ADVISORY VISIT TO EAST LOCH TAY, PERTHSHIRE
for Taymouth and East Loch Tay Angling Clubs

Frontispiece: View of Loch Tay looking west from Kenmore.

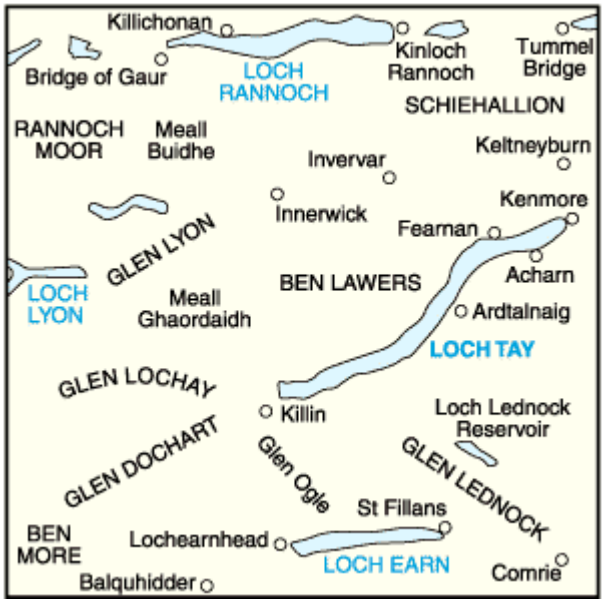
By Dr Andy Walker, Ellwyn, Moulin, Pitlochry PH16 5ER
(Tel: 01796 472743; E-mail: Libisandy@aol.com)

On behalf of Windrush AEC Ltd, The Cottage, Fordwells, Witney, Oxon OX29 9PP

BACKGROUND AND OBJECTIVES

Mark Bowler requested an advisory visit by the Wild Trout Trust to the Kenmore Village area at the bottom end of Loch Tay and including the river flowing out of the loch, where the trout fishing is controlled by the Taymouth Angling Club and the East Loch Tay Angling Club (see www.fishingnet.com/fishing_clubs/ELTAC.htm). Taymouth AC controls trout fishing on two and a half miles of the River Tay starting at Kenmore. East Loch Tay AC controls fishing at that end of the loch. The visit took place on 27 October 2007 when Mark Bowler and Robert McIntyre, Secretary of both angling clubs, were in attendance. The Wild Trout Trust (www.wildtrout.org) was established in 1997 by a small group of people dedicated to the idea that ailing populations of wild trout can be given a helping hand through restoration and conservation of their habitat. It provides practical guidelines and encourages riparian owners, angling clubs and community volunteer groups to instigate habitat projects, not only to protect and improve stocks of wild trout, but to deliver many gains to local biodiversity. The Trust continues to grow in strength and now operates throughout the United Kingdom and Ireland.

The Kenmore visit focused on the situation regarding a rainbow trout cage farm on Loch Tay, at the east end by Acharn, which is causing concern to the clubs due to both the perceived threat of habitat degradation and the apparently high levels of rainbow trout escapes from the farm. The advisory visit was undertaken to provide an overview of potential impacts on wild brown stocks and to identify opportunities to advance the conservation of this important species.



Loch Tay is 24 km long and 155 metres deep and is Scotland's sixth largest loch (26.4 square km). It is fed at its western end by the rivers Dochart and Lochay and the River Tay starts at the eastern end at the village of Kenmore. The rainbow trout cage farm near Acharn has been operating for at least twenty years, although not continuously. It was started and operated by a local landowner, but is now apparently owned by Scottrout Farming Ltd, one of the leading trout farming organisations.

