

WESTER ROSS FISHERIES TRUST

Wester Ross Wild Trout Project Report for Year 2006 - 2007



Peter Cunningham, February 2007

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Wester Ross Wild Trout Project Report

2006 - 2007

1. Introduction

1.1 The Wester Ross Wild Trout project was set up in 2003 to learn more about the productivity of wild trout lochs within parts of Wester Ross and to investigate options for managing them. By adopting a collaborative approach with anglers, angling clubs and with local fisheries proprietors, the project aimed to generate interest and create greater awareness, especially within the local community, of the potential for developing local waters for wild trout fishing and for wildlife.

1.2 Progress was reviewed at the end of 2003, in January 2005 and March 2006. These reports summarised findings from a series of investigations of local waters, including Lochan nam Breac (near Gairloch) and a series of other lochs in the Gairloch area, and included an analyses of trout catches recorded via the Angler's Log Book Scheme. Records of trout caught in the famous Fionn Loch suggested that there had been little change in the size of growth of trout since the early 20th Century. In parallel with research studies, a series of children's angling days were organised each year in collaboration with local angling clubs all of which were popular with youngsters and well attended. The Ullapool Angling Club developed its own project to restore and develop a trout fishery for which it won the Wild Trout Trust's prize for a project (amateur category) in 2004.

1.3 The first three years of the project provided data relating to trout growth rates and the variability and productivity of a series of trout lochs, particularly those in the Gairloch area. In her student project of the lochs in the Gairloch hills, Caroline Bowes, a volunteer field assistant, found variation in water quality and the fauna they supported, including variation in the occurrence of the freshwater shrimp, *Gammarus*. For unforeseen reasons, the "Wee Wildlife Guide to the Gairloch Hill Lochs" based on Caroline's field studies has yet to be completed - though we still hope to complete the booklet as one of the outputs of the project.

1.4 In 2006, in addition to further samples from a range of hill lochs in the Gairloch area, trout were sampled in lochs near Cove (Loch Ewe) and in the hills above Loch Broom. Trout were also sampled from streams flowing into Loch Maree and Loch Maree for studies of growth and genetic variation as part of the '**Loch Maree Wild Trout Project**', an off-shoot of the Wild Trout Project.

1.5 In 2006, the **Angler's Log Book** scheme was again promoted to Angling Club members. Overall, the level of participation by local anglers in data collection has been modest, and the scheme has not been as successful in generating catch-per-unit-effort information as envisaged. Reasons for this are discussed later in this report.

1.6 This report also provides a summary of brown trout data held by the Wester Ross Fisheries Trust and reconsiders factors that determine trout growth rates and fisheries potential of local waters. Conclusions from the past four years are presented. The report **looks ahead** at ways of managing lochs for trout and for wildlife. Management requirements for fisheries and wildlife need not be mutually exclusive. Recommendations focus both on the need to protect native wild trout, opportunities for the development of wild trout fishing in the area for the benefit of the local community and visitors to the area, and opportunities for minimising disturbance to safeguard other special wildlife.

2. Trout size, growth rates and production

2.1 Big trout

2.1.1 In 1878, J.H. Dixon and his friend caught a 'yellow' trout of 21lb (9.5kg) in Coree Bay in Loch Maree. This may not have been the largest trout in Wester Ross. The largest brown trout recorded during the project was a fish of 4.5kg, about 74cm long, which was caught in Loch Dampb by Tony Hutchison on the 23rd May 2003, with the late John Heath as ghillie. This fish was aged by scale reading to be 7 years old, having grown rapidly throughout its life. Loch Dampb (River Balgy system) has a reputation for producing big trout: even larger trout have been taken in the past. The loch supports two farm salmon smolt production units. In addition to producing big trout, big charr (to over 1.5kg) and big 'wild' (origin under investigation) 1+ year old salmon smolts are also produced. Although the loch's reputation for large 'ferox' predates salmon farming, the unusually rapid growth of fish in more recent years appears to relate closely to fish farming. Big trout are found in waters where there is abundant food. Supplements of waste feed or nutrient enrichment enhances rates of fish growth.

2.1.2 The Wild Trout Project was more concerned about more 'natural' variation in trout growth. The great majority of trout lochs in Wester Ross are not subject to discharges associated with human activities. Indeed, many lochs are as natural and pure as anywhere else within the British Isles. However, they should not be regarded as 'pristine'. In the past, many lochs were managed more actively for producing trout. Within living memory, some families in Gairloch had their 'own' traditional fishing sites on some lochs. Catching trout was primarily about providing for a family meal; fish size was less important than the overall quantity of fish caught.

2.1.3 We have found out, so far largely through anecdote, that the occurrence of wild trout, especially in some of the smaller lochans, is the result of a 'helping hand'. Some of the larger trout recorded, including the one shown on the cover of this report which was caught in a small lochan near Gairloch in 2006, appear to be the product of introductions by particularly 'dedicated' wild trout enthusiasts. For most wild trout enthusiasts, there are few more magnificent creatures than a big trout, especially one stocked as small fish a year or two earlier! The temptation to move trout to lochans where there is good feeding is a strong one. In most lochs where there is good natural spawning in an inflowing stream, trout of between 200mm and 250mm are most frequently caught by fly fishermen. These fish are typically four to six years old. However, trout from these waters, when introduced to waters where competition from other trout is lacking for a particularly abundant food resource (mayfly, caddisfly, chironomid, and dragonfly larvae, water beetles, water bugs; freshwater shrimps, newts and frogs [including tadpoles]. . .), grow quickly, reaching a larger size than their siblings.

2.1.4 Table 2.1 gives the ages of some of the 'big trout' recorded based on the reading of scales in the WRFT collection, with comments about the lochs they come from. The list is far from inclusive. Big trout have been caught in other local waters for which WRFT has no scales. Some of the smaller lochs have been coded (rather than named) to ensure that they do not attract attention!

2.1.5 Note that large (>350mm), fast growing trout can be found in small lochans at altitudes of up to and over 300m. Studies elsewhere have shown that trout growth, size and longevity can be influenced by genetics and temperature. In Wester Ross waters, the availability of food is a particularly important factor determining the growth and size of trout. This is discussed further in section 3.3.

2.1.6 Larger trout were recorded in lochs located on Moine schists, Lewisian gneiss-amphibolite, and Torridonian sandstone outcrops. Four year old trout of >350mm were caught in small lochans without permanent inflowing or out-flowing streams (just seepages through or over peat). The freshwater shrimp, *Gammarus*, was found in some of these waters, but not all of them.

2.1.7 A multi-mesh size gill net set in an unnamed lochan near Aultbea to target arctic charr of 50mm upwards caught only 4 trout all of over 350mm in length (including one of over 500mm). The lochan was previously thought to contain only charr; the trout are assumed to have been introduced by a local trout enthusiast and to have grown quickly (scale samples still to read!).

