{-1}. The Ewe is possibly the only river where salmon are able to enter and ascend to holding pools at all river levels.

The next largest rivers in terms of catchment area and discharge are the Carron and the Gruinard. The River Carron has a catchment area of 137.8km^2 with a mean rainfall of 2,600mm. The average flow is 10.76m^3s^{-1}, the Q95 flow is 1.06m^3s^{-1} and the Q10 flow is 26.25m^3s^{-1}.

Note that up to date information on river levels can be found at www.sepa.org.uk/riverlevels.

2.2.3 Water abstraction and flow regulation

Water is abstracted from the River Broom (Droma) and the River Ewe headwaters (upper Bruachaig) and diverted into the River Conon system for hydropower generation. There are hydropower projects in the River Kanaird catchments (the Dhu Loch and nearby waters are dammed); the River Broom (Cuileig – run of the river), the River Kerry (Kerry Falls: Loch Bad na Sgalaig is dammed), and the Inverbain River (near Loch Torridon). Although flow regimes in the River Kerry are regulated according to hydropower generation; a recent report commissioned by SNH concluded that the regulated flow has not been detrimental to the Freshwater pearl mussel population for which the river is a designated Special Area of Conservation.

2.3 Land use and land management

Most streams in Wester Ross drain catchment areas of low fertility. Levels of biological productivity, like those of 'rainforest' areas elsewhere in the world, are limited by nutrient availability. Heavy rainfall leaches soils of nutrients. Nutrient retention and recycling, crucially that of phosphorus [P], are dependent upon the biota. The productivity of streams and lochs is heavily influenced by land and biota management practices.

2.3.1 Changing land use practices

Changes in land use can be traced back to Mesolithic and Neolithic times with clearance of scrub woodlands and the development of the 'round house – field system' type of settlement. As the wild woods were lost, the large predators were removed. Until 200 years ago many people (without modern sanitation) lived during the summer months in the upper catchments of some rivers (e.g. Gruinards) and tended cattle. Anecdotes indicate that pastures were more fertile than in the past few decades. In the 19th century grazing pressures increased with sheep production on a large scale (latterly encouraged by state subsidy). The number of inhabitants living in the glens declined considerably with emigration to the cities, to North America and elsewhere. Subsequently, most of the land was managed for sporting interests. Deer numbers rose. Moor burning and the export of deer carcasses out with catchment areas may have contributed to a further reduction in fertility.

Much of the land is currently grazed by red deer and sheep. The predominant vegetation types reflect this. The most extensive vegetation type [from CEH data sets] is 'heather moor', with mosaics of grasses, sedges, mosses and lichens in mountainous areas above 500m. Where catchment areas are denuded of living matter, nutrients are lost from the ecosystem and the growth and productivity of plants and animals declines until fertility is regained. Additional consequences of thin soils include excessively rapid run off following heavy rainfall, exacerbating damage to streams, streamside habitats and manmade structures (e.g. Strathcarron railway in July 2007).

There are a few cultivated fields in some of the lower lying valleys. Around the coastline, there are crofting townships with small areas of arable land. Even in these areas, vegetation is healthiest where it is allowed to grow during the summer months, sending roots deeper into the soil, without being grazed.

2.3.2 Forestry

In the 20th century, particularly after the second world war, plantation forests of mainly non-native coniferous trees were established in some river catchments, including the Broom, Dundonnell, Ewe, Carron, Ling and Glenmore (Glenelg) rivers. In the past few years, there has been extensive wind damage to plantations. The Forestry Commission has sold off some of its uneconomic woodlands during the past 10 years.

Notable native Scots pine woodlands remain within the catchments of the Ullapool River, the River Ewe (Beinn Eighe NNR) and the River Carron. Remnants of ancient native broadleaved woodlands are found in most catchment areas. Some of these have been enclosed within Woodland Grant Schemes in recent years to limit grazing pressure and allow regeneration. One of the largest native woodland restoration projects in Scotland, the 'Balle Mor' WGS scheme is located in hilly ground between Gairloch and Loch Maree. The area includes parts of the River Kerry catchment and parts of the River Ewe catchment area. There are many lochs within the reforested area that support brown trout.

2.3.3 Nutrient retention and fertility management

A few streams have been enriched as a result of nutrients discharged from houses and fish farms (e.g. Tollie Burn, Kinlochewe River, River Balgy, River Carron). In contrast, it is likely that many other waters are currently less productive than in the past when more people lived and worked in headwater areas.

Trials on Beinn Eighe NNR have demonstrated that over a 50 year period, the fertilisation of degraded, formerly burnt land can help restore soil and vegetation cover, and enhance biodiversity in addition to increasing bioproductivity. In the past, animals such as bears and wolves would have facilitated nutrient recycling and higher biological productivity. Can fertiliser be applied in a way to mimic an extirpated natural process? The potential for restoring fertility and regaining more productive ecosystems can also be seen around the Sheneval Bothy in the upper River Gruinard catchment. Where soils have been enriched, oak trees grow, earthworm populations are healthy enough to support a mole population; the Sheneval steam supports fatter, faster growing juvenile salmon than in the nutrient-deficient mainstem nearby.

Figure 2.4 *Vegetation map of the WRFT area showing locations of some places referred to in the text.*