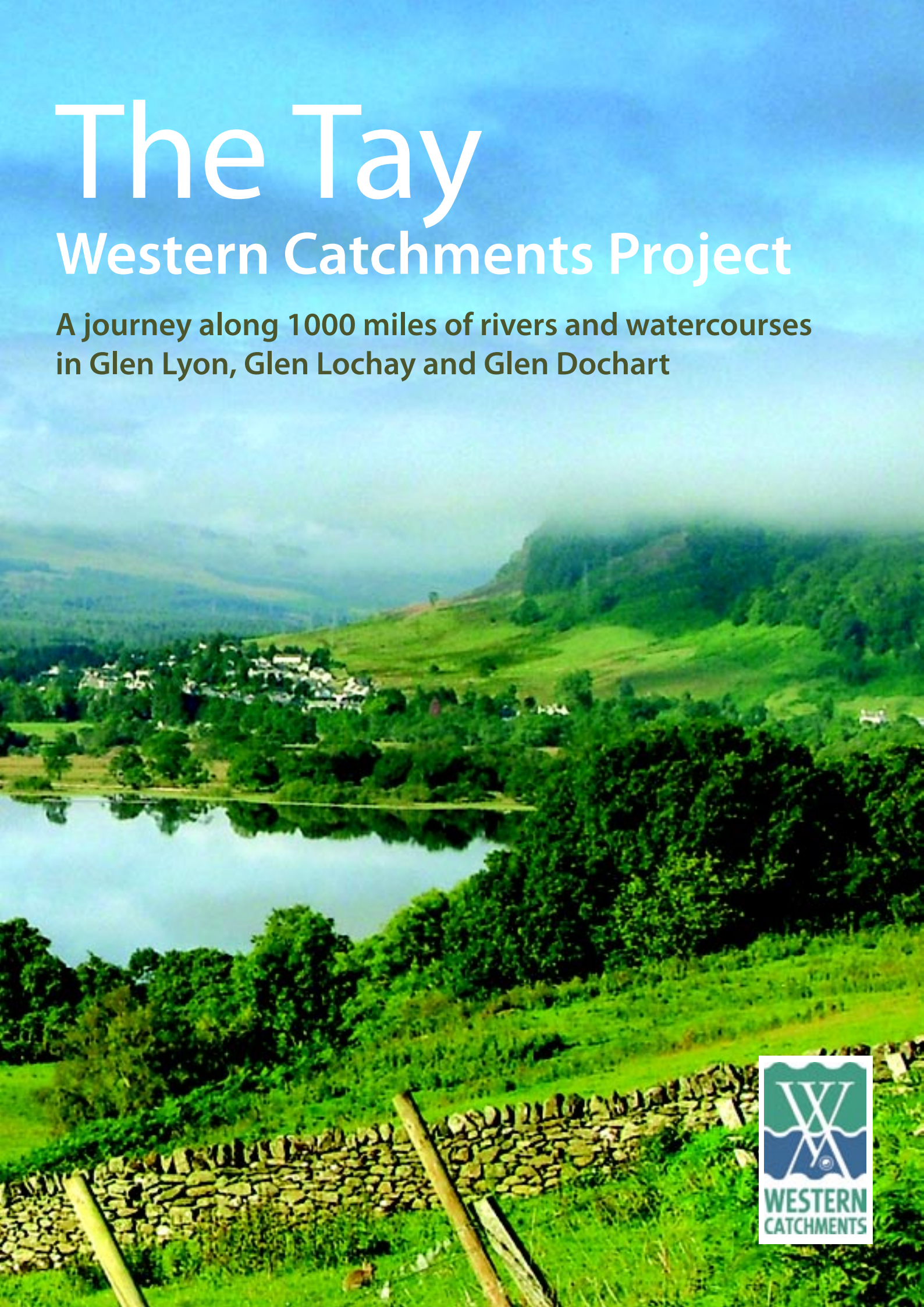
The Tay

Western Catchments Project

A journey along 1000 miles of rivers and watercourses in Glen Lyon, Glen Lochay and Glen Dochart



Acknowledgements

Any significant project of this nature and scale can only take place with the genuine help and commitment of a large number of people.

The Tay Western Catchments Project was guided by:

Angus Stroyan	Glen Lochay (Chair)
Alastair Riddell	Glen Lyon Salmon Proprietors Group
Emma Paterson	Dochart catchment
Jock Monteith	Tay Ghillies Association & Inchewan Burn Project
Alex Stewart	Tay Liaison Committee & Killin/ Breadalbane AC
John Apthorp	Tay District Salmon Fisheries Board
Dr David Summers	Tay District Salmon Fisheries Board

This project steering committee met at regular intervals to oversee delivery of the survey effort. Recognizing the number of other interested organizations in this field and the politics that often arise from this, a conscious decision was made not to constitute the group.

Within Scottish Native Woods, essential support has been provided by Gordon Gray Stephens, Alison Mitchell, Dianne Laing and John Parrott.

The actual survey work required communication with many landowners, agents, employees, agency staff and other interested groups. During the course of the survey effort, nothing less than full and enthusiastic support was received from all those contacted across the three main glens involved.

David Marden and Andrew Warwick of the National Trust for Scotland at Ben Lawers kindly helped us in the initial training period, in particular with the identification of montane willow scrub species. Helen Gray from the Cairngorms National Park Authority helped us refine our water vole survey protocol in 2008.

In addition to the author of this report, the majority of the survey work was carried out by Gordon Wilson, Neil Wardman and Adam Baxendine.

They were helped for a short period at the outset by Laura McAuley and James Nicol. Sally Argo and Richard Turner helped survey the main stems of the Dochart and Lyon by canoe in 2008. Around twelve percent or 120 miles of the total survey work was completed using volunteers.

Details relating to the funding of the project are discussed in the main text. Suffice to say that a very great many people and businesses contributed to and supported this project from the outset and without them, such an undertaking could never have been contemplated.

Thank you to everyone.

Victor Clements

Highland Perthshire Area Manager
Scottish Native Woods

September 22nd, 2010

Contents

Foreword

This report details the findings of an extensive survey of one thousand miles of rivers and watercourses in the western catchments of the Tay river system.

The objective of the survey was to illustrate a range of issues affecting the catchments of the rivers Lyon, Lochay and Dochart; to quantify and cost a series of projects that might remedy some of the problems encountered and to provide opportunities for wider community involvement.

The purpose of this document is to:

- Provide an accurate, up to date account of the wider natural environment within these three glens
- draw attention to what we believe are the priority areas for intervention for both public and/or private investment
- discourage unnecessary investment in lower priority or "tick-box" projects
- encourage a genuine catchment scale approach to management of resources and to make sure that projects are strategically co-ordinated
- provide information and ideas for inclusion in the Tay River Basin planning process and the Tay District Fisheries Management Plan
- provide our many funders with a clear insight into the issues present in the symbolic headwaters of the Tay

The Roman Bridge, Glen Lyon

- stimulate interest, enthusiasm and a sense of direction in addressing all of the above.
- encourage communication and participation in the evolving local good steward ship programmes by elements of Government, Government Agencies such as SEPA, LLTNPA, and local utilities and water users such as SSE, inviting their participation and contribution to projects and improvements.

The document is set out and illustrated so that it is hopefully easy to read and attractive enough so that it might be sold through local shops, fishing huts and angling clubs to provide funds for further project works on the Tay.

The information gathered across one thousand miles is extensive and no-one can say that we do not now know these glens very, very well.

Being constrained by space within this publication, summary statistics are given in relation to each of the subject headings and directions given to where the more detailed data can be accessed.

We hope you find this publication of some interest. ❖

The Tay Western Catchments logo

The Tay Western Catchments Project logo was designed by Stephen Cameron, a graphic designer from Glasgow. Very simply, he asked what our project was about, who our target audience was and how we anticipated using the logo in the future.

The logo was produced and received back in less than an hour from the necessary details being forwarded. No further communication was required from either party.

The "W" stands for "Western", "Water" and "Work". The work that you do on the land is reflected in what happens in the water.

If you look closely at the "W" in the water, from the side, you will see that this also resembles the head of a fish, our barometer of water quality in the Tay Western Catchments area.

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Executive summary

The tributary rivers of the Dochart, Lochay and Lyon form the symbolic headwaters of the River Tay. The communities that live along the Tay have strong economic, environmental and historical ties with it. The Tay river system is the most extensive in Scotland and much of the area's native woodlands and wider biodiversity is associated with these tributaries.

Salmon and freshwater angling are crucial to the economic well-being of the area and as fish are an important indicator species, their current health or otherwise provides a useful barometer on wider biodiversity and water quality.

In July 2007, Scottish Native Woods launched the Tay Western Catchments Project (TWCP), Phase One of which was to survey over 1000 miles of rivers and tributaries in the three glens gathering information on habitat quality and wider biodiversity. The outcome of this will help identify and quantify projects which could rectify any problems encountered and thereby maximize the value of the great biodiversity already present.

Although managed by Scottish Native Woods, the Tay Western Catchments Project is not wholly concerned with native trees and woodlands, nor is it a fishing project as such, this being too narrow a perspective to engage potential future stakeholders.

The Tay Western Catchments Project is:

- A catchment-scale environmental project based in the western part of the Tay system
- a project looking at a range of habitats and species, integrating a number of land uses within the area
- a project that will provide future opportunities for ghillies, fishermen and other interested groups within the local community to get involved in riparian conservation work
- a means of identifying suitable projects for these groups to get involved with.
- a project centred on the riparian habitats in the area, but recognises that it is management of the surrounding land that dictates the health of these habitats.

Such an approach will complement the ongoing process of river basin planning and will help contribute to local obligations of the Water Framework Directive. A project with a strong local mandate will ensure that local aspirations and concerns will be represented from the outset of this process.

The survey covering the 1000 miles of watercourses took place over two summer and autumn seasons, finishing at the symbolic source of the Tay on Ben Lui on 10th December 2008.

The purpose of this report is to raise the profile of the area concerned, underline the strategic importance and diversity of wildlife associated with these glens and set out a series of projects which we believe should be addressed in a systematic and co-ordinated manner. Its sets a tone for improving stewardship across the district with an underlying outcome to improve runs of salmon into the headwaters of the Tay System, and to improve angling more generally.

The report details how we went about organizing the work and its limitations. it Is a document designed to highlight core issues. It is set out to be non-technical and easy to read and is interspersed with invited articles from organizations operating in the area to develop the overall context of the report. It includes a variety of photographs and other illustrations to make it as attractive as possible to a wide range of potential readers.

Whether you are familiar with the area or not and whatever your particular interests, we hope you find this document a worthy account of this wonderful area in 2010.

Strategic recommendations

Based on our survey work and contacts that have been made during this project, we set out the following actions as being the priority considerations in the western catchments of the Tay.

1 The organization of fisheries management within the Tay catchment

Fisheries and river management within the Tay district is highly factional and this impacts upon the ability of any one organization to effectively forward projects and gain the confidence of their membership.

- A more effective delegation of responsibilities and functions, a process already started, involving the Tay District Salmon Fisheries Board, Tay Foundation, the Tay Liaison Committee and Tay Ghillies Association, must be completed during 2010. Such structures should facilitate communication with all other local groupings, be they fishing or wider community groups, or Agencies of government. Existing lines of communications need to be strengthened and structures developed to allow for co-ordinated delivery of riparian projects.

- River Basin Management Planning on Tayside is not yet engaging landowners or local communities in any kind of meaningful manner. While legal commitments might be being met at a government and strategic level, this process has completely

bypassed communities in this area and this will ultimately undermine the implementation of the Water Framework Directive (WFD) unless this issue is addressed. This process must become more locally applicable if it is to become accepted, or become effective.

Proposed Action and Recommendation 1:
Tay District Salmon Fisheries Board to convene a meeting of all interested parties or their representatives to examine these issues further with a view to considering devolving some aspect of RBMP to a much more proactive and meaningful riparian level, perhaps by engaging locally and inviting more participation in the process from Government eg, SEPA, SNH, etc.

2 River Wardens in the headwater catchments

To facilitate this process, strengthen communications and deliver a wider scope of environmental and rangering outputs, we are recommending the local deployment of four river wardens, employed by the Tay Foundation. The likely annual cost of this will be c£150,000. This report will be used to try and finalize such a funding package. The emphasis of this proposal will be to ensure a more cost-effective overall solution, not to add in extra costs in an unsustainable manner.

Proposed Action and Recommendation 2:
The Tay Foundation to engage with respective funders and supporters seeking suitable sustainable funding.

3 Addressing water abstraction and quality issues on the Lochay and the Lyon

Under the current WFD planning cycles, water abstraction issues on the River Lochay will not be addressed until 2027.

The classification that the Lyon is at Good Ecological Potential is highly vulnerable to challenge and should be questioned and over-turned to allow further research and mitigation to be forwarded.

Third party lobbying has been shown to be effective in these matters. As the non-governmental organization with greatest expertise in this area, TDSFB should co-ordinate all future third-party involvement, within an agreed structure to make River basin management more applicable locally in this area.

To wait until 2027 to address these two important issues would be a failure of good stewardship by all involved. Clearly these timeframes are wholly and totally unacceptable. These two matters now need urgent action and attention.

Proposed Action and Recommendation 3:
A committee led by the Tay District Salmon Fisheries Board and other angling interests, including representatives from the upper catchments (principally Lochay and Lyon but also Dochart), SEPA and involving SSE should be formed to address these issues now, develop a plan for improvements, and raise the necessary support to implement change in abstraction and physical structures as well as oversee riparian/fisheries stewardship schemes in the headwaters.

4 A better system of collaborative working

The Scottish Rural Development Programme (SRDP) must be streamlined to allow local collaborative projects to take place with less bureaucracy and expense. Effective invasive species control, among other projects, will be put on hold until this is addressed. Current requirements for demonstrating collaboration are too restrictive, and catchment-scale initiatives will never progress until current issues are resolved.

Proposed Action and Recommendation 4:
A project manager should be funded to develop a pilot mechanism for delivering better collaborative projects in this area. Appointed by TDSFB and associated interests in the upper catchments, to develop the necessary changes required in conjunction with the two local RPAC committees and co-ordinate and bring together the more holistic projects required in each of catchments to work towards improving the community involvement/access, riparian and wider environmental issues.

5 Stimulate Local Demand for timber products

Habitat problems relating to woodlands in all the Catchments, (especially the Dochart catchment) are best addressed by stimulating local demand for woodfuel, this being more cost-effective and sustainable than non-commercial woodland management that requires continual grant funding. A feasibility study, probably costing £35-40,000 should be given immediate priority.

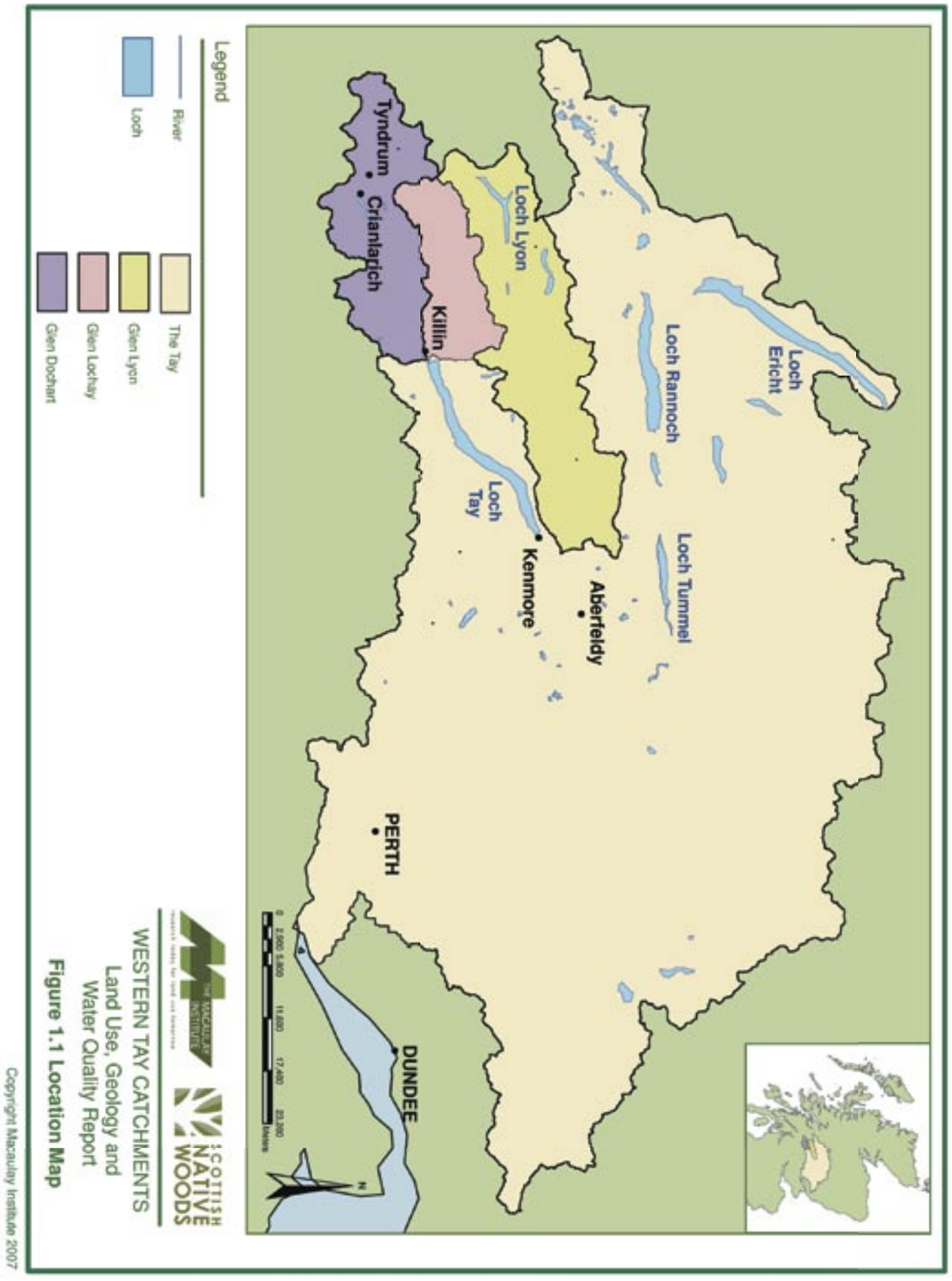
Allied to this, all woodland holdings within the wider area should be encouraged to sign up to an appropriate Forest Plan with riparian management featuring among the essential priorities.

Proposed Action and Recommendation 5:
Statement 4/5 continues with its themes and recommendations for a holistic and co-coordinated approach in problem resolution. Appoint a Project Manager, with the understanding of, and capable of dealing with Recommendations 3,4 and 5.

6 Develop a training and education delivery and support structure for the Tay river system

To develop local capacity to undertake and monitor further project work in future, administered by the Tay Foundation.

Proposed Action and Recommendation 6:
The Tay Foundation to accept this challenge and develop the necessary scope, support and scale. ❖



The Tay Western Catchments Project

Background

The TWCP project came about simply because Scottish Native Woods had existing clients on the Dochart system and in Glen Lyon who were interested in riparian issues and some thought had already been given as to how a significant catchment scale conservation project might be initiated. Independent of these sites, contact had been made with fishing interests further down the Tay, particularly at the Inchewan Burn site at Birnam and a wider picture regarding riparian issues on Tayside was beginning to emerge. Experience had also been gained through the Middle Dee Project over the period 1997-2006. Over and above these contacts, a number of smaller scale catchment projects had been undertaken elsewhere by others and valuable lessons learned from these.

From January to May 2007 considerable time was spent liaising with riparian owners and angling interests, both within the area concerned and more widely. Careful consideration was given to what kind of project might actually be in demand in the area concerned.

It quickly became apparent that a native woodland project was not going to arouse much enthusiasm, although landowners had an obvious connection with their native woodlands, both in their own right and as a symbol of a healthy environment. What was going to engage people was the fishing interests, both within the three glens and on Tayside more generally.

While the Tay is one of the top four salmon rivers in Scotland (many would say that given its size it should be THE best) providing some of the best salmon fishing, it also caters extremely well for local anglers fishing for salmon and a range of freshwater species eg. brown trout and grayling.

Fishing permits are widely available at low cost. This is made possible under the terms of the Tay Protection Order which is policed by local angling clubs and the Tay Liaison Committee (TLC).

Salmon in the western catchments are now reduced to very low numbers compared to the pre-1990s. This is highly detrimental to Tay salmon fishing as the western catchment area is where a very large proportion of the Tay's most sought-after spring salmon run originate. Returning adult fish must navigate the entire main stem river and Loch Tay in order to return to these historic Tay salmon headwaters, creating a benefit to all Tay economies through the highly lucrative influx of fishermen from all over the UK, Europe and the rest of the world. If these fish are not there in sufficient numbers, and at present they are not, then the whole river suffers. This much has been known for some time by all who remember the relative abundance of wild salmon in these headwaters less than two decades ago.

Salmon also serve as a good indicator species for the viability of other fish species and riverine habitats. The Tay Liaison Committee's evidence, for example, shows that other fish in the Western Catchments are also in decline. Brown trout have reduced in quantity and quality, Arctic char have become locally extinct and are threatened elsewhere and eels, which were once commercially harvested and are now in major decline, are no longer fished for. Pike are locally important.

There was no question that an appetite for addressing some of these issues existed across a wide range of interest groups.

Achieving a mandate to become involved was the most important factor going forward. Internal and wider experience has shown that catchment-wide riparian habitat projects are notoriously difficult to get off the ground. The agenda of the organisation initiating proceedings is often questioned and very often riparian schemes comprise a number of small, unconnected projects which do not address the real priorities in a catchment and fail to tackle the bigger picture. For this reason, a small project management committee was put together to guide and advise on how things might be progressed.

Funding for riparian projects is given considerable priority and a number of organisations such as the Loch Lomond & Trossachs National Park Authority(LLTNPA), Tay Ghillies Association (TGA) and Tay Liaison Committee (TLC) are willing to help riparian projects and Scottish Natural Heritage (SNH), Perth & Kinross Council (PKC) and a range of private trusts all have commitments to habitat restoration. From 2008, the Scottish Rural Development Programme (SRDP) and the Restoration Fund administered by SEPA also became available. However, suitable projects in the Tay Western Catchments area were extremely slow to come forward and were certainly not doing so in any kind of structured manner.

Scottish Native Woods proposed that Phase 1 for the Tay Western Catchments Project was to survey 1000 miles of watercourses in the catchment areas, quantifying and mapping the existing habitat quality and identifiable problems and to draw together a comprehensive but succinct report which will set out and cost those actions required to deal with the issues identified. We wanted to bring that bigger picture firmly in to focus.

Role of Scottish Native Woods

Scottish Native Woods are a recognised charity and a non profit distributing organisation.

Scottish Native Woods would initially act as facilitator and the Project Manager, working on behalf of the committee and would provide financial and administrative back-up as required and handle all enquiries about the project.

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  Further information about the Tay Western Catchments Project can be found at:
  http://www.scottishnativewoods.org.uk/index.asp?lm=60

  A blogsite, http://taywesterncatchments.blogspot.com was also established to host articles, photographs and videos relating to the project. During the survey, this was updated on a daily basis and it now has nearly 4000 posts.

Strategy

By June 2007 it had been established through consultation that there was indeed a demand for such a project locally and individuals had been identified who would represent the various interests involved. It was not however apparent what the issues were going to be and while the various agencies were, in theory, sympathetic to the idea, they too were obviously not sure what issues would emerge, how they may be able to contribute to the project, or what the capabilities of such a group might be.

With the support of the main local interests it was decided to begin by surveying Glen Lochay, the smallest of the three glens, as a pilot which would then be written up as an interim report on which further consultation could be made. The interim report would allow closer focus on specific problems and highlight issues which were not yet identified, although a number of these could be anticipated at the outset.

To this end the Tay Western Catchments Project was launched in July 2007, with coverage on BBC Reporting Scotland, Radio Scotland and in many national and local newspapers and magazines. Media coverage was stronger than anticipated. We had indeed come up with an idea which was of interest to people. The pilot survey took place in Glen Lochay and a proportion of the Dochart catchment in 2007, the interim report was published in December and was consulted on through to April 2008. A number of minor changes were made to the survey protocol, the survey effort re-commenced in June 2008 and, due to the exceptionally wet summer finished later than expected on 10th December.

The final outcome of Phase 1 of this project will be to produce this '1000 mile report' on the health of the riparian resource in the three glens concerned, to identify and devise means of addressing the issues and to influence policy makers over strategic decisions that would benefit the environment and also the rural economy in this part of Highland Perthshire. With the new Scottish Rural Development Programme (SRDP) and the river basin planning system only now becoming established, the timing for this is excellent.

Strategic objectives

1 Economic
Enhanced salmon, trout and other freshwater fish stocks will increase the number of fishing visitors thereby protecting and creating jobs. Increased economic activity will have positive spin-off benefits to Tay Valley businesses. We will seek to influence policy directing payment of future RDC grant money in Highland Perthshire, supporting and expanding those rural enterprises which can make a contribution to a genuine and sustainable local rural economy.

2 Environmental
Improving the riparian habitat for salmon and trout will also benefit native flora and fauna in the wider area, the tributaries and burns having a key role as wildlife corridors. There will also be landscape, amenity and access benefits.

3 Sporting
Fishing throughout the Tay system will be improved which will also benefit the local economy by encouraging further tourism and investment.

4 Compliance with Water Framework Directive
This major piece of European legislation, which is already being implemented in Scotland, will soon dominate how river catchments are managed and will encourage catchment scale thinking. This community-based project will ensure that local interests are represented from the outset and fully considered as work on the Scottish River Basin District is taken forward.

Fundraising and publicity

The project was primarily privately funded with donations being received from local ghillies and fishermen as well as employees from other river systems, local hotels and other businesses, riparian owners, angling clubs, the Tay Ghillies Association, private charitable trusts and other interested individuals. This private funding allowed us a level of flexibility to develop the project that would not have been possible had we been totally dependant on public funding and the many conditions that might be attached to that. Indeed, during the period of the work, many such sources were not available, pending the development of the Scottish Rural Development Programme.

Limited public support was also provided through the LLTNPA Natural Heritage Grant Scheme. Scottish Natural Heritage contributed to core costs of Scottish Native Woods during the project development process along with input from European Objective 2 funding.

The public support and applications to private charitable trusts was co-ordinated by Scottish Native Woods. By far the greater part of the private funding was achieved through the efforts of Newtyle head ghillie, Jock Monteith

Duncan Glass of the Tay Ghillies Association presents us with a cheque. Judge Stroyan of Boreland House (right) acted as chair of the TWCP committee. Author of report (left).

Well known wildlife artist Alistair Makinson made prints of Tay beats available for raising funds. These were advertised through FishTay & fishing huts.

Eric Paterson, Free Presbyterian minister from Golspie won our photographic competition on the "74" board, part of the prize being a day on the Tay at Dalguise with clean living Celtic fan and Tay ghillie, Stan Pelc.

but significant funds were also forthcoming from freshwater fisheries interests in the west of the district. The internet salmon fishing sites, Salmon Fishing Forum and Salmon Pro-boards (aka the "74") helped make a significant contribution through online auction sales of equipment, organizing competitions and overall publicity.

The final cost of the project was just under £68,000, less than the original £73,000 budget.

A breakdown of the overall funding package is as follows:

National Lottery Awards for All	15%
Private charitable trusts:	20%
European Objective 2 Funding:	10%
LLTNPA Natural Heritage Grant Scheme:	7%
Private and business donations (including angling clubs & Tay Ghillies Association)	48%

We are grateful to the following individuals and organisations who immediately recognized the importance of such a project to Tayside in general and to Highland Perthshire in particular, and were willing to register their support from the outset. We believe that this represents a diverse and genuine range of stakeholders and that this wide ranging support will be significant in taking the project forward in future years.

Funders are listed in order of their making contributions to the project. Each contribution was acknowledged by an individual stakeholder certificate.

Tay Western Catchments Project funders

Jim Reid, John Irving, Nigel Passmore, Kenny Reid, George Mason, Perthshire FWAG, Neil Tong, Rob Woodford, The Tay Ghillies Association, Major General Charles Ramsay, Mr A Greene, Colin Tait, Stan Pelc, Tony Black, Ian Redford & Gordon Mitchell of Gordonian Fishings, Royal Hotel Dunkeld, Grev Humphrey, Charlie MacDonald, D'Oyly Carte Charitable Trust, Simon Jones (Quales Pitlochry), Jock Monteith, The Tay Liason Committee, Killin/ Breadalbane Angling Club, Cromlix House Hotel, East Haugh House Hotel, James Leeming (FishScotland), Dunkeld Smoked Salmon, Dan Heath, Nick Bailey, Alan Rennie, Iain Quinn, PD Malloch (Perth), Ross Macdonald, Robin Barbour, Simon Furniss & Jim Ferrie of Dunkeld House Fishing, Simon Ramery, James Duffield, Denzil Onslow, David Thompson, John McElroy, Paul Robertson, Jock Tait, Charlie Martin, John Sheward, Ian Calcott, Richard Quibell,, Arthur Muirhead, The Capercaillie Restaurant (Killin), Strathfillan Wigwams (Tyndrum),Mr W Gallaher, Mr N Gallaher, Heritage Lottery Fund Awards for All, Michael Sly, Allan Dunnet, Colin Dunnet, Mr RL Morgan, Upper Scone Fishings, Chris Andrews, Brian McAskie, Strutt & Parker, Ann Medlock, Adam Stork, David Brown, Mike McCall, Andy Robertson, Mike Walsh, West Loch Tay Salmon Fishers Association, Emma Paterson, Joe Gorman, Ian Arthur, Alastair Makinson, Angus Stroyan, Dr Michael Riddell, Summary Ltd, David Harrison, Bill Hoare, Tim Fison, James Duncan Millar, Andrew Mineyko, Wattie Barbour, Jack Mawdsley, Highland Adventure Safaris, Elaine Whewell, David Cant, Loch Lomond & Trosachs National Park Natural Heritage Grant Scheme, Meggernie Estate, Danvers Valentine, Gregor Nimmo, David Halliewell and Bill Robbins.