Table 2.1 Some of the larger brown trout caught in Wester Ross between 1997 and 2006 for which scales have been collected and read.

| Loch | Area / River Catchment | Altitude (m) | Length (mm) | Age (years) | Sea trout access? | Stocked? | Comments |
|---------------------------------------|------------------------|--------------|-------------|-------------|-------------------|----------|--|
| Dubh Loch | Kanaird | 190 | 405 | 9.3 | NO | ? | Hydro-reservoir: limited natural spawning in in-flowing burn below falls. 50% of trout taken by anglers were over 300mm in length. Access via Ullapool Angling Club permit. |
| | | | 385 | 6.3 | | | |
| | | | 365 | 8.2 | | | |
| | | | 350 | 7.3 | | | |
| Loch Achall | Ullapool | 85 | 600 | 10.4 | ? | NO | Over 80% of trout caught in Loch Achall are between 200mm and 250mm in length. |
| | | | 400 | 7.2 | | | |
| Lochan U1 | Ullapool | 250 | 390 | 6.3 | NO | ? | Limited natural spawning |
| Lochan U2 | Ullapool | 290 | 393 | 8.3 | NO | ? | Limited natural spawning |
| Loch B1 | Loch Broom | 365 | 435 | 7.5 | NO | ? | Limited natural spawning |
| Lochan D1 | Dundonnell | 385 | 580 | 11.3 | NO | ? | Limited natural spawning; newt-eating variety of trout; small head, big shoulders. |
| | | | 490 | 9.2 | | | |
| | | | 460 | 9.2 | | | |
| Lochan D2 | Dundonnell | 380 | 580 | 10.2 | NO | ? | Fast growth; good feeding; many trout >250mm in 3-4 years |
| | | | 355 | 4.2 | | | |
| Lochan D3 | Dundonnell | 340 | 510 | 8.3 | NO | NO | Fast growth; good feeding; many trout >300mm in 4-5 years |
| | | | 490 | 8.2 | | | |
| | | | 445 | 7.3 | | | |
| | | | 385 | 4.3 | | | |
| Loch na Sealga & upper Gruinard River | Gruinard | 85 | 665 | 14.6 | YES | NO | Lager trout taken at the outflow of the loch. Many trout of 250-300mm in 4-5 years. |
| | | | 615 | 11.6 | | | |
| | | | 540 | 14.6 | | | |
| | | | 470 | 9.3 | | | |
| Lochan Gr1 | Gruinard | 235 | 570 | 10.6 | NO | NO | Most trout 250mm-300mm in 4-5 years |
| | | | 430 | 8.5 | | | |
| Fionn Loch | Little Gruinard | 175 | 730 | 12.3 | ? | NO | Most trout 210mm-260mm in 4-5 years |
| | | | 430 | 8.5 | | | |
| Lochan C1 | Cove | 70 | 360 | 4.3 | NO | ? | Probably stocked. |
| Lochan C2 | Cove | 50 | 360 | 4.4 | NO | ? | |
| Lochan Ga1 | Gairloch | 290 | 385 | 6.4 | NO | ? | Possibly stocked: the loch has no apparent spawning habitat. |
| | | | 380 | 4.4 | | | |
| | | | 375 | 4.4 | | | |
| Loch Garbhaig | Gairloch | 225 | 400 | 6.3 | NO | NO | Has been stocked in past; trout though to be of wild origin |
| | | | 380 | 5.3 | | | |
| Loch Bad an Scallaig | Gairloch | 115 | 350 | 3.6 | NO | YES | This loch has pike; larger trout caught each year. |
| Loch Maree | Ewe | 15 | 600 | 12.2 | YES | NO | Ten of the largest. Many of these fish were taken in a fyke net in 1997 and 1998 at the end of a season set to catch sea trout. However, trout of >350mm aged 4+ or 5+ years were taken regularly. |
| | | | 570 | 9.5 | | | |
| | | | 515 | 8.6 | | | |
| | | | 500 | 6.3 | | | |
| | | | 460 | 6.3 | | | |
| | | | 450 | 5.8 | | | |
| | | | 440 | 5.8 | | | |
| | | | 430 | 5.8 | | | |
| | | | 420 | 8.3 | | | |
| | | | 410 | 5.3 | | | |
| Loch Damp | Balgy | 45 | 740 | 7.2 | YES | NO | This loch has two salmon smolt cage farms in it. |
| | | | 700 | 7.2 | | | |
| | | | 660 | 6.7 | | | |
| | | | 640 | 9.8 | | | |
| | | | 450 | 6.3 | | | |

2.1.8 Projected growth trajectories for four of the larger lochs where large trout have been caught are shown in Figures 2.1 and 2.2. In Loch Achall and the Fionn Loch, growth rates of a few large trout appear to show an acceleration aged six or seven, consistent with a change in diet. The change in growth rate appears to be similar to that of piscivorous 'ferox' trout reported elsewhere (e.g. Campbell, 1979). Arctic charr are known from the Fionn Loch but not in Loch Achall.

Figure 2.1 Projected growth trajectory for trout in the Dhu Loch (Kanaird catchment) and Loch Achall (River Ullapool catchment).

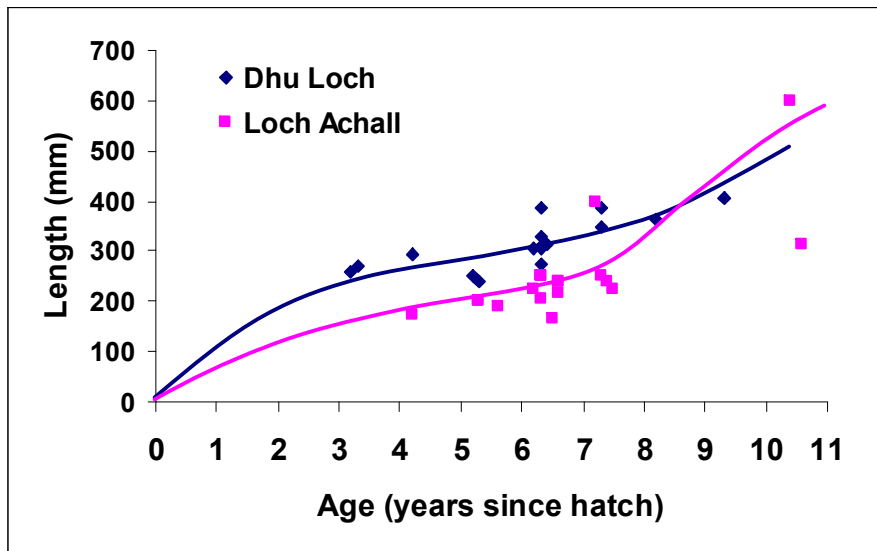
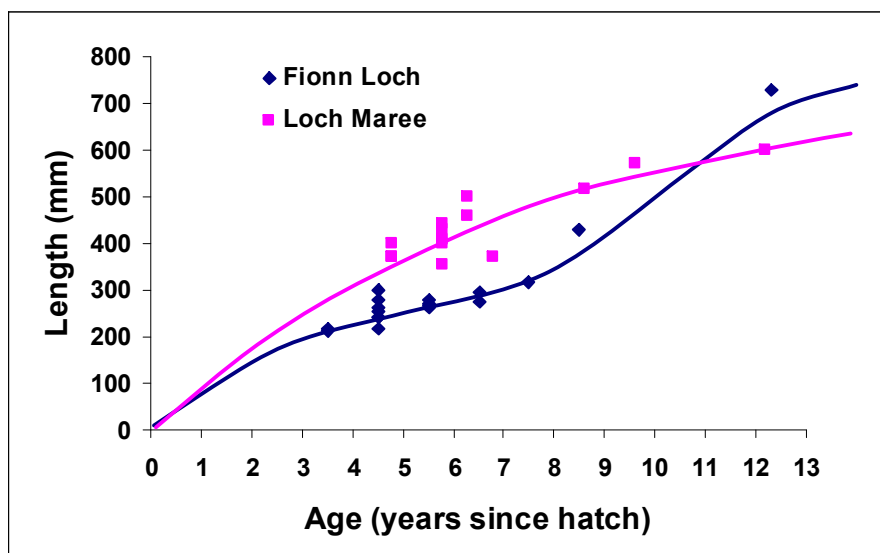