Plate I: Rainbow trout farm at Acharn, East Loch Tay

Rainbow trout are farmed in several other large Scottish lochs including Loch Earn and Loch Awe. The Acharn farm has consent from SEPA for 250 tonnes of trout. Loch Tay also holds wild stocks of brown trout and salmon, Arctic charr, perch, pike, roach, eels, lampreys, minnows and sticklebacks. The roach are believed to have arrived relatively recently, possibly by migration upriver, or perhaps more likely as bait fish by pike anglers. There appears to have been no comprehensive study of the fish stocks in Loch Tay, although the Tay District Salmon Fishery has reported on a gill-net survey of pike and roach stocks at the western end of the loch.

1.0 COMMENTS FROM THE ADVISORY VISIT

The trout fishing in the Taymouth AC stretch of the river is available for members and visitors and is both highly regarded and well-controlled. Brown trout are common and average around the pound mark, although there are some bigger specimens. There is usually a strong flow of water from Loch Tay and the river is relatively fast-flowing and provides good natural cover for trout and salmon through overhanging mature deciduous trees and a in-channel boulders. Trout fishing on Loch Tay is traditionally carried out by casting a team of flies from a drifting boat, but a growing number of bank anglers have been arriving to exploit rainbow trout, including some very large specimens which have presumably escaped from the cage fish farm. Commonly in Scotland, cage farms attract both escaped and wild fish that feed on stray pellets and faecal material. The growth rates of feral and wild fish species can be substantially enhanced in this way. Due to the additional fish food and wastes, there can be a tendency for gradual eutrophication of the surrounding water and this may be noticeable in some lochs at times through algal blooms and

sometimes at sites where intensive culture has taken place for several years by gas bubbling from the bed of the loch. Large, deep lochs such as Loch Tay are favoured for cage production because they provide a large volume of water that rarely freezes over in winter and maintains a more stable temperature regime relative to shallower still waters and rain-fed rivers. However, the deeper areas tend to remain very cold, because water reaches its maximum density at 4^{o}C. As a consequence, the biological disposal of accumulating organic material takes longer to occur here than at coastal sea sites, which are subject to tidal mixing effects.

In "*The Fresh Waters of Scotland*" (1994) (eds. Maitland, P.S., Boon, P.J. and McLusky, D.S.), Harriman and Pugh ("*Water Chemistry*") state that Loch Tay, together with Lochs Ness, Awe, Morar and Lomond, holds more than half of Scotland's standing water. Lyle and Smith ("*Standing Waters*") write that "Scotland is fortunate in having an abundance of high quality water for domestic, industrial, recreational and environmental requirements"… and "Management is of prime importance if this is to be safeguarded."

Fish farms in fresh water, as in the sea, are subject to local authority planning conditions, but many of the farms have been operating for a long period of years and conditions imposed at the outset may not have been reviewed unless changes in farming operation have been sought. New fish farms applications, including changes of use, would often require to be supported by an environmental impact assessment (EIA). It is unknown whether the fish farm on Loch Tay has ever been required to commission an EIA.

Now, under the Water Framework Directive which became law in Scotland under the Water Environment and Water Services (Scotland) Act 2003, SEPA operates under an enhanced legal framework for the protection, improvement and sustainable use of surface waters, transitional waters, coastal waters and groundwater. Part of their new task is to identify those water bodies that are at risk of failing to meet the environmental objectives in the Directive and to set about corrective action. River Basin Districts have been instigated, each of which must have a River Basin Management Plan (RBMP). These plans describe, amongst other things, the environmental objectives (targets) for all water bodies, present the Programme of Measures (actions) to achieve these objectives and display the monitoring programmes set up to assess progress. In delivering the Programme of Measures, SEPA must rely on a number of organisations, individuals and other plans and planning processes working together to achieve shared objectives.