Although driven partly by circumstances, pursuing a privately funded project in Scotland is unusual because many people expect the government to lead on such issues and, indeed, government expect that they should lead on such issues. We were however aware from the outset that this strategy would give us flexibility, both in terms of exact outputs and timing. It also allowed us to follow our own agenda and not to have that dictated by others.

It is probably fair to say that throughout this project many Agency staff were supportive of the concept, but suspicious of the exact rationale or eventual outcomes. It is true of course that we did not try to anticipate the exact outputs that would be forthcoming, preferring to keep an open mind and record things as we found them, not as perhaps we might have been expected to find them. No conventional or government funder would have dared support such a cavalier approach, but the situation did demand it and others were happy to step up and support us.

Funding conservation projects through private funding is a very American concept and will only very slowly sink in to the Scottish environmental mindset. There can be little doubt however, that both individuals and businesses can be persuaded to support such initiatives if they can be shown how they will benefit, either directly or indirectly. Very many people immediately saw the opportunity presented.

The majority of investment in rural Scotland comes from private sources, not government grants. We sometimes forget that. Certainly, Government often forgets.

The Tay Western Catchments Project is a reminder that there are other ways of doing things, and that people will support such an approach if they see it will be in their interests to do so. It has also emphasized that catchment/ river management is primarily about managing people and their motivations, not managing fish or water or strategies or anything else.

The River Tay Special Area of Conservation

Special Areas of Conservation (SACs) are areas designated under the European Directive commonly known as the 'Habitats' Directive. Together with Special Protection Areas, which are designated under the Wild Birds Directive for wild birds and their habitats, SACs form the Natura 2000 network of sites. Most SACs on land or freshwater in Scotland are also underpinned by notification as Sites of Special Scientific Interest (SSSIs) although that does not extend to the River Tay SAC. The additional SAC designation is recognition that some or all of the wildlife and habitats are particularly valued in a European context.

Jock Monteith (right), Newtyle head ghillie helped us raise the major part of our private funding.

John Young, then Chair of the TGA, presents Jimmy Ross of Pitlochry Angling Club with a TWCP sponsored trophy for salmon conservation measures.

Publicity was paramount at the outset.

Alan Greene tied flies as competition prizes on the Salmon Fishing Forum.

The River Tay SAC extends throughout the three catchments including Loch Tay, and includes all those waters to which migratory fish can access.

It is designated for the following species:
Atlantic salmon *Salmo salar*
Brook lamprey *Lampetra planeri*
Otter *Lutra lutra*
River lamprey *Lampetra fluviatilis*
Sea lamprey *Petromyzon marinus*

In addition, the following habitats are also a qualifying feature:
Clear-water lakes or lochs with aquatic vegetation and poor to moderate nutrient levels

The River Tay SAC extends to over 9,000ha throughout the Tay system and is perhaps the most all encompassing and powerful designation within the Tay Western Catchments Project area.

Salmon and freshwater catch statistics in the TWCP area

Data relating to the migratory species (salmon and sea trout) is very comprehensive, with consistent information being gathered over many years.

Data relating to fresh water species is very much more fragmented, and no analysis is undertaken here. However, it is hoped that, as the Tay Protection Order is strengthened, information relating to freshwater species will be collated on a more consistent basis and this should then better inform fisheries management in the future.

TWCP salmon catch statistics, 1994-2008

These notes and graphs summarize the salmon catch statistics for the three TWCP rivers - Lyon, Lochay & Dochart - for 1994-2008. Figures for Loch Tay are also included and catches are also described in the context of the Tay system as a whole.

The data analysed here is subject to Crown copyright, used with the permission of Marine Scotland Science. Marine Scotland is not responsible for interpretation of data by third parties. While it can not be guaranteed, the data used is the best available and returns on Tayside are considered to be 95% or more accurate.

Proprietors with their primary salmon interests elsewhere on Tayside would be excluded from the sample. However, local knowledge suggests that this will not be the case to any significant degree. Some catch returns have been headed "Loch Tay, Dochart & Lochay rivers", with no way of apportioning numbers. However, these figures have only amounted to 3-8 fish in recent years and a maximum of 13-20 in 1994-96. They have been excluded from the exercise.

The available data allows a breakdown of spring, summer and grilse runs, average weights and Catch & Release (C&R) percentages. Weights and C&R rates are not described here due to lack of space.

In all the graphs data is presented as five-year running averages. So, for example, a figure in 1996 will be the average of 1994-98, 1997 will be 1995-99 and so on. This averages out peaks and troughs and allows trends to be shown more clearly.

The last year of data supplied was 2008. The 2008 data is therefore incorporated in the last five year average figure for 2006.

There are two sets of graphs. The first set of graphs compares the different components within each river and Loch Tay separately. The second set compare spring, summer, grilse and total salmon catches between each of the rivers and Loch Tay.

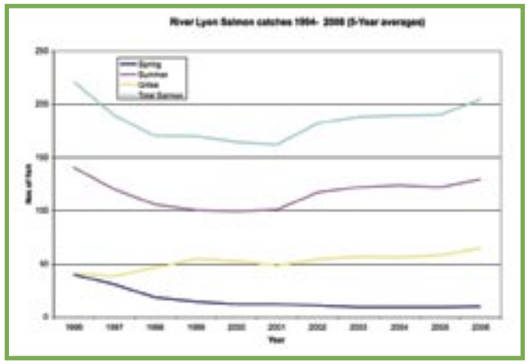
Finally, the graphs are somewhat simplified, because during the period when this information was collected - 1994-2008, there was NEVER a single salmon caught legally and reported on in the upper part of the River Lochay until 2007, other than the very small number which might have been included in the Lochay, Dochart and Loch Tay figures and have been excluded from the analysis. With a change in ownership in the upper Glen, this situation has now changed for the better, but numbers reported are extremely low, with only two spring salmon and six grilse being reported in 2008. Given that the Lochay was supposed to have been opened up to compensate for the loss of spawning grounds on the Lyon after hydro-abstraction in the 1950's, this is obviously a very significant issue and highlights the fact that a better accommodation is now required!

The spring season is defined as 15th January to 30th April. All later caught salmon are referred to as "summer" and grilse are distinguished separately.

There follows some brief notes on the graphs presented. It is worth noting throughout that the figures referred to are for whole rivers and the biggest loch in the Tay system, not for individual beats. The numbers involved are indeed very modest. Only the river Lyon contributes any significant number of sea trout, with 30 being recorded in 2008. The other areas did not record any at all.

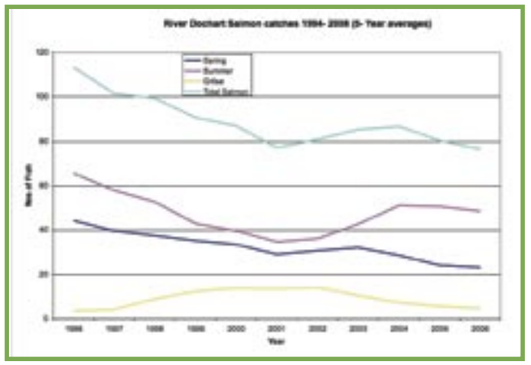
TWCP individual rivers

Lyon salmon catches



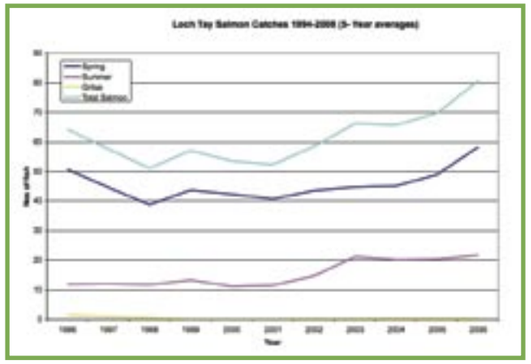
Total catches for the Lyon show a similar pattern to the Tay river system as a whole, with the average at the end of the period being only slightly less than at the outset. However, there have been changes in the fine detail. Spring salmon numbers have fallen very significantly, possibly by 60-75%, grilse numbers have increased. The pattern for summer salmon follows that of Total Salmon.

Dochart salmon catches



The Dochart shows a decline of approx 20% over the period in total salmon caught. Spring numbers are declining, but not as sharply as the Lyon. Grilse numbers were increasing for a period but then declined. However the numbers of fish involved is very small. There has been an almost 60% reduction in summer fish reported over the period, although increasing again in recent years.

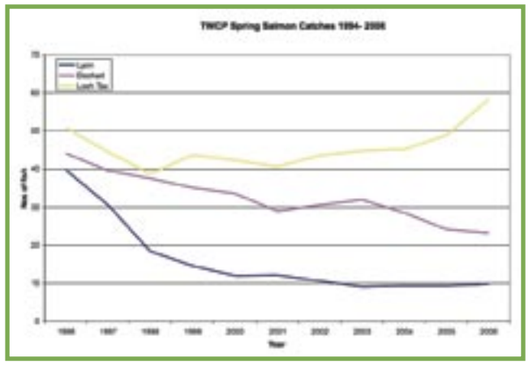
Loch Tay salmon catches



Spring salmon catches are very steady, seemingly increasing in recent years, but with numbers almost always between 40-50. The raw year by year data does show significant variation within this picture. Summer salmon numbers are rising after a steady period, but numbers are very low. Grilse numbers are virtually negligible, with only 1-2 fish caught in most years, and many years had none at all.

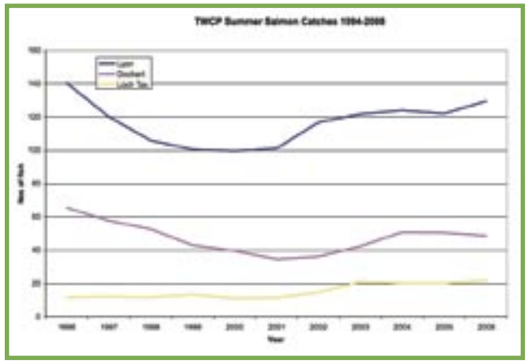
TWCP rivers comparison

TWCP spring salmon catches



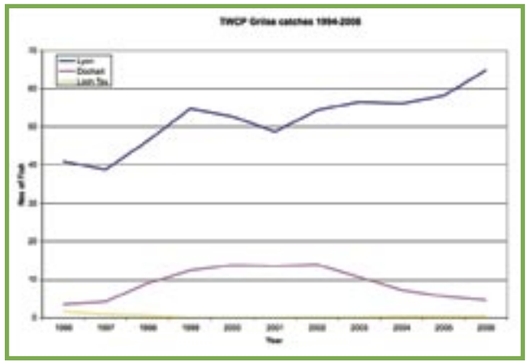
There appears to be a modest increase in the number of spring fish caught on Loch Tay in recent years. The Dochart is showing a steady decline of 20-30%. The noticeable difference is on the Lyon, with an almost 75% reduction in spring fish numbers over the period although numbers have been very steady since about 2000. To put this in perspective, the Lyon is one of the longest tributary rivers in the Tay system and is currently only catching one spring salmon per 3 miles of its length.

TWCP summer salmon catches



The Lyon is the only river with any significant number of summer fish, with a similar pattern to the main part of the Tay. The Dochart is showing a steady decline, increasing very slightly in recent years. Loch Tay is negligible.

TWCP grilse catches



The Lyon is showing a steady increase in grilse numbers. The Dochart is declining again after a period of increasing numbers. Loch Tay barely registers at all in numbers of grilse.

TWCP Salmon as a % of the total Tay System Catch

The Tay catch data over the same period is not presented here, but the total TWCP spring catch, including Loch Tay is significant, 8-12% of the total, seemingly declining by 4% over the period. This is concerning. Grilse numbers are only 2% of the Tay catch as a whole, summer salmon 3%. Total salmon numbers are 4% of Tay as a whole. TWCP area plus Loch Tay therefore accounts for 1 in 25 salmon overall within the Tay district, but 1 in 10-12 spring fish. Spring salmon numbers on the Tay average just less than 1000 - the lowest of the four major Scottish salmon rivers. These tributary rivers in the headwaters of the Tay river system should be supplying a disproportionately high number of the spring catch on the wider system, with this being reflected in healthy catches within each of the rivers themselves.

At present, this is not happening. ❖

Organizations with fisheries management responsibility in the Tay Western Catchments Area

Beyond those organizations operating at a national level, there are a number of organizations within the TWCP area with a responsibility for fisheries management.

For migratory fish (salmon & sea trout), the Tay District Salmon Fisheries Board (TDSFB) is the statutory body. The Tay Ghillies Association (TGA) provide an organization for those professionally employed in salmon angling throughout the system and they help to fund and implement a range of conservation and educational projects, and complement those initiatives being undertaken by TDSFB. A number of Tay ghillies are also Board members of TDSFB. Within Glen Lyon, the River Lyon Salmon Proprietors Group co-ordinate local initiatives and information sharing between the owners there.

The Tay Liaison Committee (TLC) are responsible for managing freshwater fishing through the Tay Protection Order.

There are two significant angling clubs within the area; Killin/ Breadalbane Angling Club, based in Killin, and the Glasgow Telephones & Civil Service Angling Association/ Crianlarich Angling Club.

In addition there are also the West Loch Tay Salmon Fishers Association who represent all those with salmon fishing rights at the west end of Loch Tay and in the lower Lochay and Dochart rivers and the Loch Tay Users Association who have a wider remit beyond just fishing.

There is also a Fishing Forum associated with the Loch Lomond and Trossachs National Park on which some of the above interests are represented.

The Tay District Salmon Fisheries Board

The Tay District Salmon Fisheries Board (TDSFB) is the statutory organisation responsible for the management of atlantic salmon (*salmo salar*) and sea trout (*salmo trutta*) within the wider Tay district which includes the Earn, Tummel, Isla and Eden catchments as well as the river Tay itself.

The Board is made up of riparian owners elected to represent the Upper and Lower parts of the catchment and co-opted members who represent the interests of anglers, the Tay Ghillies Association and the Tay Foundation. The roles of these two organizations are outlined below. The Board holds regular meetings throughout the year, usually on a bi- monthly basis and the current Board members are drawn from right across the district.

The Board has offices and a hatchery close to the city

The Tay at Meikleour

of Perth and employs water bailiffs and biologists who advise on river management and undertake project work. Together they look after over 5,000 miles of rivers, burns and lochs. Their work includes river management, conservation and habitat projects, scientific research and fisheries protection. The Tay catchment is massive, with many significant issues affecting the river system and a very large population either within the area or within a relatively short journey time, including a very large number of angling clubs, each with their particular areas of interest. Co-ordinating this is a very significant undertaking.

Water bailiffs are there to protect salmon and sea trout and their environment. Their primary duty is to enforce the laws and they work in shifts 365 days a year, day and night if circumstances dictate. They have powers of arrest and confiscation, including tackle and vehicles.

- **A comprehensive description of the Board's work is available on their website at: http://www.tdsfb.org/ A full listing of current members and annual reports can be obtained from the Administrator: Callum Towns, Strathtay MS Ltd. 5 Strathalmond Green, Edinburgh. EH4 8AG. Tel. 0131 4670092.**

Salmon fishing on the Tay

The rights to fish for salmon and freshwater fish in Scotland are privately owned. Fishing for salmon and sea trout without the legal right, or written permission from a person having such a right, is a criminal offence. Fishing for all other freshwater fish without the right or written permission is, in general, a civil offence.

There is demand for increased availability of fishing, but satisfying this demand must be within the context of maintaining sustainable fisheries. Access to angling can be increased not only by opening up new fisheries,

but also through bringing existing opportunities to the attention of the angling public.

Salmon fishing is the most important component fishery on the River Tay and its tributaries. Salmon are fished for throughout the length of the Tay from Perth upstream including all the major tributaries.

Today nearly all the fishing is by recreational angling but historically there was a big commercial fishery. Salmon angling on the Tay is a very significant contributor to the local economy, both in terms of jobs and income generated from fishing, and also from ancillary and supporting services such as accommodation provision, tackle shops and pubs & restaurants. Many anglers will commonly come as part of a bigger group on holiday and participate in a range of activities when they are here. Very often, it is the fishing opportunity that is instrumental in the choice of destination and other parts of the local economy then benefit as a result.

Sea trout fishing

Compared to some other rivers sea trout fishing in the Tay is of much lesser importance than salmon. The Tay itself has only a modest sea trout run. The best tributary for sea trout is the River Earn which historically has been an excellent sea trout river.

The Tay Foundation

The Tay Foundation is a Charitable Trust helping the River Tay and its tributaries, fish and environment, and works in a close partnership with TDSFB. There is a clear division of functions, with TDSFB being the statutory body with an interest only in salmon, but being somewhat constrained by that. The Tay Foundation can adopt a wider remit, allowing for involvement in wider conservation management and fundraising that would allow salmon to benefit indirectly. The aim of the Foundation is to restore and maintain aquatic biodiversity by means of practical, responsible and sustainable approaches to land water and fishery management, based on sound science for the benefit of the community as a whole.

The Foundation seeks to protect, conserve, improve and enhance all fish species and their ecological cycles, to advance education, training and research and to provide a communications resource for all interested parties.

It is anticipated that the Tay Foundation will be the most appropriate vehicle for taking forward some of the ideas outlined in this report.

Newtyle beat on the Middle Tay

The Tay Ghilies Association

The Tay Ghillies Association (TGA) was formed ten years ago from a working group of boatmen, ghillies and other river workers, to try to bring fishing on the Tay back to the halcyon days of 50 years ago. The Association has grown in strength over the years and now can boast a membership of over 80% of all full time ghillies and boatmen on the River Tay and tributaries.

The Tay Ghillies Association is a registered charity and its primary function is to raise funds for project works

Casting demonstrations

'Catch the egg' at Ballinluig Fun Day

throughout the Tay catchment area. It also provides a very useful forum for the ghillies to discuss ideas of mutual interest, and also serves an important social function. New employees on the Tay will always find a warm welcome at a TGA meeting in Stanley, putting them in contact with their fellow ghillies and allowing them the opportunity to learn about and participate in what is going on. The TGA also host a number of interesting talks throughout the year and these are always well attended.

Its members have been pivotal in carrying forward the Tay District Salmon Fisheries Board's recommendations on catch and release and achieving a quantum leap in amounts of salmon released back into the river. The Association partly funded the construction of the existing hatchery and has funded the extension of holding tanks, egg trays and other associated works relating to the hatchery.

Since its inception the Association has raised over £250,000 which has all been invested back into the river to improve the environment for the returning Atlantic salmon, providing them with the best chances of survival and reproduction. This money has funded a wide range of conservation projects, removal of weirs and other obstructions and important infra-structure improvements. The TGA are also very much involved in the education of young anglers through projects such as AFYD (Angling for Youth Development, see below) and "Salmon in the Classroom" which will ensure that the skills of this generation are not lost for the next.

The TGA consider themselves to be the real ambassadors of the River Tay and work on a day to day basis with TDSFB and the Tay Foundation as well as every visiting angler to the Tay and its tributaries. Several TGA members are also members of TDSFB.

The TGA are currently helping to finance the extension to the existing hatchery at Almond bank. This will ensure the valuable broodstock which are caught have the best chances of survival prior to stripping.

The TGA fun day at Ballinluig is usually held on the first weekend in August, just off the A9 in the field beside the Ballinluig junction. This event is always well attended and keenly anticipated, especially by local families and visitors wanting a good day out, and they are seldom disappointed.

On 11th June last year at Ballathie House Hotel, the Tay District Salmon Fisheries Board (TDSFB) announced that the 2009 Ballathie Award for Conservation has been won by the Tay Ghillies Association in recognition of their work in increasing catch and release rates on the river. This is a prestigious award and very much merited by the TGA.

The Tay Ghillies have been key supporters of this catchment project, both as an organization and as individuals and have helped us form an effective link with the lower river. It is no exaggeration to say that we could not have progressed this initiative without them.

- **For more information on the Tay Ghillies Association, visit their website at: http://www.tayghilliesassoc.co.uk/about.html**

The West Loch Tay Salmon Fishers Association (WLTSFA)

As previously stated, WLTSFA represents the interests of all those holding salmon fishing rights at the west end of Loch Tay and the lower Lochay and Dochart rivers.

Salmon fishing rights are extensive and complex around Loch Tay and WLTSFA is a useful forum for exchanging necessary information, dealing with problems, and co-ordinating project work. Taken together, the voting rights within this organization are significant within the wider Tay district.

The River Lyon Salmon Proprietors' Group

This Group helps to co-ordinate salmon fishing interests along the River Lyon, and also provides a useful link with the Tay Liaison Committee (over).

The group have had a number of notable successes in recent years:

- Negotiating a more suitable schedule of freshets with SSE and making sure that all riparian owners are aware of this at the start of the season.
- Encouraging research projects on the Lyon with particular emphasis on the effects of the dam at the top of the glen.
- Negotiating an agreement on river access with the Scottish Canoe Association.

In addition, increased stocking has been achieved in recent years and the group provides a useful link in facilitating that process.

Two current members of the group, including Chairman Iain Wotherspoon of Glenlyon Estate, are also members of TDSFB.

The Tay Liaison Committee and the management of freshwater angling

Alex Stewart (Recorder, Tay Liason Committee)

Background

The remit of the Tay Liaison Committee (TLC) is to have controlled access for all anglers to the waters of the River Tay and its tributaries, accompanying lochs and reservoirs. The livelihood of landowners and other parties is part of the negotiations of any agreement and the privacy of residents must be respected. The committee recognize the need for restrictions at certain times of the year to allow for other sporting activities to be enjoyed, and these are taken into account in discussions. There are also seasonal activities to be considered in agriculture, both arable and livestock, forestry. Other activities may also restrict access for a period for safety reasons.

Co-operation must come from many avenues, for the welfare of all freshwater species and their habitat, this being essential to the protection and improvement of the system for everyone to enjoy.

TLC Protection Order sign

Looking north from Meall garbh, Glenlyon

The River Tay System covers 6,475 square kilometres and is one of the largest natural drainage areas in Scotland.

Protection Orders

A Protection Order is granted if it is conclusively demonstrated that there is a demand for access to fish the beats on a river system for freshwater fish and that access can and is being provided.

Area covered by the Tay Protection Order

The first meeting of riparian owners and angling clubs, to look into the possibility of applying for an Order, took place in the Birnam Institute in 1982. This culminated in the River Tay Protection Order being granted on the 10th of September 1986, and brought the main river along with the tributary Rivers Almond, Braan, Lyon, Lochay, Dochart, Fillan & Cononish and all lochs and streams draining into the main river and the named tributaries, under the terms of the 1976 Freshwater Fisheries and Salmon Act. Revisions were made in the 2003 Consolidation Act and on the 7th of August 2007 the latest changes came into law with The Aquaculture & Fisheries Act, especially the prevention of disease and transportation of live fish regulations and that blanket protection is no longer applicable.

Formerly any order covered every beat and all who own fishing enjoy the terms granted under the Act, which basically requires written permission, i.e. a permit, to fish for any freshwater species and that it is an offence under Criminal Law not to be in possession of that permission.

The new legislation

The new Act allows for an application to be made to the Scottish Government to vary the existing Order, where a committee have proof that terms of the Order are not being adhered to. Due to the new legislation, the TLC are required to have all Riparian Owners sign a revised access agreement and at the same time point out to everyone

Men in boats

the reasons for the revisions. This exercise proved extremely difficult to complete within a reasonable time scale and many hours were spent and miles travelled by members trying to resolve various difficulties. Eventually, after taking advice from Government departments, the committee published their intention to seek a revision of the River Tay Order.

At the AGM in 2008 a motion was tabled that the TLC will seek to have the existing Order amended to exclude beats where riparian owners have failed to supply information to comply with the terms of the Act.

In the Autumn of 2009 the TLC made the first approach to the Scottish Government to open preliminary discussions, as is required, prior to eventually making a formal approach for a variation. After much correspondence and face to face meetings with staff and the Permanent Under Secretary, the TLC have now presented the first set of papers which will be followed in due course by the formal application.

All input is voluntary

It is important to point out that all the work and the considerable time involved with the TLC is voluntary. The object is to protect all freshwater species and see them managed, where they exist, for the future and for the overall benefit of the system. At the same time the riparian owners, without whose assistance none of what is happening could be achieved, should expect the full co-operation of both the resident and visiting anglers to the River Tay, its tributaries and lochs.

Monitoring is carried out to check if access is being adhered to and returns are required for the annual report, which alone is widely circulated and demonstrates if the Tay Order is being managed and the owners complying with the terms.

A complaints procedure is in place and this when activated must be followed through to a satisfactory conclusion within the set timescale.

Other legislation

There is often confusion in the terms of the Land Reform Act and those in the Aquaculture and Fisheries Act, with regard to access and it is worthwhile clarifying the difference.

The Land Reform (Scotland) Act 2003 guarantees access to the countryside under certain conditions for groups and individuals. The legislation does not include anglers as individuals guaranteed access and identifies the sport and its followers as individuals specifically excluded from it.

It is important for anglers to understand this legislation as there will be occasions when access to water may require an individual to cross over a landowner's ground and if that ground is not near water then access rights can be claimed. However on approaching any water the Angler is no longer protected by the Land Reform (Scotland) Act and comes under legal requirements placed upon him under the terms of the Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003 and the Trespass (Scotland) Act.

Many anglers enjoy a fishing and camping break on the banks of a river or a loch. While the Land Reform Act acknowledges "wild" camping for walkers as part of their journey, it also places the legal responsibility upon them to comply with relevant provisions.

Anglers camping have no such protection under The Land Reform Act and if permission for camping has not been obtained, they can be charged under The Trespass (Scotland) Act. Anglers camping on or near to water require the land owner's permission.

Freshwater Fishery Wardens

To assist in monitoring the Tay System, Freshwater Fishery Wardens are appointed by the Scottish Government Minister, on the recommendation of the TLC, and after a training course has been completed. The warrant card issued gives the holder legal powers to enquire as to the legal right or written permission of any person to fish in the area if there is reasonable cause to suspect that the person has no such right or permission, and to require the person to produce written evidence of such right or permission. If there is reasonable cause to suspect that a person is fishing without legal right or permission, or is attempting or preparing to do so, the warden may seize any equipment used or calculated to be of use. The equipment is to be handed over to the appropriate authority, ie the Police, together with an incident report and a receipt issued to the angler.

Wardens have the right to enter land in the vicinity of water for the purpose of exercising their powers or to prevent or detect persons fishing without right or permission, and may also enter land to fix copies of orders or notices, but may not enter buildings. Any person who willfully obstructs or refuses a warden to exercise his or her powers or rights is guilty of an offence.

Wardens have no powers to charge an offender and any contravention should be brought to the attention of the Criminal Authorities (The Police or Procurator Fiscal) as soon as possible.

It can be appreciated that such powers should be exercised in the correct manner and with a witness, hence the reason for vetting and training. There is a tentative link with Bailiffs who work for the Tay District Salmon Fisheries Board, whereby information can be exchanged and possibly a witness required. This cross (close?) co-operation can only add to the care of all fish species.

Range of angling opportunities

The whole system offers a range of angling for various categories of fishermen. Indiginous Brown Trout, Arctic Char, Grayling, Pike and Perch and introduced species, Rainbow Trout and Roach. River fishing, bank fishing on lochs, and boat hire are all available. The hill lochs are not so easily accessed since there is usually some walking involved and, at certain times of the year, these may be closed for sporting activities and for the safety of everyone. Exclusion zones are in place for a variety of reasons - safety, privacy, SSSI or sensitivity of flora and these areas must be respected.

Methods of fishing have been part of the agreements with riparian owners and in some areas the local club rules are designed to take account of the type of water which it is permitted to fish.

Comrie Bridge

Local consultation

The overseeing of the working of River Tay Order crosses many boundaries and involves members having discussions with other parties in the system and having representatives attend meetings to show support, give opinions and sometimes advice. There are many factors in the catchment, both in business and recreation, At times these clash and need to come together to find solutions. There are also improvement projects underway, some of which have received a grant from the TLC.

The area west of Killin is within the Loch Lomond & Trossachs National Park, which has recently published the first Biodiversity Action Plan. This, in many ways, highlights outstanding issues which the Tay Western Catchment Report has also raised, although it does not mention the specific actions required to address them. At the same time it does evaluate improvements and surveys which are already represented on the Park Fishing Forum, not just to report on progress, but to have an input to all angling matters and associated projects. There will be a great deal of co-operation required to prevent duplication of funding awards in this important part of the Tay System and to take forward appropriate riparian projects.

Other representation

Other groups have representatives on the committee, as the remit has always been to consult widely and involve all interests. The River Lyon Riparian Owners Association, The West Loch Tay Salmon Fishers Association, The Loch Tay Users Association, The Upper Tay Riparian Owners Association, Salmon Riparian Owners Representative, The Tay District Salmon Fishery Board, The Tay Foundation, together with co-opted members if and when special needs arise. It was considered essential to have a broad based representation and with the angling clubs, to form a group with credible credentials within the remit of the Act.