Figure 2.2 Projected growth trajectory for trout in the Fionn Loch and for trout in Loch Maree



2.1.9 However, in other water trout show more steady growth to large size [c Jonnson *et al* 1999]. Some of the large trout caught in the Dundonnell lochs grew steadily to 500mm or more; some were found to contain newts. In Loch Maree (Figure 2.2) growth of some trout to a large size also seems to be relatively steady. Within the past 20 years, the Loch Maree sea trout stock collapsed and minnows have become abundant. Further work could be done on trout scale collections (WRFT & FRS collections) to find out whether rates of brown trout growth in Loch Maree have changed.

2.1.10 Some local anglers firmly believed that periodic stocking of lochs with trout from outwith the area improved the quality of fishing through the introduction of 'new blood' for the same reason that new rams were brought in to maintain the quality of hefted sheep herds. 'Loch Leven trout' were said to have been introduced to some of the lochs in the past. There is a genetic basis for trout growth and size. Duguid *et al* (2006) found that the 'ferox' trout of Loch Awe and Loch Laggan were genetically separate from the other sympatric brown trout in respective lochs, and indeed were more closely related to the 'ferox' trout of Loch Melvin in Ireland.

2.1.11 Thanks to studies such as that of Duguid *et al* (2006), awareness of the need for the genetic conservation of Scotland's native wild brown trout is growing. Over the years, trout from out with the local area have regularly been stocked into hill lochs by proprietors and angling clubs. The genetic diversity of wild trout in Wester Ross is currently being investigated via the **Loch Maree Wild Trout Project [LMWTP]**. This collaborative project which will look at all trout within the catchment (brown trout, sea trout and 'ferox') may draw attention to the need for better informed management of wild trout in Scotland to safeguard locally native populations.

A 'ferox' from Loch Maree taken in a gill net in July 2006. A normal brown trout that grew large, or a genetically distinct species of wild trout?(Steve Kett)

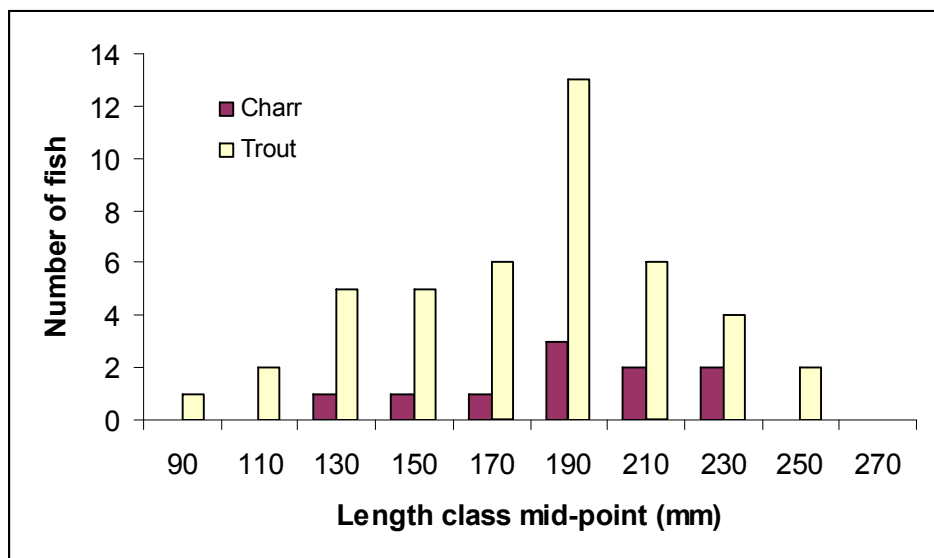


2.2 Typical Wester Ross wild trout lochs

2.2.1 Most trout caught by fly fishermen in most of the lochs were between 200mm and 250mm in length. Although dedicated trout anglers nowadays may prefer to catch larger trout, in past years fish of 200mm - 250mm in length were very acceptable as food for local residents. In 2003 in Lochan nam Breac near Gairloch, few trout of over 250mm were caught using rod and line, gill net or with a fyke net in the spawning burn. Trout grew quickly, reaching lengths of 200mm in 3 years, but few trout of more than 5 years of age were caught. Many of the larger trout were heavily infected with parasitic tapeworms (via seagulls) and nematodes, thought to be a cause of mortality of larger trout.

2.2.2 Two multi-mesh gill nets (identical to the net referred to in 2.1.7) were set overnight to sample Arctic charr in Loch an Draing, a relatively inaccessible water near Cove. 44 trout were caught in addition to charr. Few of these trout were over 200mm in length, none were over 250mm (Figure 2.3).

Figure 2.3 Sizes of Arctic charr and Brown trout taken in multi-mesh gill nets in Loch an Draing, recorded on 9th November 2006. This loch is further from the road and less likely to have been stocked than more accessible waters.



2.2.3 Trout in many of the other lochs investigated during the project were of a similar size to those in Loch an Draing. In the Gairloch hills, children's wild trout expeditions visited Loch Airigh a'Phuill (in 2005) and Loch Laraig (in 2006). Nearly all children were able to catch a trout big enough to take home for tea. Although these lochs are not of great interest to dedicated trout anglers, they provide great destinations for family trout fishing expeditions. Youngsters can also be introduced to some of the other wildlife along the way.

2.2.4 The project was not able to obtain data from which refined production estimates can be made. Although most anglers appear to make some effort to buy a permit, catches of brown trout are not routinely recorded. For most waters catch records are far from complete. Reasons for this are discussed in section 4.4. A mark-and-recapture study of Lochan nam Breac in 2003 was inconclusive: none of the marked fish were recaptured. Regarding trout loch production, the project has little to add to the conclusions of Campbell, 1971.

2.2.5 The size of trout taken by fly fishermen in Loch Achall and the Fionn Loch had changed little in over 80 years. Both lochs produced many trout of 200 – 250mm in length, as they did in the 1920s. During the period 1961 – 1965, over 1,000 trout were taken each year from Loch Achall of average weight about 150g. Larger fish were rarely taken by fly fishers. The Loch Achall records indicate that an annual catch of 150kg of brown trout was sustainable (without change in the average size of trout). Loch Achall is 125ha in area, giving a yield of about 1.2kg / ha / yr.