A SEPA report on benthic sampling at the cage site on Loch Tay in 2002, is shown as APPENDIX I. This report is the most recent in a series carried out there by SEPA and indicates considerable benthic impact caused by waste food and faecal material out to a distance of at least 25 metres. The surveys carried out in the years following cessation of an earlier period of production in 1997 continued to show high levels of contamination in the sediments close to the cages although gradual improvement was observed. The results were manifested by highly elevated abundances of oligochaete worms, mainly of the family *Tubificidae*, and showed a considerable shift from the normal fauna of an oligotrophic loch bed. Abundances of Chironomid midge larvae were also significantly higher than at the control sites. The results of the 2000, 2001 and 2002 surveys, obtained after resumption of production at the site and with additional

cages anchored nearby in deeper water, showed continued localised impact (pers.comm. Ian Lorimer). No information was provided by SEPA on monitoring of water chemistry, on seasonal abundance and diversity of phytoplankton and zooplankton abundance, or other ecological impacts, in the lower part of the loch and the outflowing River Tay.

In addition to water quality concerns resulting from aquaculture, it has been common for some years now for anglers to catch escaped rainbow trout in fairly large numbers in the large lochs in Scotland where there are cage farms. Clearly, it is not in the economic interests of the fish farmers to lose their stock. However, escapes can and do occur because of wear and tear of net pens (cages), through storm damage, collisions, malicious human attacks, or from predatory animals or birds. Unlike at land-based sites, escapes through over-flooding are not a problem with floating cages. Escape incidents must now be reported to Fisheries Research Services (FRS), the responsible Scottish Government agency. This year, Scottrout Farming Ltd reported an escape at Loch Tay of 1000 rainbow trout averaging 15g (0.5 ounce), having occurred on 5 July due to "equipment failure." Reports of unusually large numbers of pan-sized fish caught in the River Tay and the loch near Kenmore became common around and after the time of the reported losses from the farm.

The concern over escapes is two-fold. First, there is the possibility of an adverse ecological impact through competition with the wild fish or other fauna, or predation, or transmission of disease or parasites. Rainbow trout in the wild have much the same range of diet as other salmonid fish and consume a wide range of invertebrates of aquatic and windblown terrestrial origin, or smaller fish. Rainbows that escape from cage farms disperse quite widely, although some may linger in the vicinity. A study on escaped rainbow trout that was carried out by FRS at nearby Loch Earn and the upper River Earn, where there were also a further two fish farms, is downloadable from the FRS website (http://www.marlab.ac.uk/Delivery/Information_resources).

In this study by A F Walker (2004), 215 rainbow trout covering a size range of 122-456 mm fork length were sampled by netting and angling in Summer 2002 to Spring 2003. All of these fish were of farmed rather than wild origin, based on fin erosion. Of the sample, 99% were aged 1+ or 2+, indicating only short-term survival at liberty. They had eaten mainly invertebrates, but also a lot of indigestible material, including sticks and stones and they were declining in condition. One fish contained a large minnow but there was no evidence of widespread piscivory. Based on electro-fishing, the densities of salmon and trout fry and parr appeared to be normal in burns and the main river close to fish farms on Loch Earn and the River Earn. Also, there was no evidence of successful reproduction of rainbow trout in the wild in this study. Sampling of the escaped rainbow trout and wild fish found with them was carried out for disease examination and the results were negative for important viral diseases (IPN, sleeping disease). Consequently, there was no evidence of adverse ecological impacts of escaped rainbow trout although it was recognised that these would be difficult to detect and quantify.

The second concern over escapes is that they attract large numbers of anglers who will come to target these fish and then place extra pressure on the stocks of wild trout in the fishery. The form of angling that they pursue is akin to coarse fishing and often involves the use of fixed rods with baited swim-feeders, or bubble floats, with maggot

or powerbait. The local Kenmore clubs and many of the riparian owners around the loch do not want a replication of the intensive fishery that has developed at Loch Earn. The following paragraphs are extracted from the above report by Walker (2004).

"The unplanned release into Loch Earn of large numbers of alien rainbow trout undoubtedly adds to the economic value of the sport fishery by attracting anglers. Large numbers of visiting boat and shore anglers catch many escaped rainbow trout and large, stocked brown trout. Smaller, wild brown trout and some charr also are caught. Most of the boat anglers seem to concentrate their efforts near the fish farm cages, whereas the shore anglers can be found all round the loch. Fishing for migratory fish is of minor consequence. In the river, by contrast, salmon and sea trout provide the main sport fishery, although brown trout and grayling are important too. There, the intrusion of large numbers of rainbow trout is seen as a distinct nuisance by some fishery owners and their managers, but just something else to fish for by others. Occasional large brown trout that are stocked in Loch Earn also find their way into the river, but these fish appear to cause less concern, perhaps because they are regarded as native fish, even though they are not of local origin.

In an interesting parallel situation in England, a court case concerning escapes of rainbow trout on the River Kennet was heard at Swindon County Court in 1993. The case was taken by the Savernake Flyfishing Club against a fish farmer (Gale and Ainslie Ltd) for damage caused by negligent escapes of rainbow trout into their brown trout fishery. No attempt was made to quantify the effect of the escaped fish on the existing brown trout and grayling population. The main point at issue was that the escapes were unwanted and reduced the enjoyment of the fishing club. Nuisance damage was proven for inconvenience, loss of amenity and enjoyment and the sum awarded was £10,500. Damages were based on a proportion of the total annual value of annual fishing membership charges (@£500 per rod) in the most affected year, plus an amenity factor of 50% representing loss of enjoyment.

It is possible to envisage a similar court action being taken in Scotland, although the outcome would depend on local circumstances. It will be interesting to see how escapes will be dealt with under the terms of the Water Framework Directive (WFD), which will increasingly impact upon the management of river catchments and ecosystems. The level of escapement of rainbow trout from fish farms and fisheries should be controllable, even if the arrangements for retention of the fish may need greater care and resourcing."

New fisheries and aquaculture legislation is pending which should have an impact on cage farming operations. An update on the situation is provided by Paul Haddon, from Aquaculture Policy, The Scottish Government:-

"In 2006, the Aquaculture & Fisheries (Scotland) Bill was introduced to Scottish Parliament and proposed legislative powers to eradicate bad practice. It was aimed at being a 'backstop' to the measures in the industry Code of Good Practice, particularly on sea lice and escapes, to ensure that farms who could not, or would not, sign up to the Code, would nevertheless have to adhere to certain minimum standards. The Aquaculture and Fisheries (Scotland) Act 2007 was passed by the Scottish Parliament on 01 March 2007 and came into force in August this year.

Amongst other things the 2007 Act makes relevant legal powers and provisions in relation to marine and freshwater fish farms for containment and fish farm escapes. Under Section 5, the 2007 Act gives inspectors powers to inspect to ascertain the risk of escape, whether fish have escaped and assess the measures in place to contain, prevent escape and recover escaped fish. If inadequacies are identified which are not voluntarily fixed then an enforcement notice can be served. Under the powers of the new Act, not having suitable measures in place to contain fish (e.g. poor quality nets) will be an offence. Section 6 of the Act provides for the serving of an enforcement notice. Failure to comply with an enforcement notice is an offence.

Now that the 2007 Act is in place further work is required to ensure we are able to use all the powers it will give and fully implement the Act; for example to conduct an inspection and/or issue an enforcement notice under sections 5 and 6 of the Act. It is intended that the Code of Good Practice will form the standard against which all fish farm sites will be measured in relation to containment. It is expected that the inspectorate will follow a risk-based approach and that companies with a history of escapes would probably feature on any set of objective risk criteria.

Work is now underway to establish Fisheries Research Services (FRS) as the Inspectorate for containment and sea lice under the Act. Scottish Government including FRS is currently developing the necessary inspection guidance and working with Scottish Government to design enforcement notices and to qualify specific containment and sea lice recording requirements against which inspections will be conducted. This work is underway through the Ministerial Working Group on Aquaculture and the Aquaculture Joint Health Working Group and will be consulted upon. FRS will also take on the role of reporting body, where a company has failed to comply with the requirements of The Registration of Fish Farming and Shellfish Farming Businesses Amendment (Scotland) Order 2002."

3.0 RECOMMENDATIONS

Mark Bowler was keen that a survey should be carried out at Loch Tay and the outgoing River Tay at Kenmore to act as a baseline for detecting gradual changes and potential ecological deterioration. There could be a number of different specialisms involved, including water chemistry, phytoplankton and zooplankton, benthic invertebrates and fish. Ideally, SEPA would carry out this work as the Government agency charged with maintaining aquatic ecological standards. However, SEPA has to prioritise its work programme and is believed currently to have no further plans to monitor the water quality and ecology of Loch Tay. No doubt they might carry out repeat benthic impact surveys at the cage sites from time to time. However, a request could be made from the angling clubs at Kenmore, or concerned riparian owners, for SEPA to undertake a more comprehensive study to monitor the ecological status of the loch and outflowing river. The clubs and other affected owners should at least ask SEPA for their assessment of the polluting and enriching impacts of rainbow trout farming in the Kenmore area. Further, representatives from the clubs should contact the local fish farm manager to explore their concerns directly. Often fish farmers are in possession of a lot of background information for their sites and, if asked, will freely discuss these and explain the regulatory controls under which they operate. The meeting also would provide an opportunity to hear about any practical measures that are being taken, or are planned, in order to detect and minimise further escape incidents.

4.0 DISCLAIMER

This report is produced for guidance only and should not be used as a substitute for full professional advice. Accordingly, no liability or responsibility for any loss or damage can be accepted by Windrush AEC Ltd as a result of any person, company or other organisation acting, or refraining from acting, upon comments made in this report.

APPENDIX I

Area/Team: **Perth / Ecology** **Code:** **F010**

LOCH TAY FISH FARM BENTHIC SURVEY 2002

Action Plan Manager: Ian A. Lorimer

Contributors: Robin Guthrie, Bruce Campbell

Date of Report: 26/03/03

Summary

Grab samples were collected from around Remony fish farm on Loch Tay in order to assess it's current impact on the benthos of the Loch. Acute enrichment of the sediment was found in close proximity to the farm, with considerable impact on the benthic fauna to a distance of around 25m from the cages.

Purpose

As a potential source of enrichment to Loch Tay, a relatively un-impacted Oligotrophic loch, the fish cages near Remony Point are monitored annually by SEPA.

After signs of increasing impact, the operators of the farm decided to leave the site fallow in 1997. Restocking of the farm commenced in summer 2000 and new cages were installed in deeper water in addition to the cages at the original location.

The benthic assessment survey was carried out as per previous years to monitor the condition of the sediments around the fish cages.

Previous Investigations

Previous surveys, dating back to 1992, have indicated considerable benthic impact from uneaten food and faecal matter directly below the cages with a slight but detectable effect to a distance of at least 25 metres. The surveys carried out in the years following cessation of production, (1997), continued to show high levels of contamination in the sediments close to the cages although gradual improvement was observed.

Results of the 2000 and 2001 surveys showed continued localised impact.

Approach

Samples were taken on the 29th October 2002 from six sites which roughly corresponded to those used in the previous studies (see figure 1), with sites 5 and 6 acting as controls.

A van Veen grab was used to collect 0.02m^2 portions of the loch bed. Samples were brought back to the laboratory where they were preserved in buffered formalin and later counted and identified to species level where possible. As with previous surveys the Oligochaete Abundance Index was employed. This classification system takes into account the numbers of worms commonly found in unpolluted oligotrophic lochs and compares them with the abundance of worms taken from around fish cages. The classes range from A to E, with A representing clean, unpolluted conditions and E severe disturbance. Worm numbers increase with increasing nutrient content in the sediments and species composition will also be altered.

It should be noted that a drawback of this index is that it can misclassify sites which are extremely polluted. The production of anoxic conditions in the sediments at such sites causes a crash in the worm population and the site will be afforded an erroneously high classification because of the low worm abundance.

Sampling and analytical results

Table 1. Invertebrate abundances per grab sample - Loch Tay 29/10/02

	Station Number											
	1		2		3		4		5		6	
Invertebrates	a	b	a	b	a	b	a	b	a	b	a	b
Oligochaeta	1266	3008	33	24	786	130	120	13	7	5	7	3
Chironomidae	24	24	48	16	76	56	42	8		6	3	4
Sphaeriidae			7		4	1	7					
Hydrobiidae			1		2	1				1		
Polycentropodidae				1								
Lymnaeidae		1										
Glossiphoniidae	2			1		1						
Leptoceridae									1			

Table 2. Oligochaete Abundance per m^2 - Loch Tay 29/10/02

	Station Number					
	1	2	3	4	5	6
Oligochaeta	106850	1425	22900	3325	300	250

Table 3. Oligochaete Species Composition per site - Loch Tay 29/10/02

	Station Number					
Species	1	2	3	4	5	6
Aulodrilus pluriseta		3	13	3	5	4
Spirosperma ferox				2		1
Limnodrilus sp.	2	1	10	5		
Limnodrilus hofmeisteri	1		1			
Lumbriculus variegatus		2	3	3		
Tubificidae indet. (Gp.3)	33	5	10	12		
Tubifex ignotus				1		
Chaetogaster diaphanus	24	1	1	4		
Slavina appendiculata	4	6	14	6		
Nais variabilis	3		1			
Specaria josinae		13	4	4		
Vejdovskiella comata		5	13	5		1
Stylaria lacustris	1					
Piguetiella blanci			2		4	4
Ophidonais serpentina	2		1			
Uncinais uncinata			2			

Data analysis

Table 4. Oligochaete Abundance Index classes for all Loch Tay fish farm surveys.

DATE OF SURVEY	Station number					
	1	2	3	4	5	6
17/9/92	B	A	B	A	A	A
23/9/93	C	B	B	A	A	A
21/12/94	D	B	B	B	B	A
14/12/95	C	B	B	A	A	A
15/10/96	B	C	B	B	A	A
17/12/97	D	B	A	B	A	A
23/9/98	C	B	B	B	B	A
11/11/99	B	B	C	B	B	B
07/12/00	A	B	B	B	A	A
03/12/01	D	D	C	B	A	B

29/10/02	E	C	D	C	B	B

Key to classes

A <200 worms ; B 200 - 999 ; C 1000 - 9999 ; D 10000 - 99999 ; E > 100000

Discussion

Oligochaete abundances at site 1 were extremely high and have deteriorated by another OAI class from last year's survey. The most abundant species were of the family *Tubificidae (group 3*- probably *T. tubifex)*. These worms are known to be intolerant of competition, surviving only in organically enriched sediments where less pollution tolerant species are excluded. A raptorial species of the family Naididae (Chaetogaster diaphanous), not normally found here, was also a dominant component of the fauna.

Oligochaete abundances at sites 2, 3 and 4 were also greatly elevated from those found at the control sites (5 and 6) although numbers at site 2 are somewhat lower than those found at site 3 (both 25m, see fig.1).

The species of worms present at these sites, along with the highly elevated abundances, show a considerable shift from the normal fauna of an oligotrophic loch bed. Abundances of Chironomid midge larvae were also significantly higher than at the control sites.

Conclusion

The benthic layer directly underneath the area of the fish cages remains contaminated by waste food and faecal material and appears to have deteriorated markedly since last years survey. This pollution is causing a major shift in the natural faunal community, an effect which can be observed out to a distance of approx. 35m.

Resumption of production at this site has rapidly returned the loch bed below the cages to a grossly perturbed state. Sustainability of this type of operation would thus appear to hinge on the ability of the operator to minimise the net input of nutrients to the loch.

I. A. Lorimer (Ecologist)