Other recreational uses

The River Tay, as with all major river systems, is under pressure from various sources to take account of increasing recreational use. New developments to cater for a variety of pleasure boating activities, an increase in the demand for moorings, greater use of the existing access for canoes and rafts, and camping as well as more fishing access.

The land use inevitably comes under pressure with changes in practices as well as the need to have access points for water sports.

In one way or another management of freshwater angling comes into contact with every aspect of recreational and business life in the Tay System. At times the TLC have wondered how representatives have become involved in discussions which, at face value, seem to have nothing to do with angling, but it turns out that there is always a connection.

Conclusion

Since the first committee was brought together in 1982, up to today's management and consultative style set up, there have been many changes in legislation, some of which the TLC has been involved with at consultation level and some which are taken at international level. The TLC can look forward to working for the benefit of all freshwater species and joining with other organisations for the future management of a resource which must be conserved and maintained for future generations.

February day out on the Dochart

- **Alex Stewart is also a member of Killin/Breadalbane Angling Club, has given evidence on freshwater fisheries management before committee in the Scottish Parliament, and is a current member of the Tay District Salmon Fisheries Board.**

Angling for Youth Development (AFYD)

Angling for youth development is a charity registered in Scotland with the purpose of offering people of all backgrounds and abilities the opportunity to participate in the sport of angling, thereby improving their quality of life. It has a very impressive mixture of both private and public sector supporters, including Tayside Police and a number of local authorities. AFYD is now becoming established in Highland Perthshire and it is anticipated that it will provide a very useful function in education and recruitment to angling clubs in the very near future.

Its patrons include Professor David Bellamy OBE and Fiona Armstrong.

The objectives of AFYD are to:

- Provide safety awareness through education and good practice.
- Develop young people's skills and self-confidence.
- Encourage responsible and positive participation within the sport and the community.
- Raise awareness of all participants of environmental issues.
- Provide instruction of the highest quality in angling techniques and fishing etiquette.
- Support any participant wishing to obtain recognized qualifications in angling and angling related subjects.

All AFYD coaches and instructors are professionally trained including child protection and first aid and are subject of enhanced disclosure. The AFYD Instructional teams are lead by their Project Leaders and Senior Instructors.

The AFYD Trout in the Classroom UK programme is sponsored by businesses providing a tank for their local primary schools. AFYD currently have five tanks operating in Perthshire and will be expanding this programme in 2010. ❖

- **More information on AFYD can be found at: http://www.afyd.co.uk**

Fishing

Land use, geology and water quality report

Philippa Booth: Macaulay Research Consultancy Services, Craigiebuckler, Aberdeen
A full account of this report can be downloaded from the Scottish Native Woods website.

Western Catchments area in the context of Tayside

1. Introduction

This report was commissioned by Scottish Native Woods and has been paid for by the Tay Ghillies Association. The purpose of the report is to summarise and interpret the information publicly available regarding land use, geology and water quality in Glen Lochay, Glen Lyon and Glen Dochart - the area covered by the Tay Western Catchments Project (TWCP). This information will compliment that being gathered through ground survey work.

Changes in the quantity and quality of streamwater are of increasing concern as landowners and government agencies seek to conserve water resources and provide healthy conditions for fish and other stream dependant life. The areas of concern and the environmental processes which cause the changes span national, regional and local scales. As a result, current hydrological and water chemistry research encompasses not only studies done in small catchments but entire regions (Neal *et al*.1997). Water quantity and quality also alter with time and reconciling the effects of long term changes with short term (storm event) responses presents a considerable challenge in understanding streamwater behaviour. Along the length of many rivers there are potentially numerous point sources of pollution, mainly from industrial and domestic effluent discharges.
The identification and regulation of such pollution is readily regulated through a combination of monitoring and licensing. More difficult to monitor and control is pollution from diffuse sources. Within this latter category, the changes in water quality currently of widespread concern are driven by the processes of: acidification of upland catchments, nutrient enrichment (eutrophication) in lowland catchments, land-use and climate change.
The impact of atmospheric pollution on both terrestrial and freshwater ecosystems is widespread in the upland areas of the UK where it can lead to soil and streamwater acidification (Hornung *et al*.1994 and 1995). Such acidification can be enhanced by mature coniferous plantations whose dense foliage efficiently scours pollution from the atmosphere (Harriman and Morrison 1982; Ormerod *et al*. 1989). However, uncertainty remains as to whether it is the chronic (long term) or acute (short term) effects of acidification that causes damage to the stream biota.

In lowland catchments, monitoring and research programmes have been established to identify the effects of different agricultural practices at a range of spatial scales. The link between intensive agricultural practices and increased nitrate runoff at the regional scale has been established (Wright et al. 1991) and models incorporating the processes controlling nitrate leaching at the field scale have been incorporated into catchment models (Dunn et al. 1998).

Alterations in UK government and EC policies are likely to cause changes in land use. Already arable land is set-aside and the possibility exists for afforestation. Over the past ten years, there has been a steady migration of people from urban centres to smaller rural communities. An increase in effluent to smaller streams in rural areas may cause localised pollution problems.

The responses to global climate change are likely to be complex and largely uncertain. However, the most likely scenario will be an increase in runoff in the north and west of the UK, with more pronounced seasonal differences occurring in flow regimes (Jenkins 1995).

As a result of diffuse and point sources of pollution, there will be a downstream effect which will have an impact on the options for other water interests such as water abstractions, fish farming and recreational usage. Recognition of this interplay between the natural environment, land-use and water resources has given rise to the need for integrated catchment management plans (Newson 1982). As part of this process this report provides a brief overview of some of the data and potential problems in the river Tay, Scotland, in particular the following sub catchments:
Glen Lyon
Glen Lochay
Glen Dochart (Including the Dochart, Fillan/Cononish catchments)

Upper Glen Lochay

Ben More from Auchlyne

1.1. The Tay catchment

The Tay is the longest river in Scotland, stretching a distance of 120 miles (193 km) from the northern slopes of Ben Lui to the Firth of Tay beyond Perth. The Tay catchment covers approximately 4970km. The main tributaries of the River Tay are the Rivers Almond, Isla, Earn, Shockie, Ordie, Braan, Tummel and Lyon (SEPA 2003).

The majority of the major tributaries of the Tay rise in the southern part of the Scottish Highlands. The geology of this area is largely metamorphic with a little granite in the North West. The geology occurs in bands with psammite to the northwest, psammite and semipelite in the mid parts and sandstone to the east. Till deposits are scattered throughout the catchment, with glacial sands and gravels and alluvium in the river corridors. Local differences in the mineralogy of these hard crystalline rocks create local differences in the form of rivers and water chemistry. Near Dunkeld, the Tay crosses the Highland Boundary Fault and from here flows over an area underlain by the softer Old Red Sandstone (SEPA 2005).

Streams in the highland part of the catchment tend to be smaller and cascade down the mountain side from the higher summits feeding rivers flowing through narrow steep sided valleys formed by glaciers during the ice-age. Due to this topography many of the smaller side tributaries of the Tay are inaccessible to salmon. The topography also means this area is attractive for hydro-electric dam building. The predominant land uses in the upper catchment tend to be sheep grazing, grouse moors, red deer and to a lesser extent forestry plantations (SEPA 2005).

1.2. The Tay Western Catchments Area

The River Tay is deemed to start 100m above the bridge at Kenmore as it flows out of Loch Tay. Upstream of this point, the river has a variety of names. For the first few miles the river is known as the River Cononish; then it is called the River Fillan, and then the name changes again to the River Dochart until it flows into Loch Tay at Killin. Another major river also joins the Dochart upstream of the start of the Tay, the Lochay. Therefore at its birth the Tay is already a sizeable water course and is already 40m wide. Two miles downstream the Tay is joined by the River Lyon. From here down it is approximately 50m wide. It is these three catchments that constitute the area covered by the Tay Western Catchments Project (see Figure 1.1, page 5)

The Lyon was once famous as a salmon river, however this no longer appears to be true. In the 1950s the river was harnessed for hydro-electric production. Prior to that time, the River Lyon rose in Loch Lyon then flowed onwards for some 50 km to it's confluence with the Tay. The Breadalbane Constructional Scheme entailed the construction of a dam at Lubreoch, impounding a new much bigger Loch Lyon. Due to the limited habitat remaining upstream of the dam no provision was made to allow salmon passage. In addition another dam, Giorra Dam, was constructed in a glen to the north east creating a new Loch an Daimh out of two small lochs, Daimh and Giorra. Water was intercepted and transferred from feeder streams in neighbouring catchments to feed these reservoirs. Loch Lyon received water from the Dochart, Lochay and Orchy and Loch an Daimh received water from the Lyon itself. Thus the catchment area of Loch Lyon was increased by some five-fold over the natural loch. After a circuitous route, water abstracted from the upper Lochay along with water from the Lyon, Dochart and Orchy finds its way back again into the lower Lochay (TDSFB 2007). Therefore all three of the catchments included in this study are affected by abstraction for energy production.

A "compensation" flow is released at Stronuich Dam which can vary between 30 million gallons per day and 48.6 million according to the time of year. Further downstream from Stronuich a number of other tributaries, the Milton Burn, the Allt Gleann Da-Eig and the Allt a' Chobhair are also abstracted, the water from these is transferred into the Loch Tay catchment (TDSFB 2007).

The damming of the Lyon means its character varies upstream and downstream of the dams. Immediately downstream of Lubreoch Dam flows vary considerably according to the generation regime. However, downstream of Stronuich Dam, apart from occasions when the dam spills, flows are very stable. As the Lyon progresses down stream it is joined by a number of flashy tributaries and gradually regains the characteristics of a spate river (TDSFB 2007).

It has been noted that there tends to be profuse growth of filamentous algae within the Lyon from the tailrace of Lubreoch Dam, continuing sometimes for over twenty miles to the lower reaches. When the algae are scraped off stones from the bed in the upper half of the Lyon, they are covered in a black precipitate. Tests have shown this precipitate contains the metals aluminium and manganese. The stones in the tributary burns are not covered in this algae (TDSFB 2007). This is not believed to be an issue of undue concern.

Table 2.1 Summary land cover of the Western Tay catchments

Land cover category	Glen Lyon Area km^2	%	Glen Lochay Area km^2 %		Glen Dochart Area km^2 %	
Arable	4.65	1.2	-	0.0	-	0.0
Improved Pasture	15.09	3.9	1.12	0.9	4.4	1.9
Grassland	76.85	19.8	24.98	19.1	49.09	20.7
Forestry/woodland	22.9	5.9	3.73	2.9	32.95	13.9
Broadleaved woodland	1.97	0.5	2.70	2.1	0.63	0.3
Coniferous plantation	17.74	4.6	0.80	0.6	31.0	13.1
Mixed woodland	3.19	0.8	0.21	0.2	1.32	0.6
Heather Moor and Montane	194.02	49.9	73.12	55.9	118.54	50.1
Water Bodies and Bog	65.44	16.8	22.37	17.1	27.28	11.5
Inland Rock	2.35	0.6	0.07	0.1	0.38	0.2
Minerals and Waste	0.03	0.0	-	0.0	-	0.0
Urban	0.03	0.0	0.24	0.2	0.43	0.2
Recreational Land	0.01	0.0	0.1	0.1	0.03	0.0
Not categorised	7.14	1.8	5.07	3.9	3.48	1.5
Total	**388.5**		**131.7**		**236.6**	

Based on LCS88 data from the Macaulay Institute and Scottish Native Woods knowledge

Fields at Auchertyre, Strathfillan

2. Land Use Patterns

The overall land cover of the three catchments does not differ significantly. In all three catchments the majority of land is covered with heather moor and montane vegetation. This is to be expected in these upland catchments. Land cover varies with topography, with heather moor and montane vegetation predominate on the valley tops and sides with the other land cover classes increasing in coverage in the lower valley areas. In the lower valley areas grassland dominates (Figures 2.1 to 2.3).

Land cover also changes as you progress downstream. In the headwaters of each catchment land cover in the vicinity of the river is dominated by grassland. However as you progress downstream in general land use in the vicinity of the river changes to improved pasture and broadleaved woodland.

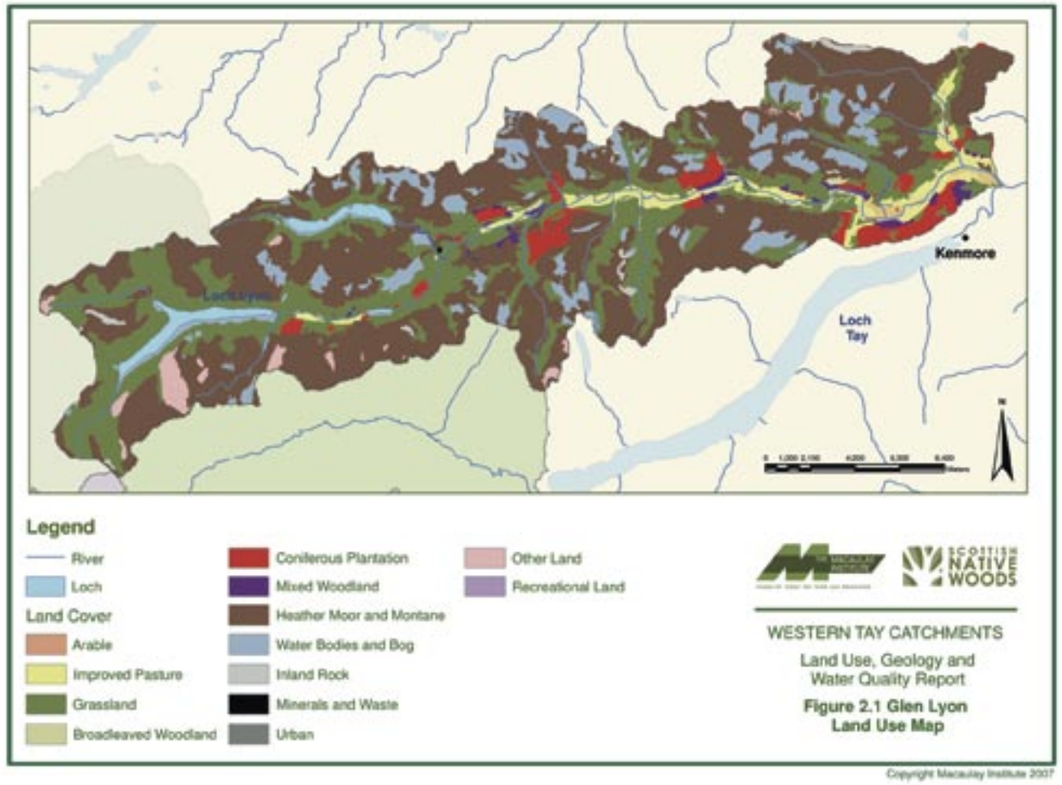
Glen Dochart contains a much greater proportion of woodland than the other two catchments, which contain greater proportions of water bodies and bog. Within both Glen Lyon and Glen Dochart the forested area is dominated by coniferous plantation, 77.5% and 95.1% of the forested area respectively. Glen Lochay contains a much smaller percentage of forested area, only 2.9% compared to the other two catchments. In the Lochay and Lyon coniferous plantations are concentrated in the lower valley areas in the vicinity of water courses and at the downstream end of the Glens (Figures 2.1-2.2). In Glen Dochart the coniferous plantations are much more widespread throughout the catchment area (Figure 2.3).

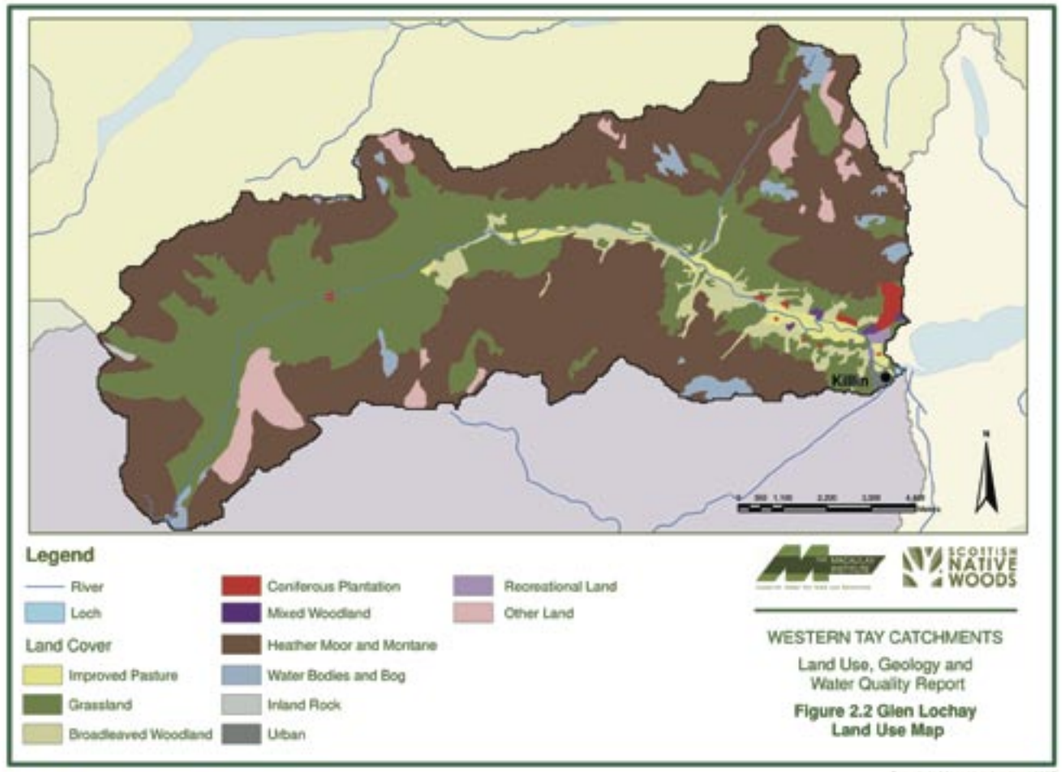
The Lyon is the only catchment out of the three to have a relatively significant proportion of land used for improved pasture and arable land cover.

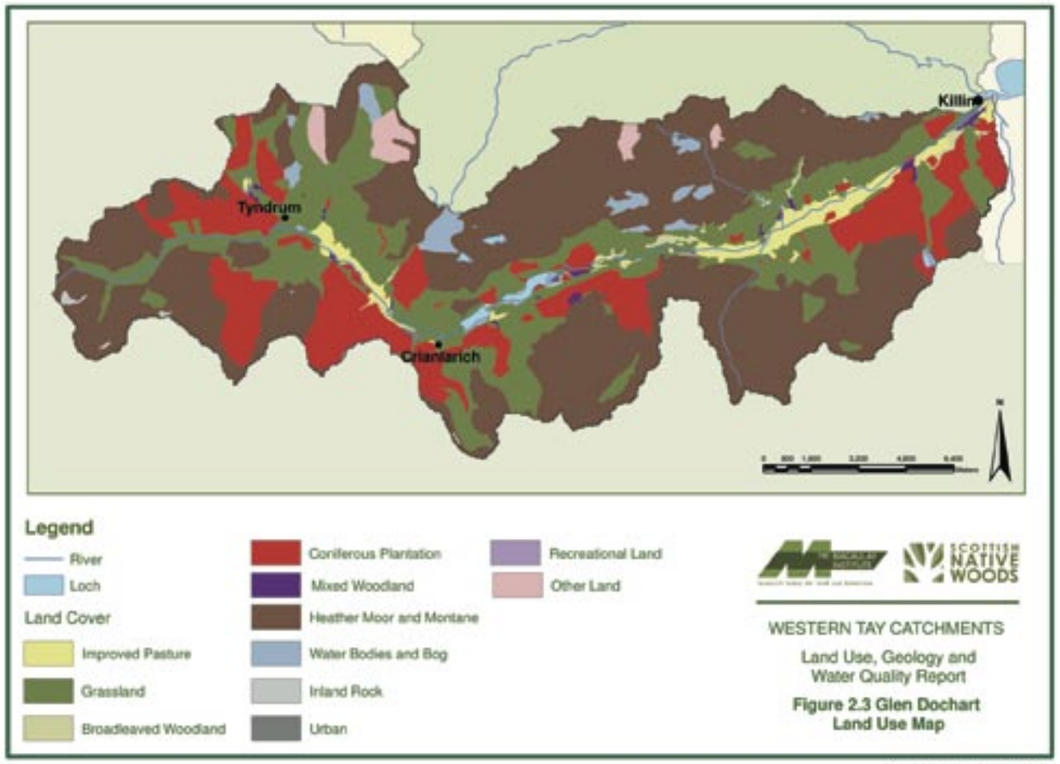
The areas of improved grassland within Glen Lochay are very much more restricted, being located just upstream from Killin. Practically no arable cropping takes place within the glen.

Apart from the area of improved pasture downstream of Killin, areas of improved pasture in Glen Dochart are fairly restricted, and also are of a lower quality than in Glenlyon.

The division of land cover observed in each of the Glens is typical for upland catchments in Scotland.







The areas not categorized in each Glen relate to areas of cloud cover in the aerial photos used to identify land cover. Examination of the location of these areas indicates that in the majority these areas are associated with heather moor and montane vegetation and grassland.

3. Geology

Similar to land cover the underlying geology and drift cover from which the soils are related does not differ significantly between the three catchments (Table 3.1). The geology of the area is largely metamorphic. All three Glens are dominated by drifts derived from arenaceous schists and strongly metamorphosed argillaceous schists of the Dalradian Series. Till deposits are scattered throughout the three Glens, with glacial sands, gravels and alluvium in the river corridors. Variation in the parent material is closely related to topography, with fluvial related material in the valley bottoms and organic deposits and other drift derived parent material located higher up valley sides.

There is a close relationship between kinds of rock, structural patterns and topographic features. In general terms, the hard rock forms the highest hills and mountains and the softer rocks are found in the valleys. Between resistant quartzites, grits, gneisses and hard slates, belts of weaker strata such as shists, phylates and softer slates have been excavated into valleys.

Together with the rest of Scotland, the Western Tay area was blanketed during the Pleistocene by ice which did not melt finally until some 10,000 years ago. In general the ice flow followed the pre-existing valleys in an east direction. The Glens were subjected to intensive erosion and display ice-moulded profiles. Loch Tay is an elongated loch occupying the excavation of a glacial rock basin. Immediately upstream of Loch Tay in Glen Dochart and Glen Lochay is a delta where the inflowing streams of the Dochart and Lochay reduce in velocity and shed their suspended material on entering the relatively still loch waters. These alluvial deposits support the arable land within the catchments.

On melting, the ice deposited vast quantities of moraine material, boulder clay and waterborne sand and gravel in valley bottoms and the lower ground. Much of this debris forms the parent material of present day soils.

Brown forest soils are common on the lower sheltered slopes of the main valleys, together with gleys in flushed and poorly drained sites. The brown soils are succeeded on the steeper slopes of the valley sides by humus iron podzols or by gleys in the wet sites and by peaty podzols on the gentler slopes at the highest level. The increased rainfall on higher ground, coupled with the more severe climate, have favoured the formation of peaty-topped soils and the accumulation of hill peat, especially on the gentler slopes, in very wet areas wet peat soils and peat occur on a variety of slopes, some of which are quite steep.

Very few Scottish soils are vulnerable to erosion unless the surface of the soil is bare. Amounts of transported sediment at SEPA's harmonised monitoring sites show no trend of increasing amounts being transported over a 30 year period. In terms of soil erosion, peat erosion might well be the issue of greatest concern at the moment in the Glens.

Soils developed on the geology of the Glens are not particularly well buffered. Drifts derived from intermediate rocks or mixed acid and basic rocks, both metamorphic and igneous will have the best buffering capacity within the Glens. Drifts derived from quartzites and quartzose grits, drifts derived from schists, gneisses, granulites and quartzites principally of the Moine Series, fluvioglacial and raised beach sands and gravels derived from acid rocks and organic deposits all have low or very low buffering capacity and will have the lowest buffering capacity of all the soils in the Glens. The remaining categories lie between these two but will all have relatively low buffering capacity.

The drifts promote the development of freely drained soils on steep valley sides and a more varied mix on the upper slopes, depending on local topography. Freely or imperfectly drained soils do tend to predominate except in receiving sites where poorly drained soils develop. The highest ground comprises cryogenic deposits formed by freeze-thaw processes and here most of these soils are freely drained.

Fluvioglacial and raised beach sands and gravels derived from acid rocks and recent riverine and lacustrine alluvial deposits occur in valley bottoms and drainage is predominantly free although there is also likely to be numerous basins with a high groundwater table and poorly drained soils.

Organic deposits comprises peat which is poorly drained and water logged for most of the year.

Land use is as much driven by climate as soils and parent material so it is difficult to make general statements on the suitability of areas for different land uses. In the Western Tay catchments, the climate precludes intensive agriculture and any arable or improved grassland is largely confined to the recent riverine and lacustrine alluvial deposits.

The remainder of the drift types cover a wide altitude range and the land use and land cover are a function of these factors. Actual and potential land use is confined by climate and/or topography to rough grazing, forestry (including native woodlands) and the sporting use of semi-natural habitats for grouse and/ or deer stalking

Table 3.1 Parent material

Parent Material	Lyon		Lochay		Dochart/ Fillan/ Cononish	
	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%
Drifts derived from arenaceous schists and strongly metamorphosed argillaceous schists of the Dalradian Series	272.0	69.9	106.4	80.5	192.0	81.5
Drifts derived from slates, phyllites and other weakly metamorphosed argillaceous rocks	18.2	4.7	9.0	6.8	-	-
Drifts derived from intermediate rocks or mixed acid and basic rocks, both metamorphic and igneous	0.4	0.1	-	-	-	-
Drifts derived from quartzites and quartzose grits	2.6	0.7	-	-	-	-
Drifts derived from schists, gneisses, granulites and quartzites principally of the Moine Series	24.0	6.2	-	-	-	-
Fluvioglacial and raised beach sands and gravels derived from acid rocks	14.3	3.7	2.1	1.6	10.2	4.3
Organic deposits	35.4	9.1	14.6	11.0	28.5	12.1
Recent riverine and lacustrine alluvial deposits	1.6	0.4	-	-	2.6	1.1
NA	20.7	5.3	0.1	0.1	2.3	1.0
Total	**389.2**		**132.2**		**235.6**	

Data from the Macaulay Institute

Looking down the Lochay

The Lyon at Innerwick

The Native Woodland Model developed by the Macaulay Institute in association with Scottish Natural Heritage (Towers et al. 2004) used soil and land cover data to predict potential woodland types which would be expected to develop under current soil and vegetation conditions, with no or minimal ground intervention, including fertilization, ground preparation and drainage. Preliminary review of the model output for the Western Tay Catchments indicates that the valley bottoms are suitable for upland Oak–Birch with bluebell/wild hyacinth of bilberry with some areas of Alder Ash mosaic. With distance from the water course and increasing altitude this then progresses into Birch with purple moor grass and open ground and Scots Pine with heather and peat land with scattered tree/scrub mosaic. The valley tops are predicted to be suitable mainly for the montane scrub communities of scattered Birch/Willow. Certain upland areas are identified as unsuitable for tree/scrub growth.

Organic deposits have a very limited range of potential uses due to severe soil wetness and are best retained as a valuable semi-natural habitat and terrestrial carbon store. Many of these areas are protected under a raft of designations.

Soils on the highest ground (cryogenic deposits) are limited in their potential uses due to climate. Again, they support valuable montane habitats.

Fine sediment is the most common type of material that is transported from all of the parent materials identified in the Glens, although gravel transport is possible from the sand and gravels adjacent to major streams. This is more likely to be caused by the action of the river itself rather than by rainfall. Boulders can be transported in major landslip events but it is very difficult to predict when these rare but potentially serious events might occur. Bare surfaces of peat can erode after a warm dry spell followed by heavy rainfall and here it is organic rather than mineral material that is eroded.

4. Water quality

A more extensive version of this article can be obtained through the Scottish Native Woods website.

4.1. Introduction

As part of their remit to maintain water quality along the major river systems of Scotland the Scottish Environmental Protection Agency (SEPA) collect a range of chemical and biological data at numerous points throughout the country for river stretches defined by confluences and pollution pressures.

4.2. The Tay catchment

River water quality for the majority of the Tay catchment is of excellent or good standard with only a few stretches in the east of poor quality. In general these poor quality areas relate to discharges (SEPA 2005). As the main land use in the Tay catchment is agriculture, the main causes of pollution are from diffuse sources, particularly in relation to agricultural run-off. Discharges from wastewater treatment plants and septic tanks can add to the concentrations of nitrate and ammonia. However SEPA reports that trends in nitrites and ammonia are improving at all sites (SEPA 2005).

The Cononish

Thirty percent of the water bodies in the Tay catchment are at significant risk of failing to achieve good ecological and chemical water quality. The key pressures for these water bodies at significant risk are morphological pressures and abstraction, affecting approximately 80% of water bodies. Diffuse source pollution affects approximately 50% of these water bodies at significant risk of failing and flow regulation 35%.

The Tay Area Advisory Group identify diffuse source pollution, morphology impacts and abstraction from agriculture and abstraction and flow regulation and morphology changes associated with the production and distribution of electricity as the biggest issues for Rivers in the Tay. Whilst pressures associated with the production and distribution of energy and water have the greatest impact on lakes. Diffuse source pollution from forestry is identified as affecting greater than 20% of coastal water bodies. Although The Tay Area Advisory Group do not identify forestry as a widespread pressure in the Tay catchment, it may occur locally i.e. impact less than 15% of river lengths or 20% of lake water body area.

4.3. The Tay Western Catchments Area

4.3.1. Glen Lyon

Approximately 90% of the water courses within the Lyon catchment are classified by the routine monitoring undertaken by SEPA and show that all of the stretches which are presently classified achieve excellent or good status overall. In the majority the tributaries of the Lyon are classified as excellent, where as the main stem achieves a good classification. Reasons for the main stem achieving a lower water quality than the tributaries will include the presence of improved pasture and septic tanks associated with isolated dwelling and settlements in the vicinity of the channel.

Despite the good water quality identified by routine monitoring, approximately 40% of water bodies in the Lyon catchment were identified in 2007 as being at significant risk of failing to achieve good ecological and chemical water quality as defined by the WFD, although in 2009 the majority of these including now the whole of the main stem of the river was deemed to be at “good ecological potential”. Abstraction, flow regulation and morphological pressures relating to power supply and water collection, purification and distribution are identified as significant issues, whilst diffuse pollution affects 93% of the water bodies identified. Sources may include agriculture, forestry activity or septic tanks. The main source identified in the other Glens is livestock farming.

4.3.2. Glen Lochay

Similar to the Lyon catchment all river stretches within the Lochay catchment included in the SEPA routine monitoring achieve either a good or excellent classification, with 80% of river stretches achieving the latter.
Within the Lochay catchment approximately 75% of the water bodies are classified as being of significant risk of failing to achieve good ecological and chemical water quality. Within this catchment abstraction and diffuse source pollution are the two principal factors involved.

4.3.3. Glen Dochart

Routine monitoring by SEPA shows that areas of Glen Dochart catchment went through a period of poor water quality between 2000 and 2003. However, since then water quality appears to have improved and stabilized, with all reaches that are classified achieving good and excellent quality, with 65% achieving the latter. Between 2001 and 2002 the stretch of mainstream upstream of Tyndrum achieved an overall rating of C due to the presence of a toxic substance in exceedance of the Environmental Quality Standard. The stretch of mainstream between Auchlyne and Killin achieved an overall rating of C in 2002 for the same reason. Review of the report produced by SEPA in 2005 implies that these incidents related to sheep dipping and that subsequent Sheep Dip Action Plans and best practice guidance introduced by the Scottish Executive have reduced this source of pollution leading to the improvement in water quality.

The River Fillan, Cononish and other tributaries of the Dochart achieve excellent water quality, whereas the main stem of the Dochart achieves good quality. Reasons for the main stem of the Dochart achieving slightly lower water quality will include the increased presence of improved pasture and arable land and septic tanks associated with isolated dwelling and settlements in the vicinity of the channel.

Only 15% of the water bodies within Glen Dochart are identified as being at significant risk of not achieving good status. These include the tributaries Auchtertyre Burn, Auchlyne West Burn and Alt Glas. All of the water bodies identified as being at significant risk are subject to pressure from abstraction (relating to power supply and water collection, purification and distribution) and 70% are subject to flow regulation (for power supply). The Lower River Cononish and the tributary Auchlyne East Burn are subject to pressure from abstraction for water collection, purification and distribution and power supply respectively. The area classified as probably not at risk, subject to pressures from point source pollution (from mining and quarrying) and diffuse source pollution (from livestock farming), is located up stream of Auchtertyre Burn.
There are two lochs, Dochart and Lubhair within the Glen, close together, but distinct, however only Loch Lubhair has been identified as a WFD water body. Loch Lubhair is believed to be probably not at significant risk of failing to achieve good water status and is only believed to be potentially affected by diffuse source pollution. The source of this pollution is identified by SEPA as either agriculture of forestry.
Some local commentators suggest that Loch Dochart has filled in significantly with sediment over last 15 years, to the extent that they can only fish now for 2 months. This is not reflected in the data provided by SEPA.

5. Conclusion

Overall water quality within the three catchments according to SEPA's routine monitoring is good to excellent. However a number of water bodies, particularly in the Lyon catchment, are believed to be of significant risk of failing to achieve good ecological and chemical status as required by the Water Framework Directive. Abstraction, flow regulation and morphological pressures are key pressures leading to the majority of this significant risk. The key drivers of these pressures will be energy production (described in section 1.2). Diffuse pollution is also a contributor to the significant risk of failure to achieve good ecological and chemical water quality. Diffuse pollution in the glens is attributed to agriculture and forestry. ❖

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The One Thousand Mile Survey

Introduction to survey protocol

The survey protocol used was based on that used by the Middle Dee Project on Deeside in 1997, varied to suit local conditions. The survey protocol was designed to record a number of simple environmental variables in a systematic and consistent manner. Care was taken not to take records or make judgements on anything that might be outwith the capabilities of those doing the survey work.

Spawning areas

From the outset it was recognized that we should not record variables which were already mapped or could be recorded more efficiently by other means, for example by the use of aerial photography. Experience suggested that some sites within the catchments would have been intensely surveyed already for a variety of reasons, but that this would only relate to a fairly small percentage of the area concerned.

The key question at the outset was straightforward: was there a package of variables which could be surveyed to reveal vital environmental information while being efficient and cost effective? The precise survey protocol devised was based on the information which we could establish during the five month period before the project was launched. Running a pilot survey over a percentage of the area and then consulting on this would help bring other information to our attention, and allow us to fine-tune the protocol for the greater part of the survey work, if this was indeed required.

A second question was also crucial, how far do we go? We could have surveyed the main watercourses within a catchment in a fairly short period of time but we would not have been taking account of the whole catchment and could, for instance, have been missing important information from the hill burns that might have had a key impact on how the river as a whole is managed.

The decision was made at the outset to survey all those tributaries that could be identified from a 1;50,000 OS Landranger map and were shown to lead directly in to the main river in each catchment area. This is where the initial figure of 1000 miles was derived, which included

In to Loch Dochart

'The decision was made from the outset, to survey all those tributaries that could be identified from a 1;50,000 OS Landranger map and were shown to lead directly in to the main river in each catchment area.'

The final survey sheet

Date:		Surveyor:		Photos:	Y/ N
Catchment:				L	R
Tributary:			LAND USE*		
Section no: XX			Heather moorland		
Top boundary co-ord:			Other moorland		
Description:			Coniferous forestry		
Section length:			B'leaved woodland		
			Improved grazing		
			Arable		
TREE COVER (%)	L	R	Rough grazing		
0					
0- 33					
33- 66			FENCES	L	R
66- 100			n/a		
Major species (life class)			None		
Minor species (life class)			Incomplete		
Non- natives? (life class)	Yes	No	Poor		
			Good		
Is management required??	Sheet 2		(Deer)		
Bracken? (0-33, 33-66, 66-100)			BANK STABILITY	L	R
Invasive species?			Good		
List:			Minor erosion		
			Badly eroded		
WIDTH OF WATERCOURSE:			No of spots		
SPEED OF FLOW:	Fast				
	Medium				
	Slow		PARR HABITAT SCORE:		
			(1-poor, 5- excellent)		
Water voles	Sighting	Droppings			
	Runs/ Burrows	Habitat	SPAWNING GRAVEL		
Other species					
			OBSTACLES		
Complete in office			ACCESS		
			Rubbish?		
NOTES:					

a high proportion of the smaller tributaries up in the hills. Making this decision without knowing exactly what we might achieve by doing this was a risk which in turn necessitated doing only part of the total as a pilot first and then making a decision whether this effort and cost was justified. If it was not justified, then the 1000 mile survey would become a considerably smaller task.

The key criteria for selecting surveyors were simply that they were competent hill walkers who could record information in a systematic manner, could identify tree species and record the wider aspects of biodiversity.

Survey work involved walking up one tributary, down the next, averaging 5-7 km per surveyor per day, depending on exact terrain and weather conditions. It is very much a rapid-survey technique, aimed at picking up the issues, and not looking at any one aspect in too much detail. The use of hand held GPS units and computer mapping packages, as well as digital cameras allowed us a simple and reliable means of quantifying and presenting the information gathered. Needless to say this amounted to quite a lot.

Survey costs

The survey costs were calculated based on the 1628 kilometres or 1017 miles of tributaries in the three catchments, as defined in the previous notes. This does NOT include the tributaries leading directly in to Loch Lyon or Loch an Daimh, or any tributaries discharging directly in to Loch Tay.

Survey costs

	Lyon	Lochay	Dochart (Fillan)	TOTAL
Lengths	kms	kms	kms	kms
Main stem	44	21	31	96
Major tributaries	62	21	57	140
Minor tributaries	470	303	620	1393
TOTAL kilometres	576	345	708	1628
	days	days	days	days
Surveying days (5 km per day)	115	69	142	326
Main stem + major tributaries	21	8	18	47
Minor tributaries	94	61	124	279
Total days (110% of survey days)	127	76	156	358
Cost (Total days x £265 per day)#		£11,241***		£54,620
# £120/day for minor tributaries				
Surveying costs	£54,620**			
Mileage (average 60milesx40p/ day)	£ 7,814	£ 1,800		
Mapping tiles##	£ 1,350	£ 350		
Geology/ hydrology report	£ 3,500			
Initial surveyor training	£ 600	£ 600		
Misc costs/ contingency	£ 5,000			
TOTAL cost of project:	£72,884			
## 51 tiles for 3 years				
	LOCHAY*	£13,991		

* As the smallest catchment area, the Lochay has been surveyed first as a pilot in summer 2007.

** £8,000 of this total was budgeted to train volunteers, fishing ghillies and members of the local community in habitat survey techniques and use of GPS etc, to give them an understanding of the issues involved within catchments of this type and endgender a feeling of ownership in the Western Catchments Project.

*** £1,590 budgeted for volunteer training, part of the total £,8000 above.

Survey methodology

Identification of Watercourses

For the purposes of rigorous future reference, all watercourses are identified in a systematic manner. Three categories of watercourses are identified:

- The main stem of the river
- Any significant tributaries, as defined by a slightly thicker blue line on OS map on the 1:50,000 OS map; and
- Minor tributaries (those with only a thin blue line on the 1:50,000 OS map).

Numbered watercourses

In each catchment, there is only one main river, although on the Dochart system, three rivers are named (Dochart, Fillan & Cononish, each leading in to the next).

The significant tributaries were labelled alphabetically: a. b, c . Branches within these were labelled a1, a2.

Minor tributaries that joined directly in to the main stem or into one of these more significant tributaries were labelled numerically, with letters allocated for branches within the tributary systems, as many of these were fairly complex. Eg 1a, 1b, 1c.

In Glen Lochay there was one main stem, fifteen major tributaries and three hundred and one minor tributaries, many

of which also had complex systems of side tributaries. In Glen Dochart there was one main stem covering the three rivers and extending up to Ben Lui, although this was broken up by Lochs Dochart and Iubhair. There were 19 major tributaries and 296 minor tributaries plus associated networks. In Glen Lyon there was one main stem, 21 major tributaries and 178 minor tributaries plus networks. The pilot study of Glen Lochay highlighted those areas where meaningful data was least likely to be gathered. We therefore excluded approximately ten percent of the total tributary network in Glen Lyon, and twenty percent on the Dochart, to give a final total length of 1000 miles overall. In both cases care was taken to cover a representative sample of habitats throughout each catchment. In both cases the excluded tributaries were minor and beyond where migratory fish could access.

Over and above this, there were watercourses which did not lead directly in to the main river or tributaries, many of which were dry in the summer months and many were old drainage ditches. These watercourses were not surveyed but in Glen Lochay, for example, they probably amounted to a minimum of another 100 miles. It is important to realise that this additional layer of drainage exists, although it has not been surveyed.

Finally, identifying watercourses in this simple manner allowed easy communication between surveyors on the hill via two-way radio, allowing positions and progress to be quickly and accurately fixed. Surveyors carried a digitized map with watercourses clearly labelled. Only labelled watercourses were to be surveyed, although items of interest were sometimes noted when travelling between two labelled watercourses.

Identification of section lengths

Each watercourse was broken down in to a number of lengths (often termed "reaches") and for each length a survey sheet was completed. Numbering of these sections began at the top and worked downstream.

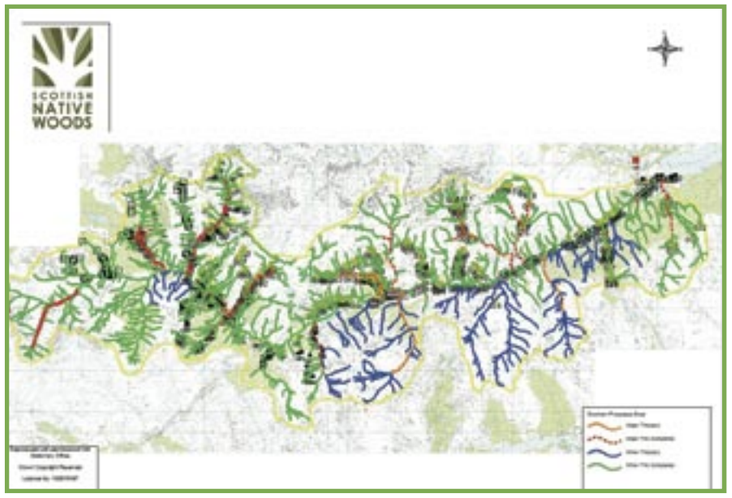
A new section was created every time there was a significant change in land-use, tributary width or speed of flow. On the main river system field boundaries were used as section boundaries, roads and bridges were also often used, or junctions with other watercourses. In the uplands the boundary might be a fence line, the edge of a wood, or at a sudden change of the speed of flow of the watercourse. For each new section the boundary was logged by GPS and a description of the boundary noted, this preferably being identifiable on the maps being used. No areas were found to be outwith GPS coverage. On the main river stem section lengths were shorter because variation in land use and habitats in and around the river was that bit more complex. Up in the hills a minor tributary usually contained just one section length, unless there was an obvious reason for more than this.

Within sections items of interest could be logged by GPS with accompanying notes provided. All tributaries were digitized before survey work started, so it was easy to record progress simply by assigning a different colour to those lengths completed and lengths were also automatically available when supervising progress.

Completing the survey sheet

General points

In all cases, surveyors were working independently and walking along one side of the tributary. Where possible, a line was taken where the watercourse itself was readily visible and where any blockages, waterfalls or spawning gravel etc could be noted. In some cases, especially where watercourses were falling quickly through a gorge, the safe line to walk may have been some way from the watercourse. One of our surveyors chose to walk down the channel of such gorges this, apparently, being the most direct route of travel in such circumstances. Surveyors were under strict instruction not to endanger



Progress map Green complete, blue yet to survey, September 2008

The Waterfall Allt Eas Anie, Cononish

themselves in any way. The steep slopes, often wet and unstable soils, and lack of defined pathways made this survey work potentially very dangerous. Almost all the routes being followed were completely away from existing tracks, mobile communications were often lacking within a gully, and a simple slip could easily have had disastrous consequences. The potential for picking up ticks within areas of bracken was very high and, of course, care had to be taken not to get caught out at higher altitudes in wet weather. A number of days were rained off.

Surveyors had to report in at the end of every day and always left the hill together. During the course of the 1000 mile survey there was only one significant safety incident when a surveyor got lost in "Puzzle Glen" between Meggernie and Boreland Estates and ended up in Glen Lochay instead of Glen Lyon.

When surveying, left and right banks were defined looking down the watercourse, this being consistent with terminology used by ghillies and other water users on the main river.

Two main surveyors carried out most of the work involved, this allowed a good degree of consistency throughout the survey. This was important as a number of issues being quantified were relatively subjective in nature.

Tree cover

The tree cover along each watercourse was assigned to one of three bands of percentage cover, or recorded as not being present to any significant extent. In the latter category, individual trees or small groups would be logged. On each section, the main tree species was noted. Minor species were included as additional notes.

In each section, notes were made of the age structure of the trees present and whether any natural regeneration was evident or not.

We were aware of the upcoming national survey of native woodlands being carried out by the Forestry Commission and were careful not to duplicate information that might be gathered by them. The FC survey would be looking at woods over 0.25 ha in size, which is actually reasonably big for a native woodland remnant. Many of the long narrow riparian remnants we were looking at would therefore not be covered by the national survey, and certainly not the fragments higher up in the hills.

We were aware at the outset that we would be finding fragments of rare montane willow habitat, many of which would have been undocumented. To help prepare for this, we underwent a day of training in montane willow identification at the National Trust for Scotland property at Ben Lawers.

During the survey we noted the presence of non-native species such as sycamore or beech and quantified the amount present.

Two significant changes arose from the pilot survey of Glen Lochay.

Firstly, a short-hand method of describing the age classes present was devised, based on work carried out at Glen Feshie by Tim Clifford.

Tree life class scores

*For each species, add age class in (**brackets**) after description. (There may be more than one tree life class, in which case add all those that are present.)*

1 Unsecured regeneration. For heavily browsed bushes eg willows, use 1.1.
2 Secured regeneration, but young and not reproductive yet. Less than 3-4 metres high.
3 Young pole stage trees, reproductive but not mature.
4 Mature reproductive, but in good health, and no signs of decline
5 1. Early decline.
2. 50% or more decline in canopy.
6 Tree alive but on way out (senescent / post-reproductive).
7 Dead.

Secondly, we gave greater prominence to recording aspen remnants in 2008 than in 2007 because of an increasing

Training day

national interest in the species as an important minor component of our native woodlands.

Bracken

The significant presence of bracken in the glens was evident from the outset and during the course of the survey we marked the limits of spread by GPS and allocated the percentage cover to one of three categories, as before, or noted that it was absent.

Invasive species

Surveyors were asked to record the presence of invasive plant species such as Japanese knotweed, Himalayan balsam or giant hogweed which have become a serious problem on many riparian habitats throughout Scotland.

We were aware of two studies already having been carried out, one by The Tay District Salmon Fisheries Board (TDSFB) and another by the Loch Lomond and Trossachs National Park Authority. However, this was a desk exercise drawing together existing knowledge.

We anticipated that we would find a number of fragments not located by these two organisations and also look at recommendations for active control in the future. In such cases discovered, the stands were quantified in square metres.

Width and speed of flow in watercourses

Speed of flow was divided simply in to three categories, fast, medium or slow. While this categorisation may appear subjective, in reality it was actually a very simple classification to make.

Surveyors were asked to state the width of watercourses. This obviously varied along a watercourse, and watercourses obviously tended to get narrower further up An approximate width at the mid-section of each reach was noted, or sometimes a range was quoted to illustrate the variation present.

Adjacent land uses

Very often the land-use next to a watercourse was different to that which could be established from the map, and surveyors were asked to classify the main riparian area in to one of 7-8 different categories. Often a mixture of land uses were present in the area. The main value of this categorisation was that it encouraged surveyors to think about what was happening in the immediate riparian zone, how the watercourse was being used, what the threats might be and what the future opportunities might be.

Fences

We classified fences as Good, Poor, Incomplete or Not Applicable. Any changes in quality within a section could be marked with a GPS. Areas of deer fencing were also noted. We concerned ourselves mainly with those fences running parallel to the watercourses.

Adjacent land uses

Bank stability

The banks of watercourses were classified as either being good, showing minor erosion, or showing major erosion. Where applicable, we tried to list the probable cause. The extremities of major erosion scars were logged with a GPS. Because survey work was carried out in the summer months, growth of vegetation will have obscured a certain amount of minor erosion. Low ground land in particular may have looked very different if cattle had been wintering there when the survey work was being carried out.

Obstacles

We logged the positions of any obstacles to fish passage and their characteristics. We also sought to define the limits of where migratory fish could naturally access. This invariably involved a certain amount of subjective judgement and very often a surveyor would be unsure whether a particular waterfall would be a barrier under all conditions or not. However, waterfalls within the glens often tended to occur as a series of falls, and it was often clear that somewhere along a particular stretch was going to represent the last point to which fish could access, even if that precise point was difficult to establish.

When we were completing survey work, we came across the various dams and other structures associated with hydro-extraction in the glen. While none of these were blocking the passage of fish (indeed SSE have ensured that major obstacles are now passable), many of these structures were denying fish access to minor watercourses by removing the majority of water from them.

Access

While undertaking the survey, note was made of any issues relating to access in the glen; where people were camping or parking, broken bridges, what routes they were tending to take, what features were attracting their attention, access to the river for fishing etc.

Spawning gravel

Large areas of spawning gravel within a river system are fairly easy to identify and then quantify and being able to ascertain the approximate distribution of this valuable resource would be important in any overall assessment of the riparian habitat in the glens. Quantifying spawning gravel also had the effect of getting the surveyors to think about how fish might be using the various tributaries.

Areas of spawning gravel were only quantified within the boundaries of where fish might be able to naturally access. In the more minor tributaries, individual patches of gravel were logged and quantified in terms of square metres. If there was a substantial length present, a percentage figure was given for that section as a whole. On the main river, most spawning gravel occurred in substantial spawning fords where the two extremities could be easily logged. Smaller pockets were also logged and an area in square metres given. Small pockets of gravel at the other side of the river could easily be missed, especially if trees were casting a shade on the water, making it difficult to see the bottom of the river, depending on where the sun was. Logging spawning habitat therefore became less accurate as we progressed down the river.

Parr habitat

This was the only classification during surveying where we decided to experiment and try to quantify an aspect of the riparian habitat that was arguably beyond our expertise and where we might leave ourselves open to criticism. As it turned out, this did not work especially well, the reasons to be discussed later in this document.

'Over and above the specific boxes on the survey sheet, surveyors were asked to note down any interesting wildlife sightings ...'

General bio-diversity

Over and above the specific boxes on the survey sheet, surveyors were asked to note down any interesting wildlife sightings or any other items of wider biodiversity value, and to be alert to any issues which we might not have anticipated in advance.

Water voles

On our training day at NTS Ben Lawers, it was suggested that if we were going up high in the hills then we should use the opportunity to map water vole habitat. At the time we decided that we had enough to be going on with and not to take on this extra work.

By mid-summer we had worked our way up the glen and the survey work in the higher hills was throwing up a number of native woodland fragments, but not much more than that. About this time we had started coming in to potential water vole habitat and very shortly afterwards, we encountered our first live water vole looking at us while we had our lunch. Discussions with local keepers and shepherds confirmed that water voles were present within the glen, and probably in good numbers. Seeing them was apparently no big thing.

We quickly educated ourselves as to what to look for and devised a suitable strategy for recording evidence of water voles. Shortage of time before the stalking season precluded any formal training activity. Discussion with SNH suggested water voles in this area were undocumented. We therefore became accidental, amateur water vole surveyors on top of the other things we were looking at.

Because of the way this came about, the bottom half of Glen Lochay has not been surveyed properly for water voles.
The survey work recorded water voles at several levels:

1. We recorded all lengths of classic water vole habitat, where slow moving water coincided with a suitable cover of rushes and sedges and where banks allowed water voles to burrow.
2. Sections of water courses that contained possible water vole habitat along a proportion of their length were also recorded as marginal habitat.
3. Evidence of water vole burrows and/or runs.
4. Evidence of water vole droppings. At this level, water voles could be confirmed for definite in that area.
5. Sightings of water voles.

It quickly became apparent that huge numbers of other vole species and possibly also rats were present in the area. Signs left by these other animals provided a steady source of distraction and probably meant that we missed many genuine water vole signs as we tried to rule out these other possibilities in some cases. Deficiencies or uncertainties in our water vole survey protocol were made good during a training day with the Cairngorms National Park water vole officer in time for the 2008 season. ❖

Thoughts Along the Way

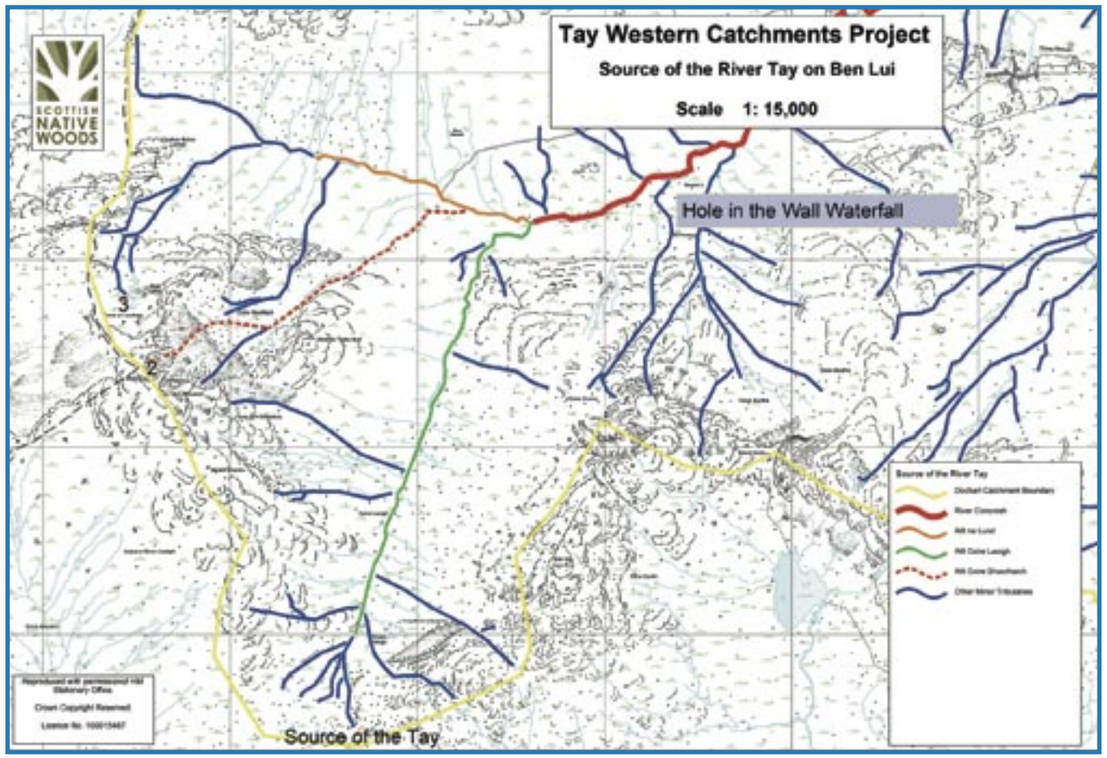
You cannot walk a thousand miles without doing some thinking, and our survey work inspired several articles which appeared in the local Press over the two years concerned.
The following four articles were all published by Commentonline during the survey period.

Where is the source of the Tay?

From mid-summer in 2008, it had been our intention to finish the 1000 miles of survey work at the very source of the Tay on Ben Lui. However, on reaching the upper Cononish it immediately became obvious that finishing at the source was not at all straightforward.

Very simply, although every commentator acknowledges that the Source of the Tay arises on Ben Lui, very few were willing to commit themselves to saying which of the several options was the ***actual*** source.

How do you define the source of a river? The Tay river system is massive, with the biggest catchment area in Britain. A series of major rivers all congregate before eventually passing Dundee and out to the North Sea. The Earn, Tummel and Isla are all major rivers, as well as the Tay itself. The furthest point from the sea in the Tay system is the source of the river Ba on Rannoch Moor, which eventually flows down through lochs Rannoch and Tummel, into the river Tummel and into the Tay below Pitlochry. The Tay proper is recognized to start at Kenmore below Loch Tay and, at birth, is already a significant river, flowing from what is one of the biggest fresh water lochs in the country. Many watercourses flow into Loch Tay, including two rivers, the Lochay and the Dochart. All these watercourses can be described as being "sources" of the Tay. The furthest point on the Lochay is the source of Lairig an Lochain on Ben Challum, but the watercourses arising on Ben Lui to the south-west of Tyndrum on the Dochart system are much further away and this is where the symbolic source of the Tay is regarded as being. This is the headwaters of the river Cononish, which flows in to the Fillan before becoming the Dochart as it leaves Loch Iubhair east of Crianlarich. The only reference to the actual source of the Tay is in the book ***Tales of the Tay*** by Joan Pearson, written in 1975. It names the Allt na Rund (Point 3) as the source, which is the furthest point west, being a mere five miles from salt water on the west coast. Because of this it has maybe been assumed that it is also the longest and hence the source of the Tay.



The Hole in the Wall waterfall

However, it has become obvious to us that another watercourse, the Allt Coire Laoigh is 160 metres longer and is also a more substantial tributary. Logically, this should be the source. A third watercourse, the Allt Coire Ghaorhaich (Point 2), arises from near the summit of Ben Lui and is the highest and certainly the most spectacular of the possible options.

An ownership map from 1780 located at Lochdochart Estate records the "Source of the Tay" but is pencilled in at the ***Hole In The Wall*** waterfall about a mile below where these three tributaries come together and which is the furthest point where migratory fish can access on the Cononish . So, in 1780, the source of the Tay was regarded as being on Ben Lui, but no-one was committing themselves to an opinion as to which tributary was the actual source. In 2008, it was almost impossible to find anyone who would commit themselves to an opinion in answering this, despite there being no end of people who are interested in the river Tay and are usually never slow to give an opinion! Although a slightly academic question, it is nonetheless interesting, not least because all the other major salmon rivers in Scotland have a single recognized source. The one quoted source for the Tay seems logically to be the wrong one. So, how do you define the source of a river? Is it:

- the furthest point from the sea
- the most dominant watercourse

Ben Lui

- the one starting furthest west, or
- the one arising from the highest point?

In many ways, it is quite appropriate for there to be no clear answer and no clear definition.

For the record, we think that, as it is the most dominant tributary and also the longest, the answer is the Allt Coire Laoigh and ,as no-one else seems too concerned, we are going to claim credit for re- defining the true source of the River Tay, this being an excellent way of celebrating the end of our 1000 mile walk as part of our Tay Western Catchments Project. The current landowner agrees with us.

Before we left on 10th December, we buried a small time capsule at the source, including some money and documents relating to this project. If you are ever passing that way and if you can find it, you can help yourself to the price of a fish supper in Tyndrum. ■

Highland Perthshire - the bit in the middle

It has occurred to us recently that, when the Cairngorms National Park moves south to Blair Atholl, there will then be less than 40 miles between it and the Loch Lomond & Trossachs National Park, with Highland Perthshire comprising the bit in the middle. In fact, the Cairngorms LBAP area extends down to Pitlochry, Loch Tummel and Loch Rannoch leaving less than 25 miles as the crow flies to the LLT National Park, with only Glen Lochay, Glen Lyon and half of the Rannoch/Tummel valley in between. We have therefore come to appreciate the strategic value of our TWCP area, because it forms a significant link between these two areas of national importance.

'What would it be like living in an area that was just ouside two National parks, perhaps only ten miles apart? Is a buffer zone required between National Parks and, if so, how big should it be?'

The well publicized southward expansion of the Cairngorms Park to Blair Atholl appears to have significant local support and in many ways this is a natural geographical boundary. The suggested expansion of the Loch Lomond & Trossachs National Park to include Loch Tay is a more recent phenonomen. Whatever the merits of these moves, it is clear that if they were to expand the bit in between which is outwith these Parks can only get smaller in the same process. The areas just outside designated sites, be they a National Park or an SSSI, are always affected by such designations. Sometimes the effects are good, sometimes not. It is often said that being just outside a National Park is the worst place to be because of the different planning standards applied either side of the boundary. It is easier building outside the Park than within and this includes the tourist infra-structure that inevitably springs up at each entrance to that Park to service it. This does create welcome economic activity, but potentially problems as well. What would it be like living in an area that was just outside TWO National Parks, perhaps only ten miles apart?

Is a buffer zone required between National Parks and, if so, how big should it be? Would a National Park lose part of its individual identity if it was too closely associated with a neighbouring Park? If two Parks get into the habit of expanding, would one be tempted to try and grab chunks of the bit in between before the other does, and what political effects would that have?

Could the LLTNPA area be expanded to take in Loch Tay alone, creating as it would an odd-looking protrusion that could only be referred to in a derogatory manner thereafter? What would this new body be called? The Loch Lomond and Trossachs and Loch Tay National Park Authority(LLTLTNPA)? The current name is unwieldy enough.

Our survey work will strengthen current knowledge associated with these glens. For example, we will gain valuable insights in to native woodland species such as aspen and montane willows in this area, ,which will allow more informed decisions to be made regarding forest habitat networks in the future. The CNPA especially are extremely interested in our water vole research. Water vole populations are virtually undocumented in this area, yet we found them all over the place. This information will be useful to both Parks and emphasizes how biodiversity functions on a large scale. It could well be then that Highland Perthshire might be able to benefit from this status as the "bit in the middle" in future, receiving some of the benefits of being in a National Park, but without the potential difficulties and extra administration that often comes from being within their boundaries. Being in the middle between two national Parks might turn out to be important and we can preserve their individual integrity (and our own) by keeping them a safe distance apart. This status is likely to be a major factor in potential funding applications for this project in future years and should not be under-estimated.

It might be an idea for people in Highland Perthshire to have these discussions in the near future and debate where this process of possible National Park expansion might be going before it becomes too established. Otherwise we will end up sitting like an owl on a fence post in the middle, continually looking one way and then the other, wondering who is going to make a move next and what we should do to avoid the squeeze. ■

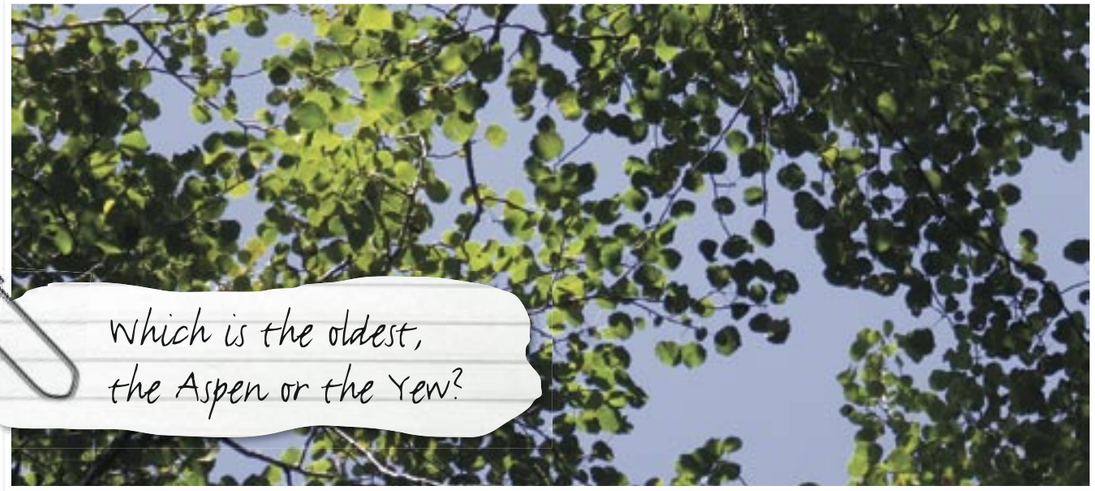
Optimum habitat or not?

One of the interesting aspects about our TWCP survey work is that we often found animals in places where they might not be expected. Because we looked at all the watercourses, we tended to find things where they actually were, not in the places where we only looked because that was where they were most likely to be.

We all know that red squirrels like conifer trees, water voles like slow moving streams with soft earth or peat to burrow, capercaillie like lots of blaeberry and pine trees. We are conditioned to think that certain species like certain habitats and that anything else must be sub-standard and therefore must be improved, often at considerable expense. The current grant programme, for example, encourages people to think in this very narrow and prescriptive manner. Things do not work like this in the real world and it is very important to maintain a degree of scepticism.

Take, for example, this red squirrel. There are only a small number of conifers in this wood yet here it is climbing up an ash tree, having been scraping around in the leaves for beech mast or whatever it could find. This is far from perfect habitat for a red squirrel, although it did scamper over one hundred metres to run up this tree and then leap across to the conifer behind to find a safe hiding spot. This illustrates the point very well that species usually require a matrix of their preferred habitat to supply their essential needs, but can utilize sub-optimal or even seemingly unsuitable habitat in between for other needs, and move through this habitat to their preferred habitat if required. Species can use a mixture of the suitable and the seemingly less suitable, and the latter can be very valuable to the species as a whole. Researchers from the Cairngorms National Park now have increasing evidence of water voles moving through seemingly unsuitable habitat to spread to different territories in neighbouring catchments, including through fast flowing streams and conifer plantations. This has important implications for conservation of the species. Capercaillie can use lower quality woodland as stepping stones between good pinewood areas when they are travelling long distances during dispersal. They are not just creatures of the native pinewoods, with plantations of differing species becoming increasingly important for them.

Many species including ourselves therefore are versatile. We know what we like and what we would prefer to have, but can often make do with a lot less for a period if needs dictate. We would expect species to evolve to be like this, as any that are too demanding or prescriptive are likely to suffer disappointments and die out. It is re-assuring that wildlife can make the best of what is available to it, allowing that core needs during sensitive periods are met. It is then useful not just to consider the areas of top quality habitat, but also the bits in between. The idea about the "bits in between", whether they be designated sites or areas of recognized optimum habitat, is a recurring feature in this report. ■



Which is the oldest, the Aspen or the Yew?

All those familiar with Highland Perthshire will be aware of the ancient Yew tree in the graveyard of the church at Fortingall, which is reputedly 3000- 5000 years old and is often quoted as being the oldest living organism in Europe. The long history of religious worship and other important symbolisms associated with the site, many of which have been carefully documented in different ways, allows us some insight to the legend surrounding this particular tree. The claim that it is 3000-5000 years old can be corroborated to a significant extent. The Fortingall Yew is a popular place to stop on the local site-seeing circuit at all times of year. It is always there, and although it is now but a shadow of it's former self, it is indeed humbling to think of the many changes and world events which have taken place since this one tree first started to capture the light of day. The thought that we might have something this old right here on our doorstep is truly mesmerizing.

The Fortingall Yew

Is this really the oldest living organism that exists locally? Highland Perthshire is a hotspot for one of our truly iconic species of tree, the native aspen or *Populus Tremula* and a great deal of very useful information exists locally on this species. Many of the steep-sided gorges in Highland Perthshire contain valuable remnants of native woodland, and as illustrated by data collected this summer during our Tay Western Catchments Project, most of these upland woodland remnants contain a small proportion of aspen. Aspen only rarely spreads by seed and most frequently spreads vegetatively by throwing up suckers, each of which has the capacity to develop in to a new "tree" if it is not browsed off. A moderate-sized stand of aspen might contain one or two very old trees, 20-100 established trees of all approximately the same age and subsequent younger generations that have arisen as periods of reduced grazing allowed them to get away. There will often be a carpet of suckers that continually get browsed off to knee height. In upland gorges, there might typically only be 5-20 stems along with associated suckers. These stems are not individual "trees" but all part of a single organism or clone. Individual stems might live 50-100 years, but the organism as a whole can persist much, much longer, the underground structures ensuring that aspen can survive at a single isolated location for many centuries.

How many centuries?

Well the simple answer is that no-one knows. Little research has been done on the age of clones for European aspen, but scientists studying the North American trembling aspen (*Populus tremuloides*) have concluded that individual clones can survive for 10,000 years or more, making them possibly the longest lived organisms on the planet. So, when you next go to Fortingall and walk along the paving slabs detailing who else has passed that way since the tree was first established, you should be aware that in many of the upland gorges all around you that there are trees growing today that may in fact be twice as old. Next time you are looking at an aspen tree or, indeed, any area of native woodland, it is worth thinking for a moment just how long it might actually have been growing in that particular spot. ■

SAC Hill and Mountain Research Centre

One of the larger landholdings within the area is the research farm of Kirkton & Auchtertyre at which a wide range of topical land use issues are studied, and practical management advice derived from this. ***Dr. John P. Holland*** (Upland ecologist, SAC Hill & Mountain Research Centre), describes the work that goes on there, much of which will have a practical application in the management of these catchments in future years.

SAC (Scottish Agricultural College) is an innovative, knowledge-based organisation supporting the development of rural communities and industries through specialist research and development resources, education and training provision, and expert advisory and consultancy services. The SAC Hill and Mountain Research Centre (HMRC) is based at Kirkton and Auchtertyre farms in Strathfillan, between the villages of Tyndrum and Crianlarich in west Perthshire. The farms cover some 2,225 hectares of land, rising from 180m on the cultivated flood plain of the River Fillan, to 1025m at the summit of Ben Challum. The livestock enterprise, like much of the Highlands of Scotland, is concentrated on hill sheep, with currently some 770 ewes (Scottish Black-face and Lleyn). The farm is composed of 74 ha of improved pasture and cultivatable land, 153 ha of semi-improved pasture, 1677 ha of unimproved hill pasture (predominantly grassland dominated by *Nardus stricta*), and 307 ha of woodland and scrub. The farms have a rich archaeological and historical heritage with particular links to St. Fillan. Over 300 archaeological sites have been recorded on the farms including St. Fillan's Priory and Graveyard which are Scheduled Ancient Monuments, and numerous shielings and enclosures. Over 300 species of vascular plant (including 3 red data book and 15 nationally scarce species) have been recorded on the farm, together with over 100 bird species and 18 mammals. In recent years a number of things have been done to diversify the land-based opportunities on the farms, including the development of the Strathfillan Wigwams tourist business and farm shop, the provision of an extensive network of way-marked footpaths and interpretation boards, the large scale planting of new native woodlands and the installation of a micro hydro-electric scheme. The main research interests of the staff at the HMRC focus around a number of themes including: options for sheep production in extensive systems and implications for animal welfare; plant ecology of grazed habitats, focussing upon acid grasslands, heathlands and upland woodlands; bio-economic modelling of livestock in upland environments; and participative research with hill farmers, environmental managers and policy-makers. Current research topics include: the impact of reduced sheep grazing on upland biodiversity; modelling the environmental and economic sustainability of hill farms; the impact of cattle grazing on upland biodiversity; cattle grazing behaviour on hill ground; and the welfare of extensive sheep.

Hill sheep production has been the core of the farming enterprise on the farms for over 200 years. The sheep system continues to be centred round the Scottish Black-face breed however the production and viability of alternative breeds such as the Lleyn are now being investigated.

The national sheep flock in Scotland declined by over 2.3 million between 1998 and 2007 (Renwick *et al*., 2008). This decline has been fuelled by a combination of factors, including the foot-and-mouth disease outbreak in 2001, a general down-turn in the economic viability of hill farms and changes in the way that livestock farmers are subsidised. In some areas, particularly in the North West, there have been reductions of between 35 and 60% (Renwick *et al*., 2008). Although hill livestock production

Fields at Kirkton with the Crianlarich hills behind

Ben Challum and Gleann a' Chlachain

has changed markedly over the last 250 years, in response to economic and environmental factors, the system of all-year-round grazing of hill pastures by hardy breeds of hill sheep has been in place in much of Highland Scotland since the beginning of the 19th Century. This relatively stable system of grazing management is now under threat. For many years grazing levels have been considered to be too high in many hill areas leading to heather loss and damage to vegetation and soils. However, the situation in some places has now reversed with little or no livestock, which may lead to problems associated with under-grazing. Reduced levels of grazing will be of benefit to some habitats and species, particularly dwarf shrub heath, tall herb vegetation and montane willow scrub, but for those habitats which are dependent on grazing, such as species-rich montane grasslands, the loss of grazing livestock is likely to be detrimental to their condition and conservation value. SAC has been looking at the impacts of "farming's retreat from the hills" on both farm economics and biodiversity (Holland *et al*., 2008).

In the late 1990's 275 hectares of new native woodland were planted on the farms, much of it linked to the Hill Sheep and Native Woodland Project. This project was conceived as a new approach to land management in the uplands, with the aim of improving the sustainability of hill farming, through the integration of an innovative sheep husbandry system with the establishment of native woodland within the same block of land. The project utilized 1438 hectares of hill land to test and demonstrate the management approach at a full systems scale. Two adjoining glens were used in the project; Caol Gleann (590 ha) and Gleann a'Chlachain (848 ha). Caol Gleann was managed using a traditional sheep husbandry system with 800 breeding ewes retained on the site year-round and with no planted trees; while Gleann a'Chlachain had 260 ha of planted woodland (from 230 to 600 m above sea-level) and 588 ha of hill land which carried 650 breeding ewes from April to October. As the woodland matures it is envisaged that there will be controlled re-introduction of grazing into the woodland. Over the first ten years tree establishment has been relatively poor over much of the site and losses have been high. This has been due to a number of factors, including the high altitude, harsh climatic conditions, nutrient-poor and wet soils, deer browsing and vole damage. The tree losses have necessitated an extensive programme of woodland refurbishment. A total of over 484,000 trees have been planted since 1998. Although the trees have been slow to establish, a mountain woodland of low growing trees and shrubs with extensive open areas will develop over the coming decades, creating a diverse and species-rich habitat which will enhance the landscape. ■

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Renwick, A., Waterhouse, A., Thomson, S., Midgeley, A., Vipond, J., Hill, G., Morgan-Davies, C., Holland, J.P., Pollock M. and Williams. M. (2008) *Farmings Retreat from the Hills*. Edinburgh: SAC Rural Policy Centre.

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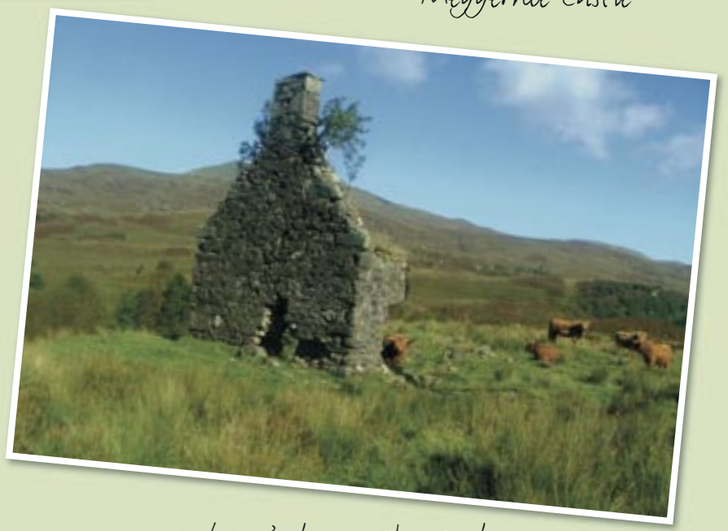
Bridge on South Chesthill

The burning bush of Glenlyon

Meggernie Castle

Tarmachan Ridge from along Loch Tay

Highland coos



Rob Roy's house, Glen Dochart

Lonesome Pine in Strathfillan

Ruined bothy, in Gleann Muillin, Glenlyon Estate

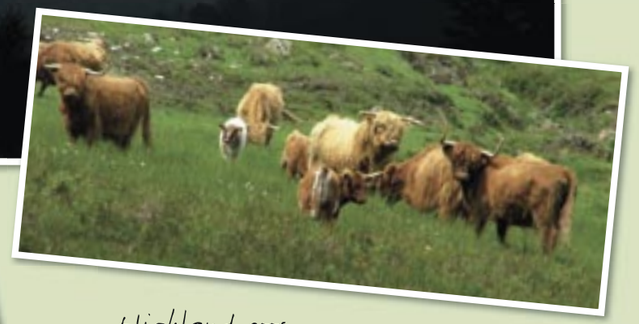
Feeding time on North Chesthill

The moon over Inverinian

Garth Castle, Keltneyburn

Boat in Killin

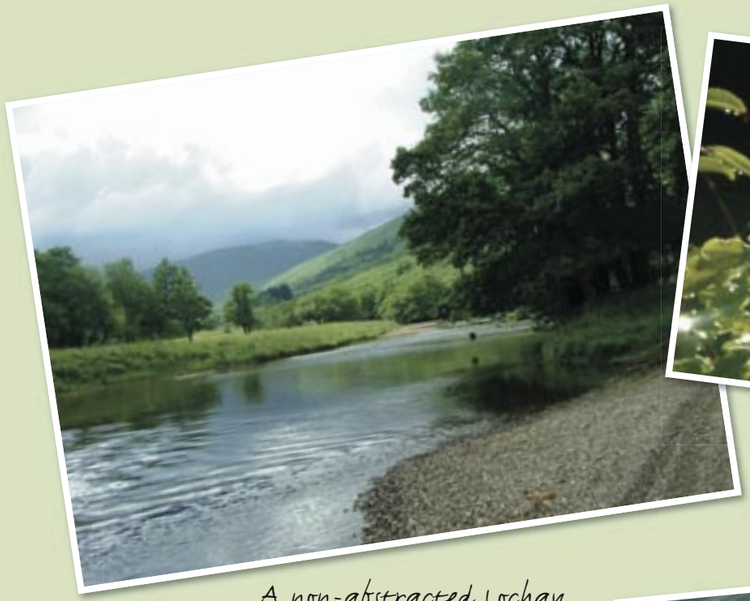
Evening light on Schiehallion



Highland coos

Coire Choille Chuilc pinewood, Tyndrum

Cononish Farm



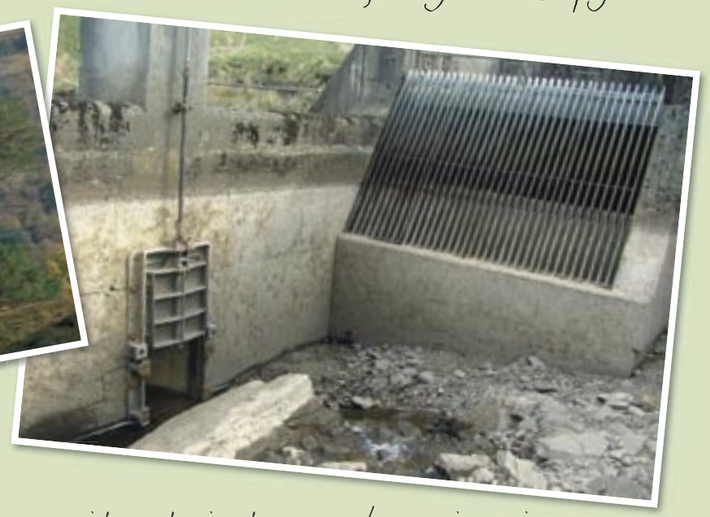
A non-abstracted Lochay

Oak

The long and winding road

Jimmy Lambie's pigs

Meggernie pinewoods



Inside a drained water abstraction point

Cononish in flood

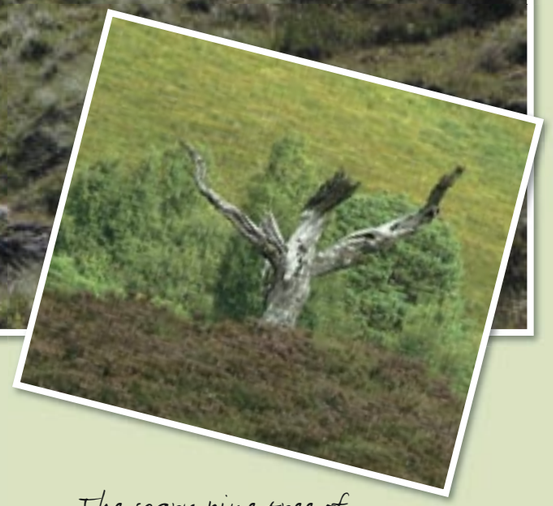
Ben Heasgarnich from Meall nan Subh

Low water in Loch Lyon, Summer, 2010

Aspen in snow

The dam at Loch an Daimh

Blackfaced sheep above Invervar



The scary pine tree of Strathfillan

Hawthorn

Bridge over the river Lyon

Results and discussion

Progress of survey

On digitizing the Glen Lochay watercourses, it was immediately apparent that we had a much longer length of tributaries than anticipated from the 1:50,000 scale Landranger maps, with 296.5 miles as opposed to the original figure of 215 miles, an increase of 35%. This was simply because the mapping tiles used were at 1:10,000 scale and more watercourses were marked on these more detailed maps.

It was clear that a more robust system was required so that we could exclude a proportion of the more minor watercourses. However, it was difficult to devise that at the outset without doing a sample area first, to see what data we might be missing by excluding a proportion of tributaries.

It was decided to progress with the longer length of watercourses in Glen Lochay and then use our experience from this to produce a better sampling protocol for the other two glens. Our initial 1017 miles had therefore increased to 1098 miles. However, this would give us a buffer to work with at a later date. The intention was still to survey a minimum 1000 miles if the data coming back justified this level of effort. As previously stated, a proportion of minor tributaries were excluded in each of the other two glens to give 1000 miles in total, finishing on December 10th 2008 on Ben Lui.

Of the 1000 miles, approx 8 % of the total length was not recorded for a variety of reasons:

1. A proportion of tributaries did not exist or could not actually be found, emphasizing how minor they must have been. This was not always apparent from the initial mapping which contained a high degree of detail at 1:10,000 scale.
2. A number of very steep tributaries on Ben Lui, Benmore and Ben Challum were not surveyed as winter was rapidly approaching, weather conditions had been poor and it was obvious that the only outputs from such work would be a limited number of native woodland fragments. Given that these areas were within designated sites that would be extensively monitored anyway, these tributaries were only checked with binoculars from a distance.
3. On a small number of occasions weather conditions closed in quickly when surveyors where at higher altitudes and, on safety grounds, they had to mark the point they had reached and return down. Given the logistics of getting to some of these places, we decided not to return in this sort of situation.
4. Finally, surveyors had instructions not to go anywhere that may prove to be dangerous.

Areas not actually surveyed have been recorded as such.

Woodlands and woodland management

In each of the three main glens, woodlands and forests are considered in three categories:

1. Native broadleaved woodland
2. Non-native broadleaved woodland
3. Coniferous Forestry

In each category, the broad management issues are discussed. By necessity, this report can only be a summary of the main relevant issues, although issues are quantified wherever possible.

In this report, emphasis is placed on management of existing woodlands. No recommendations of extensive planting are being made. However, there are already several sizeable woodland plantings being contemplated in this area, almost all pinewoods or native woodland plantings and all subject to appropriate Environmental Impact Assessments.

Native broadleaved woodland

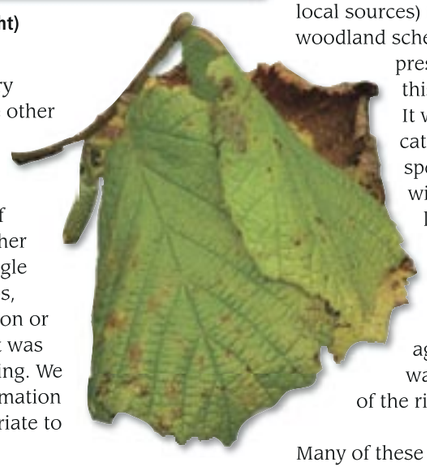
Glen Lochay

Glen Lochay is regarded as having one of the biggest areas of native broadleaved woodland in Stirling district. The survey effort revealed both the extent of these important woodlands and the diversity of tree species within them.

In the catchment as a whole, some 45 miles or 20% of the total length of tributaries surveyed to date were dominated by broadleaved native woodland within the riparian zone, a remarkably high percentage for a Highland glen, if not for the more heavily wooded hills of Highland Perthshire. Scattered fragments existed beyond this dominated area, many of these previously unmapped. The percentage increased to 45% in the bottom half of the glen.

Of the total amount of broadleaved native woodland length surveyed, 51% was dominated by birch/rowan, 33% by common alder, 1% by ash, and 0.7% by hazel. Some extremely rich woodlands dominated by a wide range of species, including oak, elm, hazel, bird cherry and goat willow were located in the bottom half of the glen. Such woodlands have been recorded as Mixed Broadleaved Woodland (MBL) and are perhaps the most valuable woods from a bio-diversity angle in the glen. They comprised 9.3% of the total woodland length. Almost all the woods in the glen comprised a significant percentage of minor species, the only exceptions to this being the common alder woods along the main river in the middle third of the catchment which were almost exclusively single-species.

Elm leaves and Hazel leaves (right)



This diversity of species is very significant and extends to the other two glens as well.

Beyond the obvious woodland areas, fragments of native woodlands existed higher up in the hills, sometimes single trees, sometimes small groups, perhaps a patch of regeneration or a shrub on a stream-side that was being kept in check by browsing. We have recorded essential information in more detail than is appropriate to relate here.

We were also interested in montane willow species (these grow as shrubs rather than trees), found in this area in reasonable numbers, but almost certainly under-recorded and actually very difficult to identify accurately. An account of montane willows is provided later in this document. They are most often to be found on crags and cliff faces and therefore our survey work did not pick up as many records as might be expected. However, we did find records of all the species of montane willows, except for woolly willow and these will be collated and added to the database of known records locally.

Most willow shrubs found at higher levels were ordinary goat willows, which also formed a significant proportion of the main broadleaved woodland areas as well. Goat willow regeneration was widespread in many areas throughout the three main glens, albeit usually suppressed by grazing.

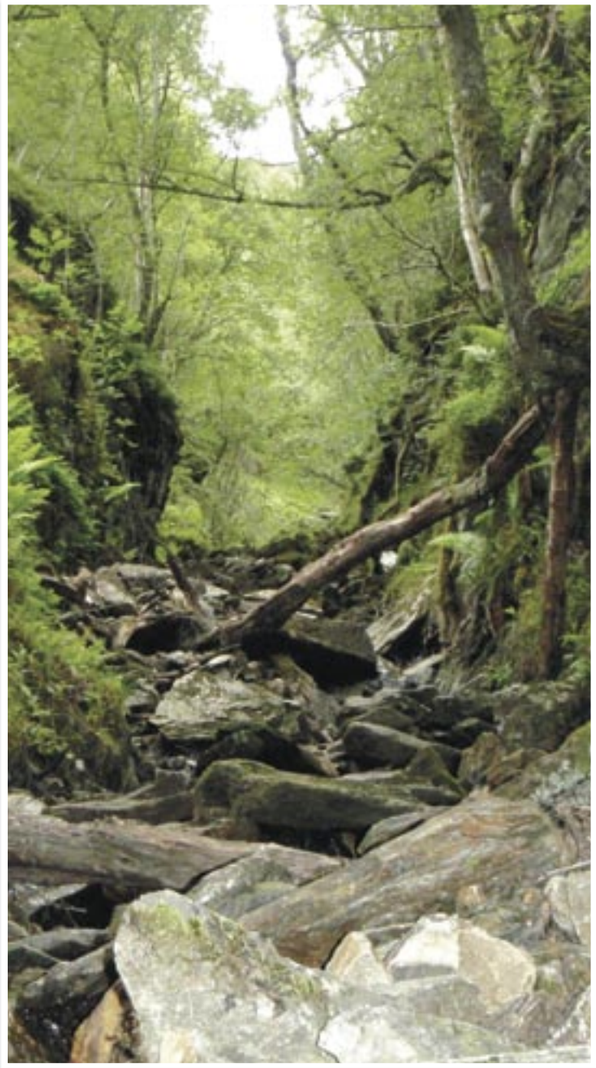
Montane willows and goat willow are a particularly characteristic of the area and significant local expertise in these species exists at both the National Trust for Scotland and the Scottish Agricultural Colleges at Kirkton. We would recommend that these species (from local sources) form a significant proportion of any new woodland schemes in this area and that future planting prescriptions are flexible enough to allow for this.

It was evident that for the woodland in the catchment as a whole, the age structure and species composition is actually very healthy, with a significant percentage of trees being less than 30 years old. Individual woods were often of a single age class, some with little signs of regeneration but, taken as a whole, the woods in Glen Lochay look reasonably well balanced, both in terms of age structure and species composition. This was certainly the case for those woods south of the river, less so to the north.

Many of these woods showed very significant regeneration for up to 40-50 metres outside their boundaries, often 20,000-50,000 seedlings per ha of birch, rowan and goat willow. Although these seedlings were obviously being eaten by sheep and deer and very few were likely to get away, this does at least illustrate that the capacity of these woods to regenerate is still extremely strong, and that regeneration could be achieved relatively easy if there was a demand and/or suitable

Goat Willows

Upland riparian woodland



Gorge woodland in Glen Lyon

inducements to do so. However, it was the pioneer species which were seeding in this manner, less mobile species such as oak, ash, hazel and elm only showed very localised areas of regeneration.

Beyond the main areas of woodland, we encountered several significant areas of gorge woodland with a very healthy species mix and age structure and where the ground vegetation seemed to be particularly diverse and indicative of ancient woodland sites. Such gorge woodlands were often associated with spectacular waterfalls.

Gorge woodlands were also prominent in the other two glens as well, notably Glen Lyon.

The Mamlorn Project

During the course of this survey, a significant broadleaved woodland project was being developed at the top end of Glen Lochay covering up to 880 ha (2000 acres) of native trees in 20 individual woodland blocks. This project recently received RDC funding and the main effect of the project will be to extend the already significant woodland cover in Glen Lochay right up into the headwaters of the glen, with the longer term objective of diversifying the overall habitat for deer and other species. It should also provide a longer term benefit to the riparian environment. The proposal has been subject to an extensive Environmental Impact Assessment (EIA) process and there are few concerns regarding pollution or run-off.

There have been some concerns expressed that such a forest area will intercept more water, resulting in less reaching the Lochay. Ordinarily this would not be an issue, but the upper Lochay is extensively abstracted for hydro generation and it is interesting to speculate if this has happened to the extent that it would be no longer possible to establish trees over a significant area without them impacting on the residual hydrology of the upper glen.

The amount of rain water intercepted depends on the "roughness" of the vegetation. Heather moorland, for example, tends to intercept more water than grassland, with less then reaching the watercourses. If trees replace heather, there is usually not much of a change in interception rates (FC Information Note, Trees & Water Yield, 2005), but trees will intercept more water than grassland if that is what they are replacing. Glen Lochay is very grassy. It is therefore possible that this woodland project may result in an increased interception of water in the upper Lochay and therefore a small reduction in water yield.

Both the other owners in Glen Lochay are also currently involved with native broadleaved woodland schemes, including the Glen Lochay Woods SSSI and a more modest planting scheme.

Glen Dochart
Unlike Glen Lochay, the broadleaved woodlands on the Dochart were distributed the full length of the glen and not consolidated at the lower end, with a mixture of densities and unwooded areas throughout. The species composition was very similar to Glen Lochay, at a broad level, but with a greater cover of mixed broadleaved woodland (25%) at the expense of birch dominated woods. Alders, although frequent, were not obviously a dominating species to any significant extent.

The main item of note was that a new generation of native woodland, 3-15 years old, was very evident in the corridor following the river and road/railway line, the presence of which was presumably deterring browsing animals. A proportion of this was probably 20-30 years old and did not appear to be managed in any way. The total resource was obviously significant and growing, as trees do. Scrub encroachment on to the floodplain was evident, mainly willow but also birch. This regeneration, probably less than five years old, was present over a wide area, suggesting recent reductions in grazing pressure in the middle parts of the Dochart. There appeared to be greater recent woodland spread in the Dochart system than there was in Glen Lochay, although the species composition of this was confined to birch, rowan and willows, the more pioneering species. This extension of the native woodland area appeared to be occurring entirely by default, as a result of wider changes in farming practice and in the longer term will lead to important climax woodland development if left to develop.

The overall age profile of the broadleaved woodlands in Glen Dochart is similar to Glen Lochay, with a significant percentage of trees being under 30 years old. In the upper tributaries there is a similar pattern of gorge woodlands and scattered native woodland fragments dominated by willows, birch and rowan.

Glen Lyon
Below Chesthill on the main stem of the river where the Glen opens out, both banks of the river are dominated by broadleaved woodland, with 66-100% cover for the entire length. The woods are dominated by a whole range of species including ash, oak, hazel, elm, wild cherry and alders, with no one species dominating. As noted below, this length of woodland has been significantly infiltrated by sycamore and beech, as has the woodland along Keltneyburn, a major tributary of the lower Lyon.

Above Chesthill, broadleaved woodlands are closely associated with river all the way up to Meggernie at the upper end of the glen, but, at 33-66% cover, never dominating. There are a number of stretches free from trees completely, but the overall balance is good. Virtually the entire Lyon from Chesthill up is open to grazing on both banks and, while the trees present are by no means all mature or senescent, the younger age classes associated with the other glens are largely missing. Glen Lyon supports much higher numbers of grazing animals (cattle, sheep and deer) than the other two catchments.


Allt Mhor below Schiehallion

While the rich and spectacular gorge woodlands are still present (perhaps the best in the entire area), the numbers of scattered native woodland fragments are less in than the other two main glens.

Management of the native broadleaved woodland resource
One of the key objectives of this report was to identify potential habitat problems associated with the riparian resource and it was anticipated that some of these would relate to woodland management.

There are no "problems" as such relating to the native broadleaved woodland cover in these three glens, with woodland management issues relating directly to the main water courses being centred on non-native broadleaves and coniferous forestry.

As described, the native woodland areas are dominated by a mixture of light-foliaged species. Dense alders are rare and where they occur it is by the main rivers and they cannot dominate the overall width of the river.


Unthinned woods


Bluebells in Glen Lyon

There is, therefore, no need to expend resources on these particular woodland types for ***the benefit of the riparian environment***. There will however be a benefit to the wider biodiversity within many of these woods themselves if they could be better managed, with local people deriving some benefit from this.

While significant native woodland was present in the three glens, it was not at all evident that this was being used or managed to any great extent, beyond use as shelter for livestock and grazing. There is certainly a considerable resource here that is not being utilized to good effect. However, current woodland markets and machinery would be unsuited to these types of woodland.

New opportunities
Most of the riparian woodland trees will readily coppice and regrow once cut down. In both the Lochay and Dochart catchments at least, grazing impacts are low enough that coppice will quickly become established. Many of these woods have not been managed in the past because the products have not been sufficiently in demand and the costs of extraction have been prohibitively high.

The equation is now changing. Demand for woodfuel is expanding rapidly, to the extent that firewood is now more valuable than Sitka Spruce in many areas. During 2009 Scottish Native Woods supported the Glenlyon Woodfuel Initiative in their successful grant application to the Climate Change Fund for a feasibility study in to supplying woodfuel to the entire glen. This will be described in more detail later and the context better laid out, but an increased demand will generate woodland management work that was not viable before, using both low value conifer timber and also re-vitalizing hazel coppice through extensive thinning, freeing up the ground flora and extending areas of bluebells and other woodland vegetation.

Timber extraction has also been an issue in the past. In 2010, there are now at least two small scale forwarders available in Highland Perthshire which are able to move up to 3 tonnes of timber with minimal ground disturbance, even on the wettest of sites. They are also able to winch timber over 30 metres. The presence of these machines now allows work to be completed that could never have been contemplated before. 50, 96

Two important aspects of the equation have therefore changed for the better, and should now allow sensitive riparian woodland management to be undertaken on a significant scale. This will allow management of all woodland types, not just native broadleaved areas.

Non-native tree species

The two main non-native tree broadleaved tree species are beech and sycamore. While many people do not regard them as a problem as such, they are particularly efficient at spreading along riparian corridors, outcompeting native species, casting a denser shade, often eliminating ground vegetation and causing subsequent erosion. The only native broadleaved species that causes this effect is alder where they become too dominant. These species therefore can detract very significantly from the overall biodiversity value of native woodlands, and can lead to actual physical problems along watercourses. In many areas of Scotland very significant sums of money are expended in their management or control. Management of these species within these catchments is therefore considered to be important.

One complication is that people in Highland Perthshire like their beech trees, which have a very high amenity value, both in the autumn and in the spring time and we are sensitive to this. Sycamore holds no place in the public consciousness and therefore allows us greater options.


Good riparian woodland

Glen Lyon in Spring

Glen Lochay
Beech was recorded as a significant species along 2040 metres, split between five tributaries and in about half of this length it was the dominant species. These areas exist at the bottom end of the glen. Beech was noted on 48 other occasions, nearly always as single mature trees, or very small clusters of trees. It was not regenerating to any significant extent beyond the few areas in which it was clearly dominant. For this reason beech is of little concern within this catchment.

Sycamore was recorded as being a significant minor species along 11 section lengths, totalling 3680 metres, mostly on the main stem of the river. In none of these areas was it the dominant species, common alder and ash always being more prominent. Sycamore was also noted on 44 other occasions and it is therefore spreading much more effectively through the wider catchment area.
It is suggested that this is not a particular issue at the moment but, in the medium term, up to 3-400 tonnes of sycamore could usefully be extracted from the lower Lochay. At the moment, most of this exists behind newly erected fences and is inaccessible for working with.

Glen Dochart
Beech is a very minor species on the Dochart, with very little regeneration or spread from mature trees. Sycamore is more widespread, but present at very low levels and the age structure here is less than that on Glen Lochay, many of the trees noted being less than 15-20 years old. Despite the Dochart being a much bigger catchment, the volume of non native trees is probably slightly less, 250-300 tonnes maximum, outwith the very old parkland trees that are notable beside several farmhouses and the field below Killin.

Sycamore does exist however through the full length of the glen, right up to Tyndrum, so the potential for increased cover in future certainly exists and should not be underestimated.

Sycamore

Small numbers of grey alders exist in the upper Dochart catchment, starting at Tyndrum and are present as far down as Dalrigh. They appear to be regenerating, although not yet profusely. Such alders can hybridize with our native species, the consequence of which is not really known.

In the interests of caution, the 10-12 tonnes of these trees that do exist might be better removed.

Glen Lyon
Both beech and sycamore are very much more widespread in Glen Lyon, with the former being closely associated with the lower Glen, adding to the overall amenity in spring and autumn.

Below Chesthill and through the woods alongside Keltneyburn, non-native broadleaved species make up perhaps 30-40% of the total trees present, beech dominating at the Pass of Lyon and Keltneyburn, sycamore being the more prominent in the more accessible areas.

There are approx 800-1200 tonnes of such timber in accessible areas (other than big mature beech trees) that could be extracted to benefit the riparian zone. It is just sitting there ready to be utilized if sufficient local demand can be generated for it.

Above Chesthill sycamore is scarce and although frequent mature beech trees are present, especially around the various big estate houses, they are not regenerating due to the higher grazing pressure in the upper glen. If grazing pressure been less, or fencing been more widespread, these non-native broadleaves would undoubtedly be more commonplace in the upper Glen. Beech is becoming an issue within the Glenlyon Woods SSSI, where a contradiction of management objectives is apparent with the general autumn amenity of the species. There is no direct relevance to the river Lyon.

Coniferous forestry

Glen Lochay
Very little in the way of commercial forestry exists in Glen Lochay, the main commercial block beside the hydro pipeline having been felled and replaced by a mostly native broadleaved/conifer plantation in recent years and the very limited plantations in the lower glen having no real impact on the river or side tributaries. This absence of coniferous stands is almost certainly one reason why the Lochay is a very clean river and there are no plans to undertake coniferous plantings there in the near future.

Glen Lyon
Coniferous woodlands are also very limited in Glen Lyon with the most extensive area being devoted to native pinewoods in the upper glen. These include the areas of SSSI at Meggernie and several hundred hectares of new native pinewood plantings over the past ten years or so. Such woods have a healthy proportion of native broadleaves and also open space and present no threat to the present riparian environment. Their primary objective is bio-diversity/amenity/future shelter for deer. Future productive capacity will be modest at best and not a motivating factor in their establishment.

Timber at Inverinian

The major coniferous blocks in Glen Lyon are at Invervar, Inverinian and Innerwick/Meggernie, with a small number of very modest planting further up the glen between the two dams. The coniferous woodland at Invervar has been identified by SEPA as potentially causing water quality issues. In the lower catchment the very much more accessible Drummond Hill is managed by Forestry Commission Scotland, based at Inver, Dunkeld.

There is a very obvious problem in Glen Lyon that limits the amount of woodland management that can be undertaken and will limit the amount of “commercial” plantings that are carried out in future.

At one end of the Glen lies the Pass of Lyon, a narrow passage way between a wall of rock and a wall keeping you out of the river. At the other end of the glen is a very minor road leading across to Glen Lochay, which is itself a very difficult glen to navigate. In the middle glen, the bridge at Bridge of Balgie is all but impossible to navigate with a timber lorry and, of course, Glen Lyon is very, very remote. Some of the very best timber in the glen is in the woods at Inverinian but, being on the wrong side of the river with only a wooden bridge in place, any significant harvesting is virtually impossible.

In the longer term, this difficult access will limit future coniferous plantings, with new woodland areas confined to those providing biodiversity, shelter and amenity functions. In the shorter term, it presents significant difficulties in the efficient management of existing woodlands of all types. This is discussed more in detail in the next section.

Conifers and stream on the flood plain of the Dochart

Conifer restructuring, Forestry Commission, Glen Dochart

Felled timber at Leskine

Glen Dochart

The Dochart has by far the highest concentration of coniferous forestry, extending to over 13% of the entire catchment area and the length of the glen. There is a fairly balanced split between public and private sector. The species composition is dominated almost entirely by Sitka Spruce, with only a small percentage of larch and other minor species.

Most of this forestry was planted with very little thought given to the watercourses running through it and, depending on where you draw the line with regards to stream width, there are at least 100 miles of watercourses in the Dochart catchment with conifers in very close proximity. This is certainly causing erosion, sediment run-off and acidification. Examples of poor practice were noticeable on areas of private forestry, with trees planted right up against watercourses, drainage ditches and ploughing discharging directly in to them and very little in the way of evidence that the riparian zone was being given any consideration at all.

The five main Forestry Commission blocks are all subject to Forest Design Plans and have riparian restoration as a central theme and this process has been started. Watercourses have also been opened up on private ground in the last two years, notably at Lochdochart Estate and at Leskine. Replanting with broadleaves will follow and this is all welcomed.

In theory at least, these Forest Design Plans (Forest Plans on private ground) will allow riparian conservation over a 20 year period. The elements to balance are that young conifers planted over watercourses are expensive to remove if the timber is yet to reach a commercial size but once it has reached a commercial size where it can be extracted at a working profit, the danger of windblow in adjacent trees is increased. Effective development of riparian zones can therefore only take place over a long timescale with the forester in charge working to a Forest Plan developed with the knowledge of constraints and opportunities that are known to him.

The main problem on the Dochart is that there are a number of significant constraints to economic harvesting. While the road network is generally good, much of the initial tree establishment in the woodland blocks on the Dochart, public and private, was very patchy. This has created a very varied crop, with a great deal of internal edge trees, badly affecting overall quality and therefore the economics of thinning. Much of the woodland area on the Dochart risks not being thinned or the riparian zones not restored because of the negative economics involved. This primarily involves the woods to the west of the catchment. Those from Crianlarich east are the better established. Access for harvesting is a serious problem in the Tyndrum block, 130ha of predominantly Sitka Spruce which cannot be thinned or managed effectively in any way because the railway line cannot be crossed with modern machinery. There were also areas of Sitka Spruce planted on the floodplain of the Fillan, on wet ground, where harvesting was obviously going to be extremely difficult and arguably it should have never been planted here. Greater strategic planning is evidently required.

The best way of ensuring that riparian restoration takes place on the Dochart is to encourage local demand for timber products within the catchment and not to attempt to grant-fund loss-making restoration activity through the SRDP or otherwise. This is discussed below.

Those privately managed woodlands not currently subject to a Forest Plan should be encouraged to participate and have riparian restoration as a central theme. This would put another 40% of the woodland area under active management.

The economics of riparian restoration could be significantly enhanced by relaxing restocking obligations in the riparian zone. A 20-30% cover with native broadleaves should be sufficient to ensure a diverse and healthy buffer zone next to the watercourses. Numerous cases were observed where the opportunity to restore the riparian zone was being lost because trees, albeit broadleaves, were again being planted at 2 metre spacing almost right up to the watercourses. There is no need to be so particular about these things. We do not require trees on every last square metre of ground. It is the wider picture that is important.

Increasing the demand locally for timber products

In 2009 a group called the Glen Lyon Woodfuel Initiative received a £21,000 grant from the Climate Change Fund (CCF) for a feasibility study looking at replacing oil heating within houses in Glen Lyon with locally sourced woodfuel. Average heating bills are currently in the order of £2,500 for many glen residents.

The demand for such an initiative is there, the material is there, the means of extracting and processing it is now available and the technology for burning it efficiently is also now more accessible and reliable.

The feasibility study is looking at how all these various strands can be pulled together and will be complete by autumn 2010.

If a co-ordinated woodfuel scheme in Glen Lyon is viable there are a number of important consequences that will arise from this:-

1. It will generate demand for possibly 1000 tonnes of timber a year ***within the glen***.
2. This will stimulate management work that will regenerate many of the wildlife habitats along the Lyon, especially the hazel woodlands, rich with their bluebells and other woodland biodiversity.
3. It will create a viable market for the smaller and less valuable end of the conifer crop. Often, it is the lack of a market for such timber that prevents an overall forestry operation taking place at all. Generating a demand for small roundwood within Glen Lyon will automatically increase the profitability of bigger management operations.
4. Creating this demand within the glen will inevitably create other allied wood processing activity within the glen. The overall result should then be that Glen Lyon will start to export value added timber products and not the basic raw materials which only provide a negligible return.
5. Only by creating demand for timber ***within the glen*** can the woodlands of Glen Lyon be regenerated and brought into a cycle of useful production.

Glen Dochart/ Glen Lochay

There are three significant centres of population in the Dochart catchment, Killin, Crianlarich and Tyndrum and this is where the major forest area is. As previously described, the economics of harvesting much of that forest area is not good and the timber quality is variable in many areas.

Killin & Ardeonaig Community Development Trust have already secured major funding from the CCF to insulate houses within their area. There is an active Community Development Trust at Strathfillan at the other end of the Dochart catchment. Is it possible to build on these initiatives, take the lead from the Glen Lyon example and submit an application for a feasibility study in to using Glen Dochart timber supplies for Glen Dochart heating needs?

As with Glen Lyon, the major advantage of this would be that it would create a local market for the lowest quality timber, improving the economics of overall thinning operations. On the back of this, the various Forest Design Plans and Forest Plans are more likely to be implemented in full, to the benefit of the riparian zone. It would create local demand for timber from Glen Lochay as well.

Priority woodlands for management activity would be the conifer woods of variable/ low quality, the conifers on the floodplain that would be best removed and the non-native broadleaved element within otherwise native broadleaved woodlands.

In the latter case, greatest flexibility could be obtained if any non-natives removed did not have to be restocked so that some open space could be generated by such management. Non-native coppice regrowth need not necessarily be sprayed off and killed, as long as it is kept coppiced on a regular basis and not allowed to mature again.

Such a Feasibility Study in Glen Dochart is likely to cost £35- 40,000.

Andrew Warwick, NTS Ranger, Ben Lawers.

Once described as a 'Cinderella habitat', unseen and unknown to most people, montane willow scrub now exists only in tiny fragments usually out of sight and out of reach, yet is an incredibly beautiful and diverse type of woodland.

A relic of the post glacial era following the last ice age, these low growing willow species would have pioneered a barren landscape. With the warming climate and encroachment of larger tree species, the willows established themselves above the tree line, in the higher altitude ranges between 650 – 900 metres above sea level.

Today, montane willow scrub sites can be made up of several species, usually growing amongst a large variety of tall flowering herbaceous plants. Many of the species prefer damp, base rich mineral soils, making the Breadalbane hills with their lime rich schists, ideal. Indeed, all the British montane willow species are found on sites across these unusually fertile hills, some with their strongholds here.

Intensive sheep grazing over the last 250 years has eradicated the habitat from ground accessible to herbivores and now most of the willows are almost entirely restricted to cliff ledges and the rocky sides of burns where they typically grow out into open space to escape browsing. There is one 18th century eye witness report of the loss of the scrub from the hillsides at the time of the introduction of large scale sheep farming, although it is mentioned in a positive sense, creating more grassland for grazing.

This consignment of the habitat to cliff ledges has resulted in small isolated populations. Many years of survey work has shown a decline of individuals within these populations and many sites have only a single bush, or all female groups. With separate male and female bushes and mostly bumble bees in charge of pollination, long distances between individuals can mean little or no seed production on many sites. The wind dispersed seed which is produced in healthier colonies, most likely blows into areas of dense grassland, the product of intensive grazing, which is unsuitable for germination and unprotected from herbivores. Willow seed needs to quickly germinate on damp, bare soil.

For these reasons, the regeneration of montane scrub outside these cliff ledges is only likely where there is a very large nearby seed source, where events such as landslips and rock falls cause bare ground to be frequently exposed and where grazing from large herbivores is very low or non-existent. Without active management of this habitat we can expect to see the continuing loss of sites, little or no new regeneration and the extinction of some species from certain areas, if not, the whole range.

The National Trust for Scotland became aware of this declining process, particularly affecting downy willow (*Salix lapponum*), woolly willow (*Salix lanata*) and also procumbent juniper (*Juniperus communis*). In 1987 and 1988, experimental work started using 2 small fenced off areas (exclosures) to remove herbivores from ground with nearby seed sources and existing willows. Several years of subsequent monitoring showed the tall herb habitats responding very quickly to this change, an increase in growth and seeding of the existing mountain willow (*Salix arbuscular*) but no regeneration of the declining species.

In 1989 and 1990 a different approach to the conservation of willow scrub was commenced with 2 permanent exclosures being constructed on the Lawers range. Within them, were proposed areas of willow scrub which was to be created using plants propagated from seed collected from cliff ledges within the Breadalbane area.

Today, these planted populations are healthy, mature, seed producing areas of scrub which are easily accessible to walkers and botanists. They are quite unlike any other sort of habitat that people are generally familiar with in this country, and they make it easy to appreciate what has been lost from our hills.

The success of these projects was certainly a step in the right direction for the conservation of the habitats, and in raising awareness, but it was still lacking in scale if the reinstatement of the natural processes of regeneration were ever to have any chance. A landscape scale exclosure was needed to create a seed source that might realistically achieve regeneration. Along with the necessary annual rain of seed, the exclosure would need dynamic hillsides, where exposed ground would frequently offer new niches for seedling establishment.

This requirement materialized in the year 2000 when the Creagan Lochain exclosure, encompassing 190 hectares

High willow

Willows on Ben Lui

of hillside and cliffs on the west side of Lochan na Lairige was constructed. Within this area were excellent seed sources for tall herbs, the best site in Britain for one willow species (*Salix arbuscular*) and remnants of montane willow scrub including downy and other willow species.

The property rangers' tree nursery enlarged to produce an average of 10 000 trees per year, the majority being montane willows for Creag an Lochain. To date over 40, 000 willows and 3000 junipers have been planted and over the same period huge natural changes in vegetation have taken place with the removal of sheep and deer from the area. Lush carpets of tall herbs and young willows now cover areas where they were formally removed by these herbivores. With that, comes an increase in many invertebrate and bird species. The pioneering montane scrub work at Ben Lawers NNR has produced this, the first and now largest project of its kind in Britain, offering a unique botanical experience to those who visit it.

The National Trust for Scotland (NTS) is continuing to expand montane willow work to other areas through involvement with the national group charged with the conservation of woolly willow. It has started to collect, with the permission of landowners and Scottish Natural Heritage (SNH), a cutting of each surviving woolly willow in the Breadalbane area. The plants grown from these cuttings will be kept in an 'ex-situ' collection in Killin. 'Second generation' cuttings from this collection will be used in future restoration projects in the Breadalbane area, ensuring that any planting site will contain the entire remaining gene pool of local provenance.

The costs and practicalities of managing large scale high altitude woodland projects mean that they are not necessarily possible on any site, but the benefit to landscape and biodiversity, which are so apparent in the willow scrub restoration work, justifies the many roles the conservation organizations play in making major contributions to the diversification of the Breadalbane hills. ■

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Aspen in the Tay Catchment Area

Summary

An important part of our TWCP survey work involved gathering information on native woodland, and native woodland fragments and we kept a particular record of rare or minority forest species. One such species was our native aspen.

During the survey, 125 records were obtained in total. Of these, 59 were in Glenlyon, 12 in Glen Lochay and 44 on the Dochart.

120 of these records are new additions to the national database. When combined with another 20 records subsequently discovered after the end of the survey period, the information gained from this work alone has increased the size of the recognized Scottish database for the species by 20%. This has encouraged us to co-ordinate efforts in other areas as well on Tayside through support from Tayside Biodiversity Partnership.

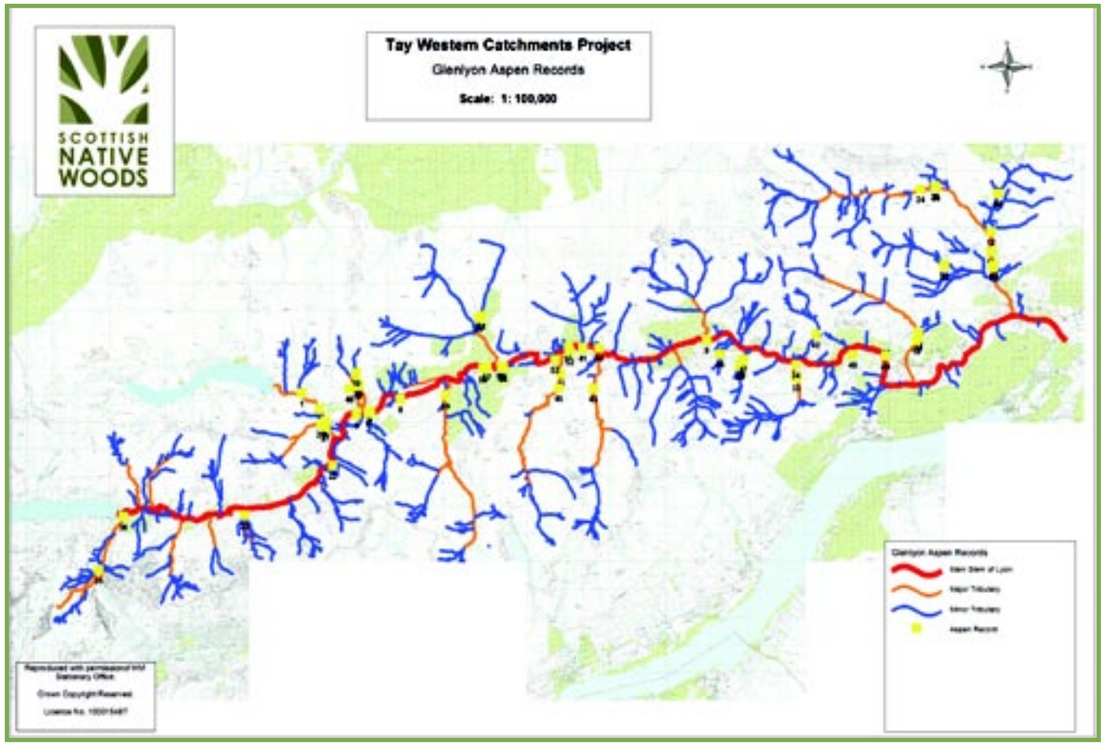
For each stand, the numbers of trees of different age classes were recorded and the location recorded by GPS.

Limitations of data

The importance we placed on locating and recording aspen increased in the 2008 survey season, to tie in with an increased interest in the species among many other organizations throughout the country, and the information gathered about each record became more specific, noting the numbers of trees of different age classes present. In the 2007 survey of Glen Lochay and part of the Dochart, aspen was given no greater prominence than other minor tree species. We therefore anticipate that a number of aspen stands will have been missed in 2007 in these areas. It should also be noted that aspen also grows as a non-riparian tree, and that there will be stands in this area not recorded simply because we were only surveying along watercourses. However, anecdotal evidence would suggest that aspen remnants that are removed from watercourses are very much more restricted than on, for example, Speyside.

Two of the broadleaved woodland SSSI sites in this area, Glen Lyon Woods and Glenlochay Woods, have aspen listed as a significant minor species in their documentation, although our survey transects did not record any. There are several other extensive areas of broadleaved woodland in this area where we did not have any survey transects that are likely to include aspen, such as the woods behind Fortingall at the bottom end of Glen Lyon and the extensive woods at Innishewan on the Dochart system.

Finally, safety considerations often meant that we had to avoid very steep and dangerous gorges, many of which contained broadleaved woodland remnants. It is anticipated that we will have missed some aspen remnants in these situations.



Aspen at Cashlie (left), Aspen leaves (right)

Glen Lyon
Aspen is well distributed throughout the length of the glen, with the most significant stands occurring in the Meggernie area and in the Allt Mor below Schiehallion, with up to 75 trees present at a number of locations. Of the 59 stands recorded, the great majority will comprise 5-15 individuals, with a number of individual trees recorded as well. Probably half of the native woodland remnants in upland gorges in the Lyon catchment will contain a small number of aspen trees, and the age structure is in fact very healthy in these areas, with a high proportion of trees being in the younger age categories. Aspen has undoubtedly been a very significant component of the native woods in the Lyon catchment in the past, with significant remnants surviving through to today.

Glen Lochay
The Lochay recorded by far the lowest number of records, but that may be partly due to the increased importance given to recording the species in the other glens the following year. However, extensive native woodland remnants do really only occur in the bottom third of the glen and in this respect, the Lochay catchment is different to the other two areas. Two significant remnants of approx 60 and 120-150 trees do exist on the Lochay down in Killin, the other records comprising only 2-10 trees. Unrecorded aspen will certainly exist in the Glen Lochay Woods SSSI.

Glen Dochart system
Aspen is well distributed throughout the Dochart system, with 44 remnants recorded, and several sites with 50-100 trees. One aspect which appears peculiar to the Dochart is that aspen was recorded in a number of situations where it was the only species present, unlike the other two glens where aspen was almost always growing among other native species. The most significant record and example of this was the sapling aspen found at 2200 ft on Ben Lui, two hundred metres from the symbolic Source of the Tay and over a mile from any other native woodland species. This is among the 2-3 highest records for the species in the UK and is easily the highest in the western half of the country.

Use for the information gathered

At present, it is extremely difficult to source planting material of native Scottish origin for aspen. There are currently new procedures being devised that will quickly increase the efficiency of both vegetative and seeding propagation of aspen A number of root samples will be collected from these records to build up the stock of suitable material that is available for planting out in both Highland Perthshire and the Loch Lomond and Trossachs National Park area. Given its light foliage and the high biodiversity of insect life associated with the species, aspen is an extremely valuable riparian species that does not have the shading and acidification issues associated with alders and conifers, for example, or non-native broadleaves such as beech or sycamore. Focusing on this species allows us to look more closely at the existing species mix in riparian woodlands and how they might best be managed to provide a more balanced interaction with the water environment. Scottish Native Woods can provide a co-ordinating role on Tayside in all matters relating to the management and promotion of this species. Aspen can therefore be considered as a key touchstone species, focusing attention on what is going on it the woods around it and how they might be managed to better advantage.

Accessing the Information

The information gathered on aspen will be added to the National database which will be made more accessible during 2010 through an inter-active mapping facility. Maps for each of the three glens can be obtained from Scottish Native Woods. Information on the inter-active website will be forwarded as this is progressed.

Bracken

We used the opportunity we had during this survey work to map the extent of bracken in these three glens, getting a feel for the extent and density. Within this report there are no substantive recommendations in relation to this, preferring simply to register this as an issue of interest and importance. Curiously, during the consultation on our pilot report, staff from SEPA in particular fastened on to this aspect of our report, to the exclusion of almost everything else, including the greater priority areas such as water abstraction. We are therefore downplaying the importance of this section in our final report so as not to distract attention from areas of greater priority.

Bracken is extensive in the three glens, but primarily in the bottom half of Glen Lochay, the lower half of Glen Lyon north of the river and the northern side of the Dochart. In general, the other areas are less affected to any major extent, but it does exist throughout. In Glen Lochay, 38% of the total catchment watercourses were affected by bracken, but only 15% or so at the highest densities where bracken covered a high proportion of the ground or was impenetrable to walk through. As with the other rivers, the main stem of the river is largely free of bracken. However, in the lower glen, 55% of the length of watercourses were affected, and 28% of the total length of watercourses were impacted severely. This is a particular problem from a number of points of view, not least because this is where the greatest potential for biological diversity is and includes the important woodland area of Glenlochay Woods SSSI.
In Glen Dochart, less than 20% of the length of watercourses were impacted and around 7-8% impacted severely, mostly on the northern side. As with Glen Lochay, the woodland areas were disproportionately affected, reducing biodiversity in many areas and severely hindering potential for regeneration.

Glen Lyon as a whole showed approx 12% of the tributaries impacted, with around 4% of this length impacted severely, concentrated particularly around the woodland habitats in the lower glen, north of the Lyon.

Discussion

Bracken is a very insidious weed which is directly and indirectly disrupting many of the wider land-uses within these three glens, in common with many other similar glens throughout the country.

Bracken on this scale is almost impossible to control. Manual control is impractical, chemical control on this scale would be too expensive and environmentally damaging, especially with the river as an SAC. Helicopter spraying, which must leave a buffer of 50 metres from all watercourses, is very difficult when many of the watercourses present are only 100 metres apart. At some point in the future, greater resources will have to be devoted to finding more practical and environmentally friendly ways of dealing with bracken. This issue is however, not one that we will be pursuing here.

Bracken:

- *Reduces the grazing area.*
- *Prevents woodland regeneration, although it was noted to be protecting a very small amount of advance regeneration in some cases.*
- *Hinders access.*
- *Harbours ticks, which are a threat to people, directly and indirectly through Lyme Disease and can devastate grouse stocks and be a significant health issue to sheep flocks, largely though the spread of Louping Ill.*
- *Is potentially carcinogenic.*
- *Reduces the biodiversity of ground vegetation.*
- *On the scale encountered in Glen Lochay, it probably affects hydrology at a local level. A Forestry Commission Information note suggests that bracken can increase the interception rates by 50% in the summer months, or 20% on an annual basis, the equivalent or greater than many woodland areas. Clearly, if a catchment is badly infested, this becomes significant.*

Invasive species in the Tay Western Catchments Area

Summary

During our survey work, the opportunity was taken to record information on invasive species, concentrating initially on the three highest profile invasives on Tayside; Japanese knotweed, Himalayam Balsam and giant hogweed. A 2006 survey by the Tay District Salmon Fisheries Board suggested only one record in the three glens, as did a survey by SNH a few years beforehand. We were potentially in a position to gather more comprehensive information on invasive species as we were targetting minor tributaries as well as the main rivers. Invasive species often establish themselves from gardens set back from the main rivers in catchments and travel along these minor watercourses. We could therefore give an early warning of potential hidden sources.

The occurrence of such species in these catchments is indeed very low.

During the survey we located seven areas of Japanese knotweed (1000 sq metres max) and two concentrations of himalayam balsam (< 100 sq m total). There is no Giant Hogweed in this area.

Rhododendrons were found in 21 main locations. They were not easily correlated with watercourses as such and therefore no overall quantity can be given. However, we have tried to identify the priority locations.

An additional invasive species, white butterbur, is present in the lower part of Glen Lyon, found at 17 locations (400 sq m). A much larger (but unmapped) area of this species occurs along the roadsides in lower Glenlyon, with smaller concentrations also apparently present within Killin but unassociated with the rivers.

Three other records were made of potentially invasive garden plants totaling c 300 sq m.

Finally, signs of mink were found throughout each of the three glens, the importance of this being documented elsewhere. There will also be a section on non-native tree species, with particularly good information on the spread of sycamore and beech within riparian habitats in the area. On the Dochart, it appears that small areas of grey alders, seemingly originating from Tyndrum, are spreading by natural regeneration and it may be appropriate to also treat these as an "invasive" species.

Limitations of data

Overall, we believe this data to be very good. The overall survey protocol and potential outputs justified us searching along very minor watercourses set back from the main rivers. In addition, in summer 2008, the main stems of the Fillan/Dochart and the Lyon were searched again for a second time using a pair of canoes, specifically looking for other records of invasive species.

The records of the three main invasives are therefore likely to be fairly accurate.

White butterbur is concentrated mostly along roadsides and therefore the greater area of this species, potentially several thousand square metres, will not have been picked up by our survey.

Finally, while the main invasives were closely associated with watercourses, rhododendrons showed no such correlation, and our survey protocol did not warrant the additional time that would be required to accurately measure their distribution. Our survey therefore only recorded those concentrations intersected by watercourses. Rhododendrons are not regarded as being as invasive on Tayside as on the west coast (FCS pers comm.) and do not seem to spread with the same alarming speed here.

It is anticipated that other potentially invasive species ***may*** be present in these catchments, in and around the main areas of settlements. Surveyors did not have the necessary botanical skills to recognize the full range of potentially invasive species, nor did our protocol allow for much time to be spent on this aspect of the survey work.

Glen Lyon

There is no giant hogweed or Japanese knotweed in Glen Lyon. A very small record of Himalayam balsam was made just below Keltneyburn, perhaps only 20 sq m. It was however noted that this area was significantly larger in 2009 and is most certainly the invasive species that represents the highest threat currently in these catchments and needs to be eradicated quickly before it becomes a significant issue.

The most significant invasive species in Glen Lyon are not actually associated with watercourses as such.

13 records of rhododendrons were made. These were almost all associated with policy woodlands around some of the bigger estate houses in the glen and it is thought that most of the records do not warrant any real priority status. There are two exceptions to this:

- the small amount of the species present within the Glen Lyon Woods SSSI site
- the very large concentration present in the woods above Garth House, seemingly extending to many hectares. This area was not recorded during our survey, but it is extremely obvious on passing from the road.

It is also known that there is a modest amount of rhododendrons present on the top of Drummond Hill.

Several thousand square metres of white butterbur are present along the road in lower Glen Lyon, between Garth House and Keltneyburn and extending down the road towards Aberfeldy.

Glen Lochay
The Lochay recorded the lowest number of records, with only three areas of Japanese knotweed totalling c500 square metres. An area of rhododendrons above Boreland House is not considered to warrant any attention. Giant hogweed, himalayam balsam and white butterbur all appear to be absent from Glen Lochay.

Glen Dochart system
There were four areas of Japanese knotweed on the Dochart, totalling c 500 sq m.

There was a small concentration of four areas of Himalayam Balsam near Kirkton Farm, totalling approx 60 square metres.

Although no white butterbur was found during our survey, it is reported that it exists in and around Killin.

There was no giant hogweed.

There were seven areas of rhododendrons recorded. Five of these records were located around Loch Dochart House and the holiday area at Portnellan. The other two records were located within Killin and a very small record at a dumping site just outside Crianlarich. Although there may well be other records within the catchment associated with gardens/woodland areas around houses, it is certainly the case that rhododendrons within the Dochart catchment should be possible to control while they are at these very modest levels and a level of priority should be given to achieving this.

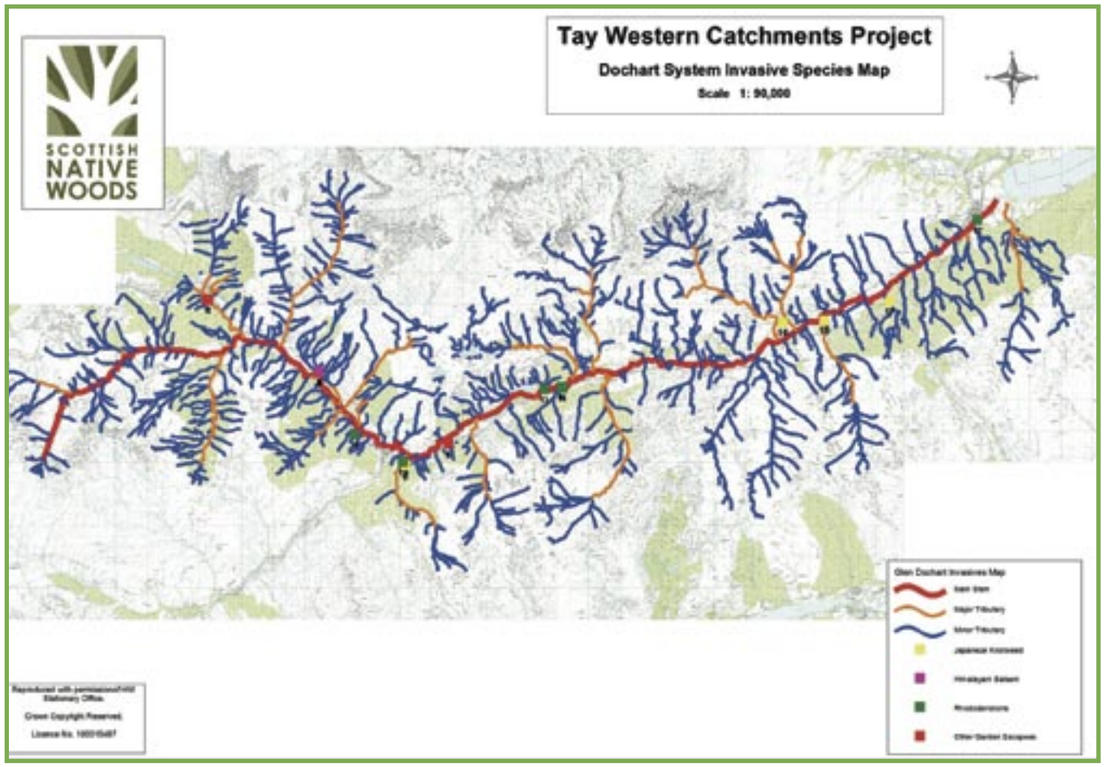
Lambium

Some garden escapees were noted in and around Tyndrum and while these were not invasive as such, they do demonstrate how these species first become established. An area of Lambium spp (pictured, perhaps 200 square metres, is present at the layby at Loch Dochart. This plant is increasingly becoming an issue on native woodland sites, and is associated with carelessly dumped garden waste.

Use for the information gathered

We anticipate that, given the low levels of invasive species present in these three glens, it should be possible to eradicate them within the next few years before they become a more significant issue.

The angling clubs in the three glens are well placed to monitor the catchments for any subsequent incursions, and it is one of our priority recommendations that their capacity to deliver this function be properly developed and supported.



What are invasive species?

Invasive species are those which have been introduced to this country from abroad, almost always as garden plants, and which can out-compete our native flora to the extent that they simply take over whole swathes of our countryside, often along river banks, roadsides or railway lines. They can be a serious issue for a number of reasons. Firstly, by out-competing native species they reduce biodiversity locally. Invasive species tend to be tall and grow very thickly and can therefore limit access to an area. By removing native species from banksides, invasive species can leave areas prone to erosion in the winter months. Finally, some species such as the giant hogweed can be quite dangerous to people. This has an extremely toxic sap and which can blister the skin when touched.

Rhododendrons

There are three main species classified as "invasive" on Tayside, all of which are thankfully not yet too well established in Highland Perthshire. The most widespread is the himalayam balsam, easily recognizable at this time of year by its purple flower. It can been seen scattered at low density along the Tay between Aberfeldy and Dunkeld. HB spreads extremely quickly. It is readily browsed by animals but can quickly become established in areas which are fenced off and not grazed. Japanese knotweed is less well distributed, but can be found around Pitlochry and Loch Tay, and can spread readily along watercourses but, thankfully, not as quickly as balsam. The final invasive species, giant hogweed, is very scarce in this area, but some can be seen from the main road between Weem and Dull.

One species which is not yet classified as "invasive" is white butterburr, the rhubarb-like plant that can be seen growing along many of the main roads roundabout, notably around Keltneyburn and up towards Garth House near Fortingall. White buttleburr has all the characteristics of an invasive species and it is surely only a matter of time before it is classified as such.

Young Balsam

Rhododendrons, while not "invasive" as such, have the capacity to spread quickly and shade out native vegetation and tree regeneration. They do not spread as quickly in Perthshire as they do on the west coast, where in many areas they are advancing at a truly alarming rate.

Finally, alien species are not just confined to plants. The American mink is present locally and can decimate all sorts of wildlife along rivers and watercourses, especially ground nesting birds, water voles and fish, as well as domestic poultry and anything else it can grab hold off.

It is still practicable to eradicate the three main invasive species from this area. We want to raise the profile of white buttleburr before it becomes too established. A large scale mink eradication programme would have enormous benefits to biodiversity locally, and effective techniques to deal with them are now available. If Highland Perthshire is to become the buffer zone between two National Parks, making it an invasives-free zone makes a great deal of sense, both at the wider strategic level and also for Highland Perthshire itself.

Japanese Knotweed

Accessing the information

The information gathered on invasive species has been passed to FCS on Tayside who employ a project officer who is to specialize in invasive species and to the LLTNPA.

Discussion

Only very small areas of invasive plants are to be found in the two catchments surveyed. However, given that these are at the extremities of the Tay catchment area, it must be considered as an ABSOLUTE PRIORITY that these areas are dealt with before they can become more established. Himalayan balsam in particular can spread very quickly. Dealing with these quickly could easily save spending tens of thousands of pounds later, as is required in other parts of Scotland, including elsewhere in the Tay system.

It is estimated that eradicating invasive species from these three glens, including those around Loch Tay and upstream on the Tay from Aberfeldy will cost in the region of £3-5000.

The issue of significance is how to achieve this, with various funding opportunities to deal with this being frustrated in 2009.

Such work could be funded by government or privately, probably through private charitable trusts. This type of output is ***supposedly*** a high priority and the subject of much discussion about partnership working.

Government grant aid is available primarily through the Scottish Rural Development Programme (SRDP). The problem in the TWCP area is that the relatively small area of invasive species are spread across 40-50 ownership boundaries, and to clear these through the SRDP mechanism, individual applications must be made on behalf of each owner. This would include individual Statements of Intent, Environmental Outcome Plans and other associated information including spraying permissions from SEPA, in addition to the online application process itself.

Two invasives

The cost of submitting these applications with the current system would almost certainly be up to five times the value of any work carried out.

New legislation being debated under the Wildlife and Natural Environment Bill (WNE) will make it easier for an organization like TDSFB or Scottish Native Woods to help tackle such infestations across ownership boundaries, but the grant application process itself is still likely to remain unaltered unless government can be persuaded that it is not fit for purpose.

There are two additional problems that also arise from this. Firstly, private charitable trusts can often be much more flexible in how they provide funding, but, in the case of invasive species, they make the case that the SRDP should be dealing with this and why therefore should they be involved? Secondly, allowing an organization like TDSFB or Scottish Native Woods to act as an agent in dealing with these issues might prevent a landowner from using another agent for a different grant application at a later date, there being significant issues yet with the IT systems involved. Eradicating invasive species will significantly advantage a wider funding package with this as one element, but very many people are still reluctant to become involved with the current process.

This "Catch 22" situation means that unless a private source of funds can be found to eradicate such species in the TWCP area, the situation will not be addressed and a minor problem will become a major one. Dealing with invasive species is not actually a priority for SEPA within the first six years of their River basin management Plan for Tayside through to 2015. We therefore cannot rely on this mechanism to help us with the strategic arguments.
The priority consideration regarding invasive species must be that the current SRDP programme develops simplified procedures for encouraging genuine cross-property co-operation for dealing with these types of issues. A mechanism devised for this area could then be usefully implemented elsewhere and could also be used for other catchment scale projects, not just control of invasives.

Until such times as people stop talking about invasives and put in place mechanisms that can realistically deal with them they are unfortunately not going to go away. We need better joined up thinking on this issue before it is too late.

Should invasives be eradicated from this area, it will still be necessary to monitor the situation in future to ensure that they cannot return. The various angling clubs are best placed to provide this monitoring. A small credit card should be devised that allows identification of the main invasive species with the necessary contact details for dealing with them displayed on one side.
As the one organization with a remit across all these catchments, it is recommended that TDSFB become responsible for such a control programme but, to allow them to do this, a more flexible funding mechanism must be in existence first.

Riparian land use/ Other habitats

Other than issues relating to forestry and woodlands, above, we tried to get a feel for how the riparian corridors were being used and what the current problems or future options might be. The greater part of the survey took place on the open hill, where low intensity grazing and sporting use was the norm.

This section of the report focuses on the land use issues relating immediately to the main stem of the river and the bottom end of the many tributaries. There is a strong overlap with fencing and these items are covered in the section below.

The main stem of each river was where farming activity had potentially its most visible influence and effects on the watercourses in the glens. Arable production was virtually absent from these three glens at the time of survey and significant changes in livestock numbers were apparent in two of the glens.

In ***Glen Lochay***, the significant issue that arose from this was the presence of species rich neutral grasslands and wetland habitats which were closely associated with the river.

There are approximately 25 hectares of species rich grasslands alongside the river Lochay, up to 30 metres wide in the middle part of the glen and 12-15 metres wide above the hydro pipeline. Species rich grasslands are declining and are valuable, particularly in an upland setting like this.

In addition to this, there were at least 15 ha of wetland, and probably a good deal more than this, depending on how it is defined.

These areas of species rich grasslands appeared to be developing by default. They were not being grazed in the summer, due to very low numbers of animals in the upper half of the glen, but there was obviously sufficient grazing pressure during the late summer/winter to remove the current year of growth and that this regime was obviously favourable to such a type of grassland developing. By contrast, the wetland areas almost certainly could be doing with a greater level of grazing more quickly, but the potential for a valuable wildlife resource was obviously there.

If entered into some sort of environmental scheme, such areas that have been identified in Glen Lochay might well be of significant conservation value in the longer term and it may be possible for landowners to receive payment towards their conservation management, possibly up to £5-6000 per annum for the areas depicted here, a not insignificant sum in this type of glen.

The situation in the other two glens was very different. Both sheep and deer numbers in ***Glenlyon*** are much higher than in Glens Lochay or Dochart, significant numbers of cattle are also present and the very fertile

Species rich grasslands

valley bottom with its better grazing land is key to supporting overall numbers. It is intensively grazed and, within the main glen itself, only a very small proportion of the total improved area was closed off for hay/silage in the summer months. The species rich grasslands and wetlands which were appearing in Glen Lochay were not so obvious at all in Glenlyon, simply because the ground was being used more intensively. This does have implications for diffuse pollution in to the Lyon and for exacerbating stretches of erosion. It could be supposed that it would be beneficial to the Lyon if some of these fields were given a rest during the summer months so that areas of bare riverbank have a chance to re-vegetate and crops of hay or silage could remove some excess nutrients. As detailed below, fences are really not an option on most of the Lyon or Dochart and the only way to give areas of riverbank some respite would be to close off whole fields for 2-3 months. Areas of higher biodiversity value and wetland within this overall area would then likely develop and seed or flower by default on the back of this.

It may well therefore be the case that the most appropriate strategy in Glen Lyon would be to encourage farmers to invest in pasture improvements, encourage more winter-feed to be conserved in the Glen itself and increase the infra-structure and productivity of the current enterprises, not let them slip into decline. This could well create a virtuous cycle for farming enterprises

within the glen. Estimating the costs and infra-structure improvements required are outwith the scope of this study, but this management of the fertile valley bottoms in the upper glen is likely to have a wide range of beneficial results and we are recommending that such an initiative be investigated further.

Like Glen Lochay, ***Glen Dochart*** has been witnessing an exodus of sheep in recent years and signs of this are obvious throughout much of the valley bottom, with ungrazed vegetation and willow and birch saplings becoming rapidly established in many areas. This was especially the case in Cononish glen, but was also evident further down the main Dochart valley to the east of Crianlarich.

While such vegetation was being grazed off in the winter months in Glen Lochay, this did not seem to be the case in the Dochart catchment in general and sustainable longer term biodiversity benefits may well be less certain because of this. LLTNPA are currently forwarding a floodplain initiative along the main valley bottom of the Dochart, centred on management of vegetation for waders and floodplain woodland establishment. Such an initiative will hopefully create some structure and financial incentives for farmers to sympathetically manage the riparian zone alongside the lower Dochart and, in this regard, the Dochart is becoming more advanced than the other two glens.

Fences

Riparian conservation schemes almost always assume that extensive fencing programmes and annual management payments for buffer zones are going to be a central theme. In this area things are different, simply because the vast majority of each valley bottom is prone to flooding and local farmers have long since learned how to work around this, the consequence of which is that many fences do not have any real relationship to the watercourses in the catchment, more usually running at right angles to the main rivers, leaving the banks open.

Glen Lochay is the exception. Fences here are much more extensive and erected to a good standard. A major fencing programme had been carried out on the lower part of Glen Lochay in recent years, as part of various RSS-type schemes. Much of the land south of the river was dominated by woodland where fences were not appropriate and fields that were evidently prone to flooding were unfenced. Fences on the side tributaries of the glen tended to run at right angles to the watercourses and therefore were not relevant to the lengths that we were quantifying. Of those fences that did exist, almost all were in a good condition. Many of the low ground fields had been fenced off against deer.

It is estimated that no more than 1000 metres of stock fences could usefully now be erected to safeguard riparian habitats in Glen Lochay. SRDP is the obvious funding mechanism, however the priority is relatively low.

Fences

On the lower ***Lyon***, below the Pass of Lyon, virtually all of the river and tributaries are well fenced off, and the one main area that is not is now subject to an RDC scheme with an agreed waterside margin grazing regime. From the Pass of Lyon through to Chesthill, both sides of the Lyon are dominated by woodlands, with only extensive sheep grazing on the south bank. Fences here are not relevant. From Chesthill to the dam at Lubreoch at the top of the glen, over 20 miles away, much of the land next to the river is prone to flooding and almost all of the riverbank is open to grazing. Fences run at right angles to the river to separate stock in adjacent fields. What fences there are running parallel to the river tend to be well set back. For almost all of this distance both sides of the Lyon are open to stock grazing on both banks. 80% of the length of banks are actually quite stable and little harm comes from this grazing, although as previously stated, diffuse pollution and some exacerbation of erosion is likely to occur because of this. On the side tributaries of the Lyon the geology appears to be very stable, with little erosion in evidence. Although limited areas of erosion do occur on the Lyon, especially where cattle congregate, it is virtually impossible to advocate fencing as a remedy to this.

Fencing is not an issue in this catchment at all, not a conclusion which might have been supposed at the outset.

The Dochart is a half-way house between the two. The areas where good fences are required tend to have good fences. Much of the floodplain area is either unfenced or, due to the very limited amount of grazing taking place, has only a token fence. As in Lyon, fencing schemes to protect the riparian zone on the Dochart are not really a consideration.

The problems with fences

During our survey, it became apparent that fences were actually creating problems in many places and often little was being achieved by them being there. In many cases cattle, sheep or deer were getting in behind fences and causing considerable bankside erosion. In the upper part of the catchment of the Lochay, cattle had the river banks

Fence effects

grazed down much better than the surrounding fields but, significantly, because the banks were much wider in such areas, there was actually very little damage being done. In the lower part of the glen the main river was very well fenced but the relatively narrow riparian strip ensured that possible woodland thinning work alongside the river could not be undertaken.

While narrow six metre buffer strips will protect river banks, they will create other difficulties. It is perfectly clear from these glens that cattle can graze in the riparian zone with very little damage to river banks as long as the riparian zone is wide enough and they are allowed to range over a wide area. Limited and controlled grazing, particularly by upland breeds of cattle, can result in considerable biodiversity benefits. Unfenced river banks allow woodland management to be carried out because trees could be felled and extracted more easily without causing damage and this would allow thinning to be carried out which would benefit the rivers in several places. These strips would then comprise a mixture of trees and natural grassland habitats. A wider riparian zone would not hinder access for fishing, as very narrow strips often do. In addition to these factors, extremely invasive species such as Himalayan balsam are actually very palatable to animals, so ensuring that banks are grazed would help in their control. Fencing off narrow six metre strips from which animals are excluded can only aid their further spread.

Finally, fences are expensive, sometimes difficult to maintain and only have a limited life expectancy. If we can do without them, we should. Throughout much of these glens they are not an option anyway, and although there are important exceptions that will be dealt with later, the geology throughout much of these catchments is such is that livestock grazing near watercourses is not a particular issue.

Bank stability

In riparian conservation projects elsewhere, the greater part of the effort required is focused on the prevention of erosion and consequent sedimentation and siltation of watercourses which can harm spawning habitat and reduce the holding capacity of parr habitat. Summarized below is an account of such issues in each of these three glens.

Glen Lochay

On the main stem of the river we logged 15 stretches of significant erosion/bank undercutting, totalling 2200 metres or 5.2% of the total length of riparian banks. Much of this erosion could not be attributed to animal damage and was likely to be the result of natural fluvial processes eroding susceptible areas of bank.

In addition, there were 4 areas of minor erosion, totalling 2000 metres, or 4.8% of the total length of river banks. This erosion was only classified as “minor” because the banks themselves were not falling away. However, there was quite serious tracking erosion inside the fence lines on these areas, which a flood could easily have exacerbated. This was caused by cattle and deer getting in behind otherwise good fences, not being able to get off the river bank easily and as a result causing quite serious damage. Together these erosion areas comprised almost 10% of the total length of banks of the river, more than had been expected. Almost all of this was in the lower half of the glen, below the hydro pipeline.

On the tributaries we found 70 point sources of erosion, almost all of which could be attributed to natural causes and are important for geomorphological recharge.

Further downstream, however, 14 areas were badly eroded, mainly by cattle wintering sites. The total length affected was 2600 metres. These areas were located at the bottom of the river and it is felt that this erosion is not a significant issue in relation to the river as a whole.

21 other areas totalling 16,000 metres were recorded as showing minor erosion. About half of this total was in the higher hills, or at the lower end of some of the bigger tributaries which were obviously prone to flash flooding.

Solid banks in Glen Lochay

Overall, 94% of the length of the tributaries was deemed to be in good condition. 80

Such erosion issues that there were in Glen Lochay did not appear to be affecting the in-stream habitat quality of the main stem of the river in any way, although some of the side tributaries on the lower river were being affected to some extent. Given this and that measures implemented to resolve erosion issues are almost always expensive and require ongoing maintenance, it is suggested that erosion control is NOT a significant consideration within this catchment as whole.

The Lochay is in fact a very clean river and, if it had more water in it, it would undoubtedly be of very significant strategic importance in producing salmon for the wider Tay system.

Glen Lyon

The main stem of the Lyon shows a very similar erosion rate overall to the Lochay, with up to 10% of the length of banks affected, but the river itself is nearly three times the length and very significant areas are present in the upper river between the two dams and in the Chesthill area. Much of this latter damage is a result of a major flood in December 2006. The river flow in the Lyon is heavily regulated, with regular freshets, but whether this has any affect on erosion or not is not known. The greater part of the Lyon shows very stable banks and, while they may be damaged by cattle in places, the overall effect on the river itself is likely to be negligible. As with the river Lochay, most livestock or deer damage to banks tended to be in areas where fences had restricted the width of bank available to them, with tracking erosion resulting from this. As with the Lochay, the Lyon is a shallow river and almost all areas of river bank could be accessed from one side of the river or the other. Areas of bank that are not being grazed are almost non-existent.

Erosion on the upper Lyon

It is noted by SEPA that 93% of the main stem of the Lyon is susceptible to diffuse pollution, much of the risk arising from this relatively high grazing pressure along the valley bottom. This issue is discussed in more detail under “Riparian Management Issues”, below. Suggested strategies for intercepting excess nutrients will inevitably allow some areas of eroded banking to re-vegetate and become more secure.

The geology in the wider Lyon catchment is relatively stable and such areas of erosion that do exist are generally just those that might be expected in upland burns that are subject to frequent flash floods.
Other than devising a strategy to reduce diffuse pollution getting to the main river, it is not recommended that extensive resources be expended on erosion control on the river Lyon.

Glen Dochart

The natural geology in parts of the Dochart catchment is obviously inherently unstable, clearly illustrated by quite serious natural erosion in Kirkton Glen. The dam above Tyndrum is full to the top with sediment and suggests ongoing sedimentation from the old lead mines in that area. There are several miles on the main stem of the Fillan and Dochart where banks are simply falling away and many thousands of tonnes of sediment must surely be entering these rivers every year. This input will almost certainly be many times greater than potential inputs from other sources. These latter eroded areas, pictured here, represent about 40% of the lower Fillan and Dochart. The in-stream habitat certainly betrays this input and it must surely be affecting fish populations in the lower river. The

Fillan erosion

A settled cloud of silt

spawning habitats in many areas of the lower Dochart and the two lochs could be relied upon to send up a cloud of silt when disturbed. This is significantly different to the other two rivers, where clean gravel was very much the norm.

Sedimentation coming from several forestry plantations was apparent and, unlike the Lochay, this was seemingly affecting a number of the side tributaries. Whether this is a consequence of the geology or of the land use is unclear.

The levels of sediment seemingly moving in the Dochart system are not the kind caused by livestock or which could easily be rectified by fences or localized tree planting. Harder engineering is not an option either.

In recent years much discussion has been made regarding flood prevention issues on Tayside and in particular what might be done in the hills by way of slowing down the flow of water. It is likely that it is such schemes that might ease a proportion of this significant erosion too. One of the unfortunate aspects of this project is that we were never really able to develop a proper structured appraisal of the possible options regarding this issue and, during 2008, the LLTNPA were frustrated in their fundraising efforts to be able to tackle these issues in a meaningful way. However, they are now beginning to develop a floodplain initiative on the main part of the Dochart which will involve management payments for sympathetic floodplain management and it remains to be seen how this develops.

A wider appraisal throughout the catchment is however an outstanding action point to be taken on, perhaps with the help of the expanded SEPA Restoration Fund. Any such appraisal must outline realistic land use options and lay out the mechanisms by which they might be achieved.

The likely cost of such an appraisal would be £12-15,000.

Specific mention of the woodland areas on the Dochart has already been made. The priority there is the implementation of existing Forest Plans and Forest Design Plans which already allow for appropriate development of the riparian zones, although the economics of doing so are very much the limiting factor.

Spawning habitat

The distribution of spawning habitat was mapped in each of the main rivers and accompanying tributaries, up to the limit of fish access.

In the three main rivers, spawning gravel/juvenile habitat is simply not a limiting factor, although the distribution is skewed in some areas. It is immediately obvious why these areas have long been considered to be the production engines of fish stocks within the Tay system.

In Glen Lochay, 43 areas of spawning gravel were logged during the survey. These ranged from very significant

Abstracted watercourses in Glen Lochay

Gravel beds in the upper Lochay

areas stretching for several hundred metres on the main stem of the river to individual patches just covering a few square metres in small side tributaries. What spawning gravel exists in the Lochay is very clean and scarcely impacted by sediment at all. This reflects the low intensity agriculture, almost non-existent coniferous forestry development and underlying geology which for the best part in the upper glen provided for stable banks and relatively little erosion.

Spawning gravel is poorly distributed in the upper glen, a factor compounded by the fact that the many side tributaries have been abstracted with no provision for compensation flow and therefore the gravel that exists there, which would otherwise provide a useful function, is sitting high and dry for most of the year.

However, given the very low numbers of salmon currently returning to the Lochay, it is suggested that what exists within the main stem of the river would be more than sufficient for them. The upper river and side tributaries are unlikely to be required for spawning in the near future. The spawning/juvenile habitat in the Lochay requires more water to make it more productive. There is little point in suggesting anything else.

The Upper Lyon

Spawning fords on the upper and middle Lyon are extremely extensive and are certainly not a limiting factor. On the whole, they appear to be very clean and the Lyon must surely have been a very impressive river in its day. Spawning gravel in the side tributaries is very limited, simply because the topography is such that much of the catchment is inaccessible to salmon, fish access often ending just a few hundred metres from the main stem. In the upper Lyon many of these side tributaries are very heavily grazed and eroded in places but, again, the numbers of salmon accessing the Lyon is such that these side tributaries are unlikely to be used much anyway.

Mention is made elsewhere of the effect of the Lubreoch dam in cooling the water of the main river and slowing the growth of juvenile fish for some 15 kilometres or so downstream. In this situation the side tributaries might be expected to form a welcome haven from what is an unnatural temperature regime in the main river, and indeed, during the survey, the bottoms of many watercourses in the upper glen were clearly holding very large numbers of fry. Unfortunately the total area of such side burns is very low, just a few thousand square metres and the scope for significant improvements to mitigate against cooler temperatures on the main river is simply not there. Had the area of these watercourses been greater, this would have been a very sensible strategy to follow.

Glen Dochart differs slightly from the other two rivers, in that there is a significant proportion of spawning gravel in the side tributaries, as well as in the main river itself. The best quality spawning fords are to be found on the river Fillan and, while spawning areas are located throughout much of the rest of the main stem, they become progressively more fragmented and sedimented downstream. Although the Cononish has a reputation for spawning salmon, the gravel there is actually very restricted with barely any at all for nearly two miles below Cononish Farm. The tributary running up to Tyndrum is now likely to be more significant.

For many of the side tributaries feeding in to the Dochart through the main floodplain area, the quality of spawning gravel in the lower sections is very poor, being very compact and sedimented and certainly affecting what can be produced here. Much of this is likely to come from the forestry plantations upstream. The area concerned, possibly 10-30,000 square metres is not a significant part of the whole system, however these side tributaries do provide greater protection to young fish from flash floods in the main stem and should be addressed in the medium term. Suggestions for doing this are outlined elsewhere

Other than the Auchlyne and Auchtertyre burns, both of which are abstracted to a greater or lesser extent, the significant side tributaries on the Dochart system enter the river from the south.

Parr habitat

Our attempts to score parr habitat within the three glens failed because the geology was such that sedimentation was not generally a significant issue, certainly not in the Lochay or Lyon catchments and only to a limited extent on the Dochart.

Very simply, the quality of in-stream parr habitat through Glen Lochay was very good, and is certainly not a limiting factor in fish production in the glen. We can state this categorically. There is very little erosion/ sedimentation within the glen and this is reflected in the quality of potential fish habitat available.

Similarly on the Lyon, it was extremely difficult to locate any significant stretches where parr habitat was being obviously compromised through sedimentation.

On the Dochart system those tributaries where parr habitat was being threatened were on the same tributaries where spawning habitat was sedimented. Again the area concerned, possibly 50-60,000 square metres is probably not a significant proportion of the total, but being sheltered from the main stem floods, is likely to be a valuable overall component that must not be neglected. In general, the overall parr habitat, mostly in the main river, could be considered to be very good.
While surveying we were mindful of the fact that areas of good parr habitat beyond the limits of fish accessibility could potentially be used for re-stocking with hatchery fish. These areas are discussed below.

Limits of fish access

The topography of these glens is such that migratory fish would only have access to a very limited proportion of the total watercourses.

For Glen Lochay this amounts to only 10-12 %, in Glenlyon, 15- 18 % and in the Dochart catchment about 22%.

In each glen the available fish habitat is concentrated primarily within the main stem of each river, however, the side tributaries are more sheltered and less prone to flash floods and in many instances will be welcome sanctuaries from high & damaging waters on the main river. It is on the Dochart where such tributaries have most relevance.

Over and above this, there are some potentially very useful tributary burns beyond the point of natural access which that could be and often are stocked from the TDSFB hatchery.

One useful output from our survey work was to get a feel for the total surface area involved. Tributary lengths with good instream habitat and ready access from estate tracks were noted. Some of these were subject to abstraction, but all had sufficient water during the period of our survey work, and in most cases, the suitable habitat was above the abstraction point anyway.

Allt Auchreoch – Inaccessible

The lower Innerwick burn – accessible

In Glen Lochay, most of the stock-able tributaries have been abstracted with very little compensation flow and it is estimated that only 20-30,000 square metres of water might exist for stocking, almost negligible compared to the main river.

There are however, very extensive areas present in both the Dochart and Lyon catchments, up to 250,000 sq metres in each. On the Lyon in particular, with problems on the main stem relating to water temperature and food supply, issues not present in the tributaries, these side burns are therefore proportionately much more important and any future fisheries management policy should make provision for their regular stocking. 46, 93
The available resource is almost certainly much greater than is regularly stocked and a strong case can be put forward for increasing hatchery capacity to achieve this. These glens are up to 60 miles from the current hatchery, creating logistical issues in catching broodstock and putting out eggs or fry. Although it is not TDSFB policy to do this, the case can be made for a satellite hatchery to supply the needs of these glens closer to source. The capital cost of this would have to be privately sourced, but the manpower required, always the most significant element, could be tied in with the River Wardens concept described later, with one of the team taking a lead on this particular aspect. Broodstock tanks already exist in Glen Lyon, so the concept of more local autonomy on this issue has already been established.

There is potentially a merit in extending hatchery provision to this area as well.

Blockages

Other than the major dams associated with the hydro electric schemes in Glen Lyon, there are no significant blockages or weirs within the three glens that merit any attention. Natural blockages are only of a more minor nature.

In Glen Lochay 10 tributaries were deemed to be blocked by fencing wire or debris, all next to the main stem of the river. The total length of tributaries affected was 2300 metres to points where fish could naturally access. On the Dochart system only two blockages were encountered, one caused by sheep netting, and the other by trees forming an impassable barrier. The total area excluded was very similar to the Lochay. No blockages were encountered in Glenlyon.

Although these blockages are relatively minor, keeping such watercourses open is simple if done on an annual basis, and can very easily be done at no cost by local anglers if the blockages are brought to their attention. This is a good example of small projects which local people like to get involved with and gain satisfaction from such involvement. Very often the confidence to do this is all that is lacking. Some co-ordinating input to help with these matters is required.

The Water Framework Directive (WFD) and Hydro Abstraction

The European Water Framework Directive (WFD) of 2000 was adopted in to UK legislation in December 2003 and has long been regarded as potentially the single most influential piece of environmental legislation to be enacted in this country. At its most simplistic, the Directive requires that:
"All watercourses should be in good ecological and chemical status by 2015"

However, the WFD does recognize that across Europe that many watercourses are very heavily utilized, not just for generation of electricity, but also for irrigation and water supplies to towns and cities, supplying the most essential of human needs in those areas. There is a strong degree of pragmatism in this recognition of man's use of the water environment, and the WFD allows in these situations the Heavily Modified Water Body (HMWB) designation, a mechanism that still ensures that all practical restoration is undertaken, without significantly impacting upon the provision of the essential service being provided.

The headwaters of the Tay river system are dominated by hydro electric schemes and the WFD was seen as an important mechanism for mitigating some of the more damaging affects of this. In the context of this report, we are especially interested in the rivers Lyon and Lochay, and both carry this HMWB designation, allowing SEPA to take this more pragmatic approach:

" The changes that would be necessary to restore those water bodies to good ecological status would have a significant adverse effect on hydro-electric power generation, so the environmental objectives set for them require all practicable steps are taken to mitigate the adverse impact on the water environment that will not have a significant adverse impact on power generation."

"Significant" is not defined, but there is an economic test that is applied once mitigation options have been identified, with the benefits of the change having to be balanced against the cost of the mitigation.

Implementing agreed measures can then allow SEPA to say that a watercourse is then at "good ecological potential", something less than "good ecological status", but the best that probably can be achieved given the wider uses that are required off that water body. This allows them and the water users to meet their legal obligations. Unlike "Good chemical and ecological status", "Good ecological potential" is not easily defined nor demonstrated, scientifically or otherwise, and is essentially a compromise, the best that can be negotiated in the circumstances. It involves a very steep learning curve for all concerned.

Before looking at some of the issues relating to rivers in this area, it is useful to summarize the history and importance of hydro-abstraction in Breadalbane.

The Breadalbane Constructional Scheme

The hydro-generation infra-structure in this area was constructed in the 1950s and known as the Breadalbane scheme, it was centred on Glen Lyon. Much of the upper half of Glen Lochay is abstracted and piped to Loch Lyon, as are a number of tributary systems further down the glen. A more modest level of abstraction is also made from the Dochart and Glen Orchy. At its lower end, Glen Lochay hosts a significant power station fed by water coming back in a massive underground pipe from Stronuich dam in Glen Lyon. The whole system is an impressive bit of engineering.

The Breadalbane scheme required a massive storage loch at the top of Glen Lyon, now Loch Lyon, a reservoir which is many times its natural size. Building this dam removed the very significant spawning areas at the top of Glen Lyon, then the most prominent and productive tributary river in the Tay system. To compensate for this, a Borland lift was installed at the seemingly impassable falls at the bottom of the Lochay, opening up a new river system for salmon and hopefully making good any losses that arose from the loss of spawning grounds in Glen Lyon. The broad theory sounded plausible at the time, the Glen Lyon owners were gently persuaded that no ill would come from the new venture and 1950's optimism and engineering skill drove the project forward.

There was however no sign-post for the returning salmon placed at the mouth of the river Lyon, directing them upstream to their new river, and in the decades since, the plan has never really achieved any significant measure of success, although modest numbers of salmon do access the Lochay. Since 1960, while counts of 2-300 returning salmon to the Lochay have been recorded, and in one year almost 500 were counted, the returning numbers have usually been around 100 or less (TDSFB annual reports). There has never been an official salmon income generated from the upper Lochay, nor has it acted as the powerhouse nursery river for the Tay downstream that the upper Lyon once was. Whether this was ever realistic or not can be debated, but this has unquestionably been the outcome.

Boreland Falls. Lift / fish counter in foreground

Upper Lochay

During the course of this project, we encountered different reports about exactly how accessible or not the Falls of Lochay actually were prior to these hydro schemes being developed, with some local commentators insisting that the Falls were always passable to a limited extent under suitable water conditions and that the presence (their records) of an amount of fresh water pearl mussel (FWPM) in the Lochay proved that natural access by migratory fish must have been possible historically. Records from 1982 and 2000 have been reported, from sources with a strong local connection with Glen Lochay, although there do not currently appear to be any at the reported sites. It is also suggested that, in building the Borland lift with its associated weir and other infra-structure, the natural accessibility of the Falls was reduced to the current negligible level and past access problems have been exaggerated, consciously or otherwise, in the period since the scheme was built. Certainly, TDSFB, SEPA and SNH all now describe the Falls of Lochay as "naturally insurmountable" and imply that this has always been the case. The above accounts, other than those of FWPM, are now second-hand, from friends and family members of shepherds and ghillies who used to work in the glen but who have now passed on. They describe salmon from the upper Lochay augmenting the sparse diet of glen workers before and just after the Second World War, and how the new Borland lift did not, to their minds, increase the numbers accessing the upper river.

A tentative plan to blow up the falls with dynamite and facilitate better access just after the Second World War was never implemented (Judge Stroyan, Boreland Estate pers comm), being overtaken by events when the hydro schemes commenced. In many ways, although the fish pass has been upgraded recently, this might well have produced a better overall result for the river, as the entrance to the Borland lift is probably difficult for many salmon to find. The Falls Of Lochay consists of a series of three waterfalls and it is the middle one which is supposedly impassable, the others are certainly not. It may well be that we are too focused on the Borland lift and counter at the Falls of Lochay and that the dynamite plan would still produce the better outcome today. If we have to think outside of the box to get more fish in to this river, perhaps all options should be kept on the table.

Coire a' Cheathaich- The Corrie of the Mist

Late on in the project, the existence of an old Gaelic song was brought to our attention by Judge Angus Stroyan who recollected having once heard of it. The song was written by Duncan ban McIntyre, probably the greatest Gaelic poet that Scotland has ever produced, and proved relatively easy to source online in a Google search, with an English translation kindly provided.

Duncan ban McIntyre was a forestor/ gamekeeper for the Earl of Breadalbane in Glen Lochay for a period after he left the army in the mid 1700's, some time just after Culloden. He was the forestor/ under forestor in the Mamlorn forest, and his beat was Coire a' Cheathaich, which is on the south side of Glen Lochay, opposite Badour, right up near the top of the glen, and past all three of the significant waterfalls, including the one that is considered to be now impassable.

The song is called Coire a' Cheathaich, or the "Corrie of the Mist", and this is now considered to be one of Macintyre's most important poems, making this corrie probably the most famous in all of Gaelic literature. A beloved scene is depicted with affectionate touches, and each section of the picture is filled in with meticulous care. The song is included in a book of his works, The Gaelic Songs of Duncan McIntyre, edited and translated in to English by George Calder in 1912 for the Marchioness of Breadalbane.

The book can be accessed at this address:
http://www.electricscotland.com/poetry/macintyre/

Did Duncan ban McIntyre know who lived here?

One of the verses reads thus:

" White bellied salmon is in the rough corrie,
Which comes from the stormy, billowy sea,
With mettlesome playfulness capturing small flies
In his best hooked beak, not awkwardly:
On the fierce current 'tis he leaps briskly,
In his sword-like mail, with back blue-grey
With gleams of silver, finny, fine speckled.
Scaly, red spotted, white-tailed, slippery"

On the face of it, this implies that salmon were able to access the upper Lochay in the mid 1700s, long before hydro power put the Borland lift in, corroborating the more recent accounts which are now second hand. This account is first-hand, it comes from some-one who would have known the glen intimately. He has made his observation and recorded it, we know the approximate date, and we know the approximate location. The main question regards whether the poet would have indulged in some poetic licence when writing this? Salmon could never access the corrie itself, they do not really eat small flies, and they are not white-tailed.

However, much lies in the exact translation, and Gaelic

Lochay Falls 2010 (above). Lochay Falls pre-hydro (right)

can be interpreted in different ways, often to ensure that it still rhymes in English or for some other artistic effect. A different account of the poem can be found online by an unknown author, also at the above address.

"In the rugged gully is a white-bellied salmon
that cometh from the ocean of stormy wave,
catching midges with lively vigour
unerringly, in his arched, bent beak,
as he leapeth grandly on raging torrent,
in his martial garb of the blue-grey back,
with his silvery flashes, with fins and speckles,
scaly, red-spotted, white-tailed and sleek."

The "rough corrie" has now become the "steep gully". The Allt a' Cheathaich can indeed be described as a steep gully, and salmon could access the bottom reaches of it, even today.

"Small flies" has been replaced by midges, the mention of "white-tailed" is still there. Neither of these sounds quite right. There may well have been some poetic license taken, but would the poet have suggested that there was salmon in the Lochay if there was not? Could the Lochay have been naturally accessible in 1750 but not today?

The second line is each of these translations confirms that this is indeed a migratory fish.

Gaelic poems such as these were written primarily for those within their own community, as a record of their own history and local cultures. They were not written to entertain aristocracy in London society. There would be no reason to lie. Indeed, the credibility of the poet would have been undermined if he sought to describe a particular locality in an inaccurate manner.

Could the falls of Lochay have become naturally more or less accessible over a period of 250 years? Well, yes, changes could occur, either through gradual or cataclysmic erosion, changing natural access one way or the other. But we don't have any evidence for this, and this account of natural access in the 1700s does corroborate local accounts in the twentieth century prior to the hydro scheme, and the account of freshwater pearl mussels up to recent years, suggesting that at least under certain conditions that migratory fish can access.

Natural access would almost certainly be less today, if it was possible, simply because the abstraction of water would decrease the number of higher water events, and placing a greater emphasis on the Borland lift to allow access.

In 2010, with all the apparent sophistication of the Water Framework Directive and water sampling and expensive Environmental audits, it is indeed a sobering but profound thought that the most telling piece of evidence regarding the Lochay could be the voice of a Gaelic poet coming back to us through the ages, spanning 250 years. Coire a' Cheathaich, the Corrie of the Mist, almost got lost in the mists of time. ■

But not quite …

Salmon can access for about 300 metres

Coming down from the Misty Corrie

In 2010 the Breadalbane/Finlarig schemes, together with the neighbouring Tummel and Earn schemes produce approximately 342 MW of electricity or about 3.5% of Scotland's total demand. It is clean, green energy, versatile and reliable. It does however also come with a cost attached and it is that cost which is being articulated here.

The Breadalbane scheme affects these three glens in different ways.

Glen Lochay

In Glen Lochay it is estimated that some 47% of the total length of watercourses are affected by abstraction, or 55-60% of the total water area. Given that this area includes the highest hills at the west end of the catchment, it is likely that 65-70% of water could theoretically be abstracted and, for an unknown proportion of the time, the maximum abstraction rate will in fact be achieved, with no requirement for a compensation flow in the tributaries concerned. The precise abstraction regime is not known, but Lochay water is essential in maintaining a suitable water level in Loch Lyon. The overall scheme could not possibly work without it.

Hydro infra-structure, particularly the sink-holes on smaller tributaries, is not affecting the passage of fish directly on the River Lochay, all being beyond the limits of where fish can access. None of the structures are visible from the main road in the glen, and other than the pipeline taking water to Glen Lyon, most people would be

Abstraction point

almost unaware that there was water abstraction here at all.

In the 1950s and again in recent years, two falls further up the Lochay were re-engineered to help fish access. In 2007 significant improvements were made to the Borland lift to make it easier for fish to locate the pass and gain access to the upper river. This work was carried out by Scottish & Southern Energy (SSE), with the value of their work being used to lever additional funds for the European LIFE project aimed at restoring salmon stocks across the country. This Borland lift incorporates a fish counter, widely recognized to be a huge improvement on what had been present before, and providing very accurate information on the fish passing through it.

The dry Lochay

As suggested above, for the past twenty years the counter has logged approx 100-250 salmon annually with a number of years being less than this. It is recognized that the counter prior to 2007 was not as effective as today, and these figures are probably an over-estimate.

How many salmon might the Lochay be capable of producing if the upper river was fully accessible and a more suitable flow regime restored to the river?

Virtually no work has been done on this, and any figures given are speculative. SSE suggest that returning numbers might be 3-400. TDSFB suggest that 1000 should be possible, with possibly 500 in bad years. Much depends on current survival at sea. An address to the Tay Ghillies Association in 2000 by TDSFB member Andrew Mc Taggart suggests that a potential salmon run for the Lochay would be 2000-3000 fish, although it is not known how this figure was derived. Current TDSFB advice is that this is over-optimistic. However, there is no doubt that the Lochay has considerable potential as a salmon nursery river, being broadly similar in size and character to the area now under Loch Lyon (Judge Stroyan pers comm). Certainly, at the time the hydro schemes were being developed, it was thought to be a worthwhile swap. There are very extensive spawning fords and juvenile habitat throughout the river. The gravel is very clean, with little obvious sedimentation. There is a good level of tree cover providing shade and additional food, and the geology of the hills is base rich, this being the underlying reason for the designation of the Meall na Samhna, Meall Ghaordie and Benn Heasgarnich SSSI sites in the catchment for the vegetation which they support. Other base rich catchments such as the Shee on the upper Ericht are extremely prolific as salmon nurseries. The Lyon catchment itself is very similar in this regard.

Vaki counters installed on the Cattie and Beltie burns on Deeside recorded 500-1600 salmon returning during 2001-2005 (Middle Dee Project), many more than might be supposed for relatively small tributary burns in more acidic catchments, heavily impacted by sediment that unquestionably affected their holding capacity. The Lochay is a river by comparison, unhindered by such problems, and with considerable other advantages.

While it is easy to become too optimistic about what the Lochay might produce, the overall habitat there is well balanced and generally very good and it is very important not to play things down either. In July 2010, with all abstraction temporarily stopped and with a natural flow in the Lochay, the possibilities suddenly become very striking. It is quite difficult to point to obvious disadvantages that the river might have that detract from such potential. Except for the obvious one.

The obvious problem which exists in Glen Lochay is that 55-60% of the water is abstracted and, although water depth is sufficient for fish ascending in November floods, at other times of the year the life cycle of all fish in the river, not just of salmon but freshwater species as well, will be severely disrupted by this.

Falling water levels cause eggs in redds to dry out, fry and parr must migrate downstream or be cut off in shallow pools. The middle part of the river is especially affected in a dry spell in summer. More difficult to comprehend is observing part of the river dry in the winter months when a severe frost has frozen the very small side tributaries that feed it at that time of year. Eggs laid in redds cannot survive in these conditions and the mortality must be extremely high. Such occurrences only have to happen once to generate this effect. Under most circumstances the river looks to be perfectly normal and very few people travelling through the glen will be aware of these issues. The Lochay is in fact the second most heavily abstracted river on the Tay system after the Garry.

The dilemma for migratory fish in the Lochay is therefore that they can only ascend now because of the hydro-electric scheme, however the scheme is not allowing many of them to complete their life cycle when they do. The unwritten contract that was to open up the Lochay to compensate for losses on the Lyon is therefore only being partially honoured. A river with sufficient water in it must surely be many more times productive than one without, not just for salmon but for other fish species as well and wildlife and biodiversity more generally. The current WFD classification that the Lochay is at Bad Ecological Potential reflects this current assessment.

Glen Lyon

The issues in Glen Lyon are different. Fish can access the river without any problem and a stable compensation flow with regular freshets is guaranteed. There is no suggestion of quantity of water within the main river being a problem. Indeed, in dry spells, the compensation flow in the Lyon can be much more than the natural flow would be. However, as noted later under "Cold Water", the dam at Lubreoch does significantly affect the temperature regime and there is evidence that invertebrate life in the river has been compromised. It is also known that the growth of juvenile fish is the lowest in the Tay district. Despite the Lyon being nearly thirty miles long and it being long regarded as the engine room of salmon production on the Tay, there were only

The dam at Lubreoch

Hydro in Kirkton Glen

60 salmon counted through the counter at Stronuich in 2009. Hydro abstraction cannot be the only factor in this decline however there is sufficient information for it to be implicated to a very significant degree.

Probably 40% of the Lyon catchment is abstracted, either in to Loch Lyon or through to Loch Tay side. Abstraction in itself here is not a key issue, with only a very limited amount of spawning and juvenile habitat lost because of it, the amount being negligible compared with what exists in the main stem of the river.

Glen Dochart
Hydro abstraction is not a significant issue on the Dochart. While two major tributaries, the East & West Auchlyne burns, are abstracted and taken through to Loch Lyon losing a certain amount of juvenile habitat, there is no problem for fish in accessing the river, nor are there any harmful effects on water temperature. New hydro schemes are multiplying quickly, but they are run-of-river schemes and it is doubtful that they have having a major effect on the fishing interest as a whole.

The Scotland District River Basin Management Plan

The necessary actions to bring "*all watercourses in to good ecological and chemical status by 2015*" as detailed in the WFD are laid out in this plan, which was very quietly posted online just before Christmas 2009 with no attendant publicity and virtually no comment made. Provision is made for the HMWB designated watercourses and a timetable set out to achieve their "good ecological potential" status.

The Tay River Basin Plan requires an increase in "good ecological potential" from 55% of water bodies to 60% of water bodies in the period to 2015.

Those expecting more from the WFD will have anticipated that something more significant than this might have been forthcoming.

The reason for this is that if mitigation costs are disproportionately costly, then mitigation can be postponed to 2021 or 2027, representing the next two WFD river basin planning cycles. This latter date is seventeen years from now.

The status of the main water bodies in the TWCP area are summarized below.

The River Lochay
The Lochay is split in to two water bodies, above and below the confluence with the Dunchroisk Burn. The Lower Lochay is classified as being at Good Ecological Potential, which means that this part of the river will not be subject to any mitigation measures within the WFD river basin planning cycles.

The upper river is classified as being at Bad Ecological Potential, the expected classification, but this only after successful lobbying by the TDSFB. However