2.2.6 For smaller waters (less than 5ha) with larger trout (500g+), sustainable annual yields may be as little as 10 - 20 trout of per year. This is the obvious reason why local anglers prefer not to report the whereabouts of small lochs where larger trout are present: one or two indiscriminate anglers might easily remove most of a year's production on a single outing. The necessity for secrecy about 'big fish waters' remains one of the dilemmas to be addressed if wild trout fishing is to be more fully developed within the area. Promoting 'catch and release' of special fish can help maintain fishing quality.

Much celebration. After the picture was taken, the trout was carefully returned to the lochan from where it came!



3. Factors limiting trout production in Wester Ross

3.1 Temperature

3.1.1 Because fish are cold blooded, their basal metabolic rate and the maximum rate at which they are able to grow are limited by water temperature. Trout and salmon are able to grow faster when water temperatures are high (up to about 15°C) than when water temperatures are low. Until recently, it was generally assumed that the observed freshwater growth rates of juvenile salmon (*Salmo trutta's* closest relative) were determined primarily by temperature. Juvenile salmon in high altitude streams at northern latitudes were assumed to be slower growing than those in lowland rivers primarily because of differences in water temperature.

3.1.2 However, recent studies (e.g. Bacon *et al*, 2005) have shown that the growth of juvenile salmon is more complex and dependent on a wider range of factors. During the spring, juvenile salmon have been found to grow faster in cold water than previously thought possible, at a time of year when food availability in the form of aquatic insects is highest. The ability to grow fast at certain times of year may be an adaptation to the seasonal abundance of food.

3.1.3 Within Wester Ross, some of the fastest fast growing brown trout reaching 350mm aged only 4+ were found in small un-named shallow lochans near Dundonnell (D2) at 380m and near Gairloch (G1) at 290m. It is possible that summer water temperatures in these shallow lochs were high compared to some of the deeper lochs at lower altitudes. However, evidence that temperature is the major factor limiting growth and production of trout in Wester Ross is lacking. Salmon farmers are routinely able to grow fish of 20cm length within one year in Wester Ross lochs.

3.2 Geology and pH

3.2.1 The freshwater shrimp *Gammarus* was found in fast growing trout waters, Lochan Ga1 and has been previously reported in Lochan D1, reflecting water of relatively high pH. These lochans are situated on metamorphic bedrocks, 'Lewisian gneiss with amphibolite' (Lochan Ga1) and 'undifferentiated Moine schists' (Lochan D2). These rocks provide a better source of pH neutralising basic minerals than the Cambrian quartzite and Torridonian sandstone underlying lochs in other parts Wester Ross. However, many other lochs are situated on similar metamorphic bedrock within Wester Ross; relatively few are noted for producing large or fast growing trout. *Gammarus* was also found in waters where trout growth was not unusually fast. Near Cove, fast growing trout were found in lochs underlain by Torridonian Sandstone.

3.2.2 Many lochs have catchments containing thick peat deposits. When the sun is high in May, June and July, lochans with peat stained water heat up more rapidly than clearer lochans. However, macrophyte plant growth tends to be restricted to very shallow water because of reduced light penetration, hence limited production of aquatic food for trout. Nevertheless, trout can and do grow large in peaty lochans, if present at low densities. Acidic lochs can support 'regular trout fisheries' (Morrison, 1997).

3.3 Depth and habitat

3.3.1 Trout (of about 300mm; size yet to be confirmed) were observed leaping out of the water at dragonflies from a shallow, clear, weedy lochan less than 1m deep at its deepest point. They were uncatchable. . . Snorkel surveys found that some lochs had lush weedbeds (typically of Water lobelia, Shoreweed, Milfoil, Bulbus rush, Pond weed, Bladderwort) across the bottom (where depth less than 3m), providing excellent habitat for invertebrates. These lochs often were particularly productive, though trout size was not always large. Other lochs had less prolific macrophyte growth with a substrate of fine peaty silt supporting little invertebrate life in deeper water. In such lochs, weed growth was restricted by water quality, water clarity, and wave action. Although these lochs tended to be less productive, large trout were occasionally recorded in some.

3.3 Nutrients and food availability

3.3.1 Biological productivity in Wester Ross is limited primarily according to the availability of phosphate [PO₄]. Phosphate sources include leaching from soil and basic bedrock, and via trophic pathways from animals (birds, amphibians and other fish). Phosphate [PO₄] is rapidly assimilated by aquatic plants in the photic (sunlit) zone of lochs. Shallow lochs where plants are attached to or rooted into the substrate are better at retaining phosphorus than deep – or peaty lochs, where growth of benthic algae or macrophytic plants is limited to shallow loch margins. In deep lochs, much of the primary production is through planktonic algae.

3.3.2 Rainwater contains very small amounts of phosphorus. Lochs which are rapidly ‘flushed’ by rainwater, especially those where there is very little macrophyte or benthic algal growth are therefore less able to retain nutrients. The productivity of trout waters which have a high flushing rate and an oligotrophic [nutrient limited] catchment is therefore usually less than that of lochs with a low flushing rate and more fertile catchment area.

3.3.3 Within the Gairloch Hills, Gairloch Estate’s Baille Mor Woodland Grant Scheme [WGS] provides graphic illustration of how application of phosphorus fertiliser can increase vegetation growth. Trials elsewhere have investigated how by increasing nutrient levels in lochs, provision of food for trout may be increased. Lochs with salmon smolt farms have enhanced phosphorus levels (e.g. Loch Tollaidh, Loch Scamhain, Loch Damph) and may support higher production than other nearby waters. The Gairloch Angling Club regards Loch Tollaidh as ‘one of their best waters’ and trout of over 1.8kg have been caught (Sandison, 1997). The loch also has non-native Eurasian minnow and *Gammarus*.

3.3.4 In contrast to the many eutrophied waters elsewhere in Scotland, large parts of Wester Ross may have been culturally oligotrophied as a consequence of land management practices over the past 200 years. WGS schemes can help restore natural fertility and wildlife populations, including production of natural food for trout.

Nutrient enrichment in the Gairloch hills. Application of phosphorus fertiliser to newly planted trees has resulted in a dramatic increase in the growth of other vegetation, including the grasses in the middle right of the picture.



3.4 Spawning habitat and recruitment

3.4.1 In October 2006, trout were observed spawning in small streams entering three of the larger lochs in the Gairloch Hills (Loch a Mhuilinn, Loch Airigh Mhic Craidh and Loch Airigh a Phuill). At two of the spawning sites, there was evidence of otter predation of spawning fish. Because these spawning streams were all very shallow (less than 2cm deep in places) and spawning gravels were very limited in area, large trout would have been less able to move freely from pool to pool than the small trout observed. Crawford (1996) noted that larger trout were unable to enter the spawning stream flowing into one of her local waters. Being too big to safely access spawning habitat is another reason why smaller trout which mature at little more than 150mm may be particularly abundant in such lochs: they have simply become adapted to their local environment.

3.4.2 Thanks partly to the tendency of large trout to eat small fish if the opportunity presents itself (a trout of 16cm was found with a fry of 5 cm inside them in the Ullapool River), some lochs with abundant spawning and nursery habitat are still able to support production of some larger trout (e.g. Fionn Loch; Loch Achall; Loch Maree). Studies are underway to find out whether the large 'ferox' of Loch Maree are genetically distinct from other brown trout and sea trout in the loch.

3.4.3 The lochs with trout of the largest *average* size tended to have very restricted spawning habitat (e.g. Dhu Loch reservoir [Kanaird] where annual recruitment may be of only a few dozen fry per year from limited spawning habitat in a stream below a waterfall). Campbell (1971) concluded that trout growth was negatively correlated with fish density. Within Wester Ross, the occurrence of a few large trout in some lochans with no apparent spawning habitat is sometimes thought to be a result of 'helping hands'. This 'traditional' and for obvious reasons largely undocumented form of trout loch management may have been practiced for many hundreds of years.

Little trout were observed moving up and down and spawning here, in a small stream above Loch Airigh Mhic Craidh in October 2006. The stream may have been too small for larger trout to spawn in (Jan Whittington).



3.5 Predation

3.5.1 In September 2006, an otter was seen fishing in a hill loch at an altitude of over 350m above Loch Broom, where it was disturbed, running away across the moor. For most anglers, the sighting of an otter is one of the most memorable events in a day's fishing. Signs of otter were recorded throughout the project area. Otters take trout, but also frogs, eels and other small animals. The only anglers to express concern about the predation of trout by otters were angling club members who had recently stocked a hill loch. More often, the abundance of small trout was such that predation by otters was considered to be of benefit to the loch as a fishery. The extent to which predation by otters is of any significance to trout production was not investigated.

3.5.2 Red-throated divers breed on some of the smaller lochans. Black-throated divers breed on some of the larger lochs, including a popular roadside loch near Gairloch where, despite a high level of fishing pressure, chicks were fledged in 2004, 2005 and 2006. Red-throated divers fly to and from breeding lochans to the sea to obtain food, rather than feeding on small trout. By doing this, they transfer marine nutrients to some waters, enhancing fertility. Black-throated divers feed in freshwater on minnows and small salmonids. Two ghillies expressed concern that Black-throated divers could be significant predators of smaller trout in Loch Maree (including young sea trout). However, the more enlightened view of appreciating divers as an integral part of the world of wild trout generally prevails. Both divers and anglers will benefit from the recovery of wild sea trout stocks.

3.5.3 Pike are present in Loch Bad na Scalaig, near Gairloch, where they were introduced in the 19th Century. Some local anglers are dedicated pike fishers; other anglers would rather there were fewer pike and more trout. Many trout anglers catch nothing. However, like other lochs with pike, Loch Bad an Scalaig is noted as a big trout water. Trout of over 500mm in length are caught in the loch most years. Efforts to catch and remove pike by gill netting in the 1990s were discontinued because of the catch of trout. It is suggested that the removal of large, cannibal, pike can have a detrimental impact on trout stocks by allowing smaller pike to proliferate.

Ala Mackenzie with a pike from Loch Bad na Scalaig near Gairloch. Pike were 'successfully' introduced to this loch by Sir Kenneth Mackenzie in 1848, after an earlier introduction (Dixon, 1886). There is much concern about the spread of non-native fish in Scotland because of the threat they pose to native fish populations.



3.6 Parasitic infection

3.6.1 Parasitic tapeworms are often found in trout. However, the high abundance of tapeworms and nematodes in trout in Lochan nam Breac near Gairloch led to the suggestion that parasitic infection might be a cause of mortality of trout in this loch, by making infected fish more vulnerable to predation by birds. The loch is much used by sea gulls attracted to a nearby waste transfer station.

3.7 Angling pressure

3.7.1 Interest in angling has probably been in decline overall in the past 20 years, with fewer local residents venturing into the hills with trout rod, and fewer holidaymakers visiting the area specifically with fishing in mind. Local children have a wider range of other activities to occupy their free time than their parents, including computer games and TV. In contrast partly thanks to TV, interest in wildlife viewing appears to have increased. One local business in Gairloch, which formerly focussed on sea fishing trips now caters primarily for the growing demand for marine wildlife tours. For those who enjoy trout fishing, but prefer not to meet other anglers in the hills, things may have never been better!

3.7.2 There are still some waters where angling pressure remains high. Loch Tollaidh is possibly the most popular trout loch in the area; those who returned Angler's Log Books fished Loch Tollaidh more often than other lochs. Many anglers catch nothing. However, perhaps in part thanks to the effluent from farm salmon smolt cages Loch Tollaidh continued to yield good catches of trout to some anglers during the past few years. However, now that the cages are inactive, the annual production of wild trout may begin to decline.

3.7.3 Away from the roadside lochs, anglers are seldom seen. Because of limited reporting, it is difficult to gauge fishing effort and the impact upon stocks. For the majority of trout lochs away from the road, angling effort has possibly been insufficient to affect trout production in recent years. Nevertheless there are a few smaller lochs where the stock of larger trout is likely to be quite limited, and insufficient to provide yields of more than a handful of fish per year.

A recently planted rowan tree takes root above one of the less accessible lochs in the Gairloch Hills. This loch has large stocks of 100 – 150g trout (10+ can be caught within a 2 hour session) and appears to be rarely fished. Trout spawn in the burn in the foreground.



4. Managing 'Wild' Trout Fishing in Wester Ross

4.1 Management objectives

4.1.1 The Wester Ross Wild Trout Project was set up with the primary aim of finding out about ways of managing the many 'brown trout' lochs of the area. Much has been learnt about the diversity of lochs, factors influencing the presence or absence of wild trout, and of the ways lochs have been managed in the past. Studies to find out more about the productivity of different lochs have not provided the quality of data required to produce useful estimates of 'sustainable yields'. Nevertheless, there is enough information to develop some recommendations. Opportunities for trout fishing and for catching big trout are not currently limited by overall levels of production. If anything, the wild trout in much of Wester Ross represent an underutilised resource.

4.1.2 Management recommendations are intended primarily for angling clubs and fisheries proprietors. They may also be of interest to agencies with a remit for safeguarding wild trout and other wildlife and for promoting the sustainable use of natural resources for the benefit of local communities and the nation at large.

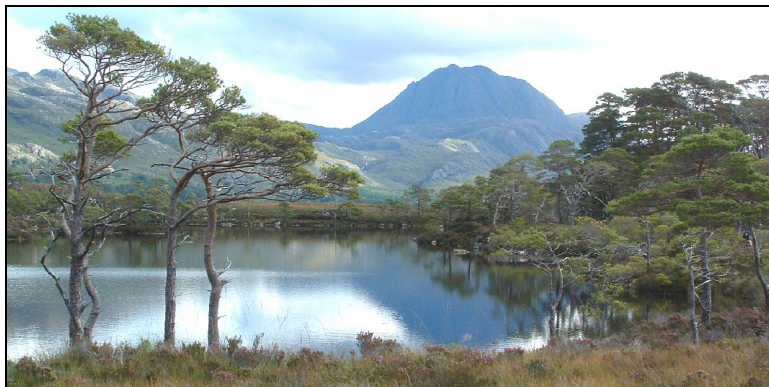
4.1.3 A prerequisite of fishery management is an ability to regulate fishing effort. Fisheries management is as much about managing people as it is about managing fish and the habitats in which they live. Local knowledge, opinion and aspiration also needs to be considered. If anglers', angling clubs' and fisheries proprietors' objectives are not met, then it is unlikely that management recommendations will be adopted.

4.1.4 There is potential for conflict between angling interests wishing to develop or to promote trout fishing, and those of conservation agencies and wildlife enthusiasts with greater concern and responsibility for protecting Scotland's other special wildlife. Fortunately, public attitudes towards wildlife have changed greatly over the years. In years gone by, egg collecting and shooting of unusual birds (sometimes simply to find out what they were) was culturally acceptable (e.g. Mackenzie, 1921). Nowadays, most anglers would not choose to deliberately disturb protected breeding birds for the sake of a few hours fishing.

4.1.3 Management recommendations have the following objectives:

1. Safeguard native populations of wild trout
2. Safeguard other special wildlife, especially protected species
3. Restoring / enhancing the quality of lochs for wild trout and other wildlife
4. Identify opportunities for developing wild trout fishing

Some lochs, where trout are not naturally present, are best left for other wildlife.



4.1.4 The wide range of lochs with trout in Wester Ross can be categorised as follows:

1. Lochs which are accessible to sea trout. These include Loch na Sealga, lochs Maree, Kernsary, Coulin, Squod, Damph, Sgamhain, Doughaill. Although Loch Achall and the Fionn Loch are accessible to salmon, sea trout have rarely been recorded in catches.
2. Lochs with wild brown trout which are inaccessible to sea trout, but which have extensive areas of spawning stream and nursery habitat. These include Dhu Loch (Canaird), Loch a' Bhraoin, Loch na Curra, Loch na h-Oidhche, Loch a' Bhealaich, Lochan Fada, Loch Lundie, and many other lochs above waterfalls that are insurmountable to trout.
3. Lochs or lochans where the presence of trout may be as a result of stocking or transfer of trout from nearby waters, and where the long-term sustainability of a wild trout population without human intervention is uncertain. Clearly, those waters where trout *are* naturally occurring and of native origin should be treated differently from those where trout have been introduced. In practice, it may be difficult to separate these – introductions are seldom documented and some may have taken place many years ago. Occasionally, trout may have access to small lochans via small temporary streams.

4.1.5 A set of categories is required for lochs according to their importance for other wildlife.

1. Diver lochs. Some of the lochs in Wester Ross are part of Special Protected Areas [SPA] for breeding Black-throated divers. These include the Fionn Loch, Loch Maree, Loch Kernsary, Loch a Bhaid-luachraich and Loch a' Mhadaich Mor. There are many other smaller waters where Red-throated divers breed, often returning to the same nesting site year after year. Divers may abandon their nest if disturbed especially during the period when they are incubating eggs.
2. Lochs in remote areas where anglers might cause disturbance to other breeding birds (e.g. Golden eagles) en route to and from them.
3. Lochs where angling is likely to cause minimal disturbance to wildlife.

4.1.6 Lochs can also be categorised according to their accessibility to people. Lochs that are located near roads and footpaths are likely to receive more frequent angling effort than remote lochs.

4.1.7 The need to manage lochs therefore depends very much upon where they fall within a complex 'matrix' of categories. For large less accessible, rarely fished lochs, with healthy and abundant stocks of wild trout and little other wildlife of note, the need for any management intervention is less than for lochs with small stocks of larger than average trout, breeding divers that are a short distance from a public road. Management recommendations therefore focus on the latter type of loch rather than the former.

This 6 year old trout was caught in a loch at an altitude of 360m above sea level. Although slightly out of condition, it had grown quickly up until the year when it was caught.



4.2 Wild Trout Management

4.2.1 Many lochs were managed more intensively in the past than in more recent years. Some lochs were stocked with non-native brown trout (including Loch Leven trout, and farmed trout from Speyside) and Rainbow trout (including 'blue trout'). Some lochs: were stocked with smaller numbers of wild trout transferred from nearby waters, had water levels manipulated through construction of small dams at outlets, had access to spawning areas obstructed if it was considered that there were too many trout, had predators (pike) subject to control measures. At least one loch was stocked with freshwater shrimp in an attempt to improve growth and size of trout.

4.2.2 Management was undertaken by proprietors, angling clubs and others who have taken a lease of the fishing, sometimes under the guidance of a 'consultant', and by anglers using their own initiative. The aim has sometimes been to improve the size or quality of trout for angling, and in other cases (e.g. some Gairloch Angling Club waters) to increase numbers of take-able trout for local and visiting (day-ticket) anglers.

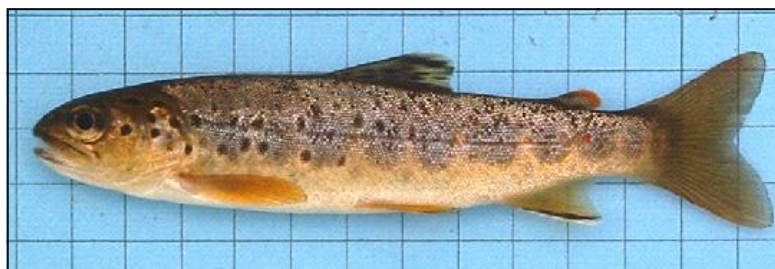
4.2.3 The extent to which there are still locally native populations of wild trout in the area is difficult to establish. Some anglers continue to regard 'Loch Leven trout' as being of better quality than locally native trout: if they catch a particularly fine looking trout they may attribute it to past stocking! However, more recently, there has been growing awareness and acceptance of the need to identify and protect populations of native brown trout.

4.2.4 The **Loch Maree Wild Trout Project [LMWTP]**, an off shoot of the Wester Ross Wild Trout Project, addresses this need. The LMWTP is a collaborative study which will provide an overview of the genetic status and any conservation and management needs of wild trout in a relatively undisturbed part of Scotland. The project has been developed by Dr Steve Kett of Middlesex University, Dr Eric Verspoor of Fisheries Research Services in partnership with WRFT. The project will identify how many different kinds of trout there are within the catchment, how they are related to each other, and the extent to which ancestral native trout populations have been retained within the Ewe catchment.

4.2.5 Perhaps of most practical importance, the **LMWTP** will subsequently inform fisheries managers (including estates and local angling clubs) of whether it is necessary to use trout of local provenance for stocking programmes to restore and enhance sea trout and brown trout fisheries. Bob Kindness of University of Highlands and Islands Seafield College aims to utilise results as a guide for the development of captive broodstocks of locally native provenance in future years. Initial sample collection has already taken place with expeditions to Strath Lungard, Beinn Eighe NNR (no trout found in upland streams!), Gairloch Estate hill lochs and Gleann Tanagaidh above the Heights of Kinlochewe. Angling enthusiasts from the local area and beyond are invited to join sample collection expeditions. The project will be more formally launched in Spring 2007.



Loch Maree Wild Trout Project: Steve and Calum at work in Gleann Tanagaidh, August 2006. All trout are measured, photographed for morphometric analyses and DNA samples taken to assess genetic relationships.



4.3 Loch Catchment Management

4.3.1 Most of the lochs within Wester Ross are located in open land, where for many years, cattle deer and, particularly from the mid 19th Century, sheep have been grazed. Because of grazing pressures, few trees now grow by many lochs, except on islands. Lochs with treed islands include the Fionn Loch, Loch Fada, Loch a' Bhaid-luachraich, Loch Bad a' Chreamh, Loch Tollaidh and Loch Kernsary.

4.3.2 Land use affects the productivity of lochs. In the 19th Century, it was 'generally accepted' that the fall in numbers of trout in many lochs was associated with a reduction in cattle numbers and an increase in numbers of sheep (Dixon, 1878). During the same period the practice of grazing cattle around shielings in the hills was declining; also increasing numbers of trout fishers were visiting the area as travel facilities improved.

4.3.3 Whether or not there has been a decline in the overall productivity of the land is difficult to assess. Production of sheep, cattle and deer without periodic application of fertiliser to replace 'harvested' nutrients (especially phosphorus), reduces levels of fertility and nutrient availability for terrestrial and freshwater production. In the past, the presence of more people living in the hills at least for part of the year without modern systems of sanitation would also have led to greater nutrient cycling within the ecosystems in which wild trout exist than nowadays.

4.3.4 The productivity of lochs is thus, closely associated with the productivity of their catchments. Lochs in some parts of Wester Ross have recently been incorporated within Woodland Grant Schemes [WGS]. These include schemes on Gairloch Estate and Letterewe Estate. Trees have been planted and fertilised with phosphate fertiliser; large grazing animals have been excluded. This change in management of the surrounding land and catchment is may lead, over a period of years, to the restoration of soil fertility and an increased supply of nutrients and terrestrial invertebrates for lochs: more food for wild trout.

4.3.5 In 2003, the Ullapool Angling Club took advantage of an opportunity to incorporate two hill lochs within a WGS in collaboration with the landowner as part of a project to develop a trout fishery. Club members have expressed satisfaction of the outcome and local school children have also been able to visit the project area to learn about the project, and how to catch trout. There are other opportunities to for restoration projects and for developing wild trout fisheries in other parts of Wester Ross. Initially, these are probably best discussed off the record.

Ancestral otter spraint site by the side of a loch near Greenstone Point. Contrast the lush green growth with the more typical bankside vegetation beyond. Otters also transfer marine nutrients to freshwater lochs near the sea, enhancing loch fertility. This loch is noted for larger trout.



4.4 Managing Anglers

4.4.1 The Land Reform (Scotland) Act 2003 establishes a statutory right of responsible access to land and inland waters. The Act sets out where and when access rights apply. The Access Code defines how access rights should be exercised. Members of the public have a right to *visit* any loch within Wester Ross, but they commit an offence if they *fish* without written permission.

4.4.2 Local anglers are able to access local trout lochs through membership of their local angling club for a modest annual subscription. Permits for visiting anglers are available in all the major villages and holiday centres. There are no Protection Orders in force in Wester Ross. Fishing for brown trout without lawful authority or written permission is therefore a civil offence, rather than a criminal offence. In practice, this means that the police have no powers to arrest anglers fishing without a permit for wild trout or freshwater fish other than salmon and sea trout.

4.4.3 One of the main reasons why anglers are reluctant to report their catches or even to disclose the whereabouts of lochs where large trout may be caught, is that they fear that by drawing attention to a special loch, the quality of fishing will decline as a result of increased fishing effort and too many fish being caught. Creating greater awareness of how many fish a loch is capable of producing in a year and the likely consequence of removing fish from the loch might help to maintain or improve the quality of fishing.

4.4.4 Most anglers now fish responsibly taking only as many fish as they feel is reasonable. Many anglers now practice 'catch and release': a good photo of a live fish looks better and last longer than a dead fish. If 'catch and release' of larger fish can become more popular, the possibilities for providing top quality wild trout fishing in Wester Ross can increase greatly.

4.4.5 Simple guidance for trout anglers might be as follows:

1. If the loch is accessible to sea trout, all trout of less than 20cm should be returned. Because of the recent decline in sea trout, all sea trout and finnock should be returned. Taking up to 4 brown trout of 25cm or over per trip is likely to have little detrimental impact upon the recovery of a sea trout fishery (it might even assist the recovery if they are cannibal).
2. If the loch is inaccessible to sea trout, over 2 ha (~4 football pitches) in area, has an inflowing stream where small trout can be seen in the pools, and most trout caught are below 25 cm in length, then taking as many fish as you can eat (up to a limit of ~10 fish) is likely to have little detrimental impact on the overall stock (remaining trout may grow faster).
3. If the loch is inaccessible to sea trout over 2 ha in area and the average size of trout is between 25 and 35cm, then taking four trout in a trip is likely to have little detrimental impact on the stock (catches should be recorded so that the guidance can be reviewed should fish catches start to decline).
4. If the loch is less than 2 ha in area and the average size of trout is more than 25cm, return trout less than 30cm and consider returning all others, except any particularly 'special' fish for a special meal (catches should be recorded so that the guidance can be reviewed should fish catches start to decline).
5. If the loch is isolated and less than 0.5 ha (1 football pitch) in area, if you catch a large trout, it is likely to be one of very few trout in the loch. If it is carefully caught (small hook), carefully handled and carefully released, you may be able to catch it again when it has grown even larger.

4.4.6 Use of live bait should be banned (especially to prevent further spread of minnow). Stocking trout of non-native origin without prior consideration by fisheries board, fisheries trust or other competent body, of the possible consequences to existing trout populations should be banned.

4.4.7 The traditional practice of transferring small numbers of trout from larger lochs into small lochans nearby may be of less concern in terms of conserving native populations and impacting other wildlife. Any impacts to native stocks will either be minimal or have taken place over past years. Small lochans are transitory by nature; most of their other inhabitants (e.g. water beetles, dragonflies, caddis flies, newts) are capable of adapting to changing conditions, or colonising similar habitat elsewhere.

4.4.7 Anglers should also be informed of the need not to disturb protected wildlife. Under the Wildlife & Countryside Act 1981 (S.9-10) and The Conservation (Natural Habitats &co.) Regulations (1994), it is an offence to disturb a protected animal the animal while using its place of shelter, to take or destroy its eggs or to damage or destroy its breeding site or resting place. The risk of harming the breeding prospects of divers, eagles and other special birds is greatest during the period when eggs are being incubated. By July, chicks have usually hatched and adult birds are less likely to abandon breeding sites if disturbed. A diver will usually escort chicks to the far side of a loch from where an angler is fishing rather than taking flight if the loch is at least 150-200m across. However, should the adult bird appear to be alarmed, anglers should leave the area. Otters also have protected status and should not be deliberately disturbed.

4.4.8 Local advice to anglers needs to be tailored to local requirements. Additional guidance might be along the following lines: anglers should be aware of the possibility that there are divers, eagles or other special birds nesting nearby. They should be advised not to visit lochs where there is a risk of disturbing breeding birds before July, unless the loch is large enough that they can keep away from a breeding site. On arrival at an unfamiliar loch, they should consider the possibility of divers breeding nearby before starting to fish.

Loch na Fideil, by Talladale, has recently been colonised by minnows, introduced to the Ewe system as live bait by anglers. The stream between this loch and Loch Maree is subject to siltation as a result of soil erosion caused by cattle trampling. Spawning habitat for brown trout and sea trout could be greatly improved if the burn was desilted and stream banks were fenced off.



4.5 Developing wild trout fishing in Wester Ross

4.5.1 Fishing for wild trout is a healthy, challenging, and at times energetic and exciting activity that has been enjoyed by local anglers and visitors to the area, young and old, for many years. Many participants develop a deep sense of respect and responsibility for looking after the natural environment. There are opportunities for developing trout fishing in several places within the project area. However, it was never within the remit of the Wester Ross Wild Trout Project to promote wild trout fishing, at least not before first considering the consequences of more people setting off into the hills in pursuit of trout.

4.5.2 Promotion of wild trout fishing in Wester Ross has implications for safeguarding protected species. More anglers means more frequent disturbance of other wildlife. Special birds such as eagles and divers can be sensitive to disturbance; although at least in the case of two lochs, the presence of anglers fishing nearby did not lead to breeding failure. Wildlife tourism is one of the fastest growing sectors of the tourism industry: if marketed appropriately, wild eagles can be as valuable to an area as wild trout (e.g. Mull and Skye).

4.5.3 There are opportunities for developing 'wild trout fishing' in Wester Ross in ways where participants get the best of both worlds: high quality wild trout fishing with opportunities for viewing special wildlife. By working in collaboration with local estates and wildlife interests (including SNH), local angling clubs can help to control and enhance the quality of fishing for all. By having a larger pool of active members, larger angling clubs are able to undertake actions that are too demanding of time and resources for smaller clubs. The Ullapool Angling Club is the largest in the area and has been able to organise events and develop projects. The Ullapool Angling Club committee meets once per month; other angling clubs meet only once or twice per year; some struggle to find enough members prepared to act on the committee and perhaps should consider amalgamation.

4.5.4 Some of the holiday makers, especially those with young families who come to Wester Ross would take more interest in trout fishing if there were places where they could receive tuition. Rather than initially directing inexperienced anglers to distant hill lochs or to a roadside loch where fish are difficult to catch, there may be opportunities for the development of more intensively managed loch fisheries where instruction can be provided and an appreciation of wild trout fishing and associated wildlife can be fostered. Funding agencies might wish to support the costs of producing feasibility studies and business plans for those who might wish to develop such facilities. Part-time employment for suitably trained angling instructors could be one gain.

4.5.5 Fishing with a guide can greatly enhance the likelihood of a visiting angler coming into contact with a large trout or seeing an eagle or other special wildlife. One problem with promoting guided fishing in areas where there are few restrictions on where anglers may fish is that the angling guide may be frustrated at times on finding others fishing the water he or she takes paying guests to. This is one area where a Protection Order, aimed as much at protecting opportunities for maximising the value of wild trout fishing for local communities as protecting the wild trout themselves, might be helpful. However, without local respect, it will be difficult to police.

4.5.6 If some lochs (e.g. those in wildlife sensitive areas) were periodically off-limits to anglers who were not accompanied by a fishing guide there would be a greater prospect of minimising disturbance to wildlife and safeguarding any improvements to the quality of fishing made as a result of management initiatives. To date, proprietors, clubs and others who have leased angling from estates have not felt that a Protection Order would help safeguard their interests. For the time being, the culture of 'secrecy' may be the only way to ensure that lochs which have been subject to management actions to enhance the quality of trout fishing are afforded some protection.

5. Conclusions

5.1 Brown trout were recorded in many lochs and lochans within Wester Ross. Lochs vary in size, productivity (most are relatively infertile), accessibility (for sea trout and people) and according to the other wildlife they support. Trout in excess of 350mm in length were found in a wide range of lochs throughout the area at altitudes of up to 350m and above.

5.2 Even in high altitude lochs and lochans, brown trout are capable of reaching 350mm in length within 4 years, if there is an adequate food supply. However, most lochs in Wester Ross are oligotrophic and trout generally grow more slowly, unless they are present at low densities or the feeding is especially rich (e.g. lochs with farm salmon smolt cages)

5.3 The degree of 'wildness' of trout especially in some of the smaller lochs is uncertain. Trout have been stocked into and transferred from loch to loch by enthusiastic anglers. The amount of fish transfer may be underestimated: local trout enthusiasts are not inclined to advertise the places where they have introduced fish, for obvious reasons!

5.4 The genetic consequences of stocking have not simply been ignored by local residents. Rather than prioritising a need to conserve native stock, some anglers maintained that 'new blood' was periodically required to maintain the 'quality' of wild trout populations.

5.5 The Loch Maree Wild Trout Project, an offshoot of the Wester Ross Wild Trout Project is focussing on the genetic variability of trout within the River Ewe catchment area. Different trout populations will be mapped out and any relict 'ancestral' stocks identified. This project will raise awareness of the biodiversity of native wild trout and of the need for conservation.

5.6 It has not been possible to quantify the productivity of trout lochs in terms of sustainable yields. Mark-recapture experiments were unsuccessful. The Angler Log book scheme was not widely supported: local anglers are reluctant to report their catches if there is a possibility that by doing so, others will be attracted to their most productive waters. However, productivity is not currently the over-riding factor limiting the quality of trout fishing in Wester Ross. Lochs in some areas could sustain higher fishing pressure, especially if 'catch and release' becomes more popular.

5.7 Management recommendations acknowledge the potential for increased disturbance of important wildlife, especially nesting birds, if wild trout fishing is promoted without careful planning. With a more enlightened clientele, the development of high quality wild trout fishing and greater protection for other special wildlife in Wester Ross are mutually compatible objectives.

5.8 Much of Wester Ross is highly oligotrophic. Years of nutrient stripping through grazing with minimal return of phosphorus has led to an impoverished, culturally oligotrophied landscape. It's desolate 'wilderness' quality is largely man-made. Natural fertility is beginning to be restored to some areas through Woodland Grant Schemes; in time the natural productivity of wild trout lochs and of other wildlife in these enclosures may recover. Elsewhere, wildlife struggles on.

5.9 There are opportunities for developing easily accessible lochs as wild trout fisheries to include wildlife habitat enhancement, with provision of facilities for instruction and guidance, for less able-bodied anglers. Some of these opportunities lie within the 'common grazings' of crofting townships. Funding agencies might wish to consider supporting feasibility studies and business plans.

5.10 Wester Ross has the potential to become one of the premier destinations for wild trout fishing in spectacular natural surrounding. However, developing this potential is as much about developing management structures and fostering local interest in management as it is about managing the fish themselves.

6. Acknowledgements

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Fishing for wild trout in spectacular natural surroundings. . .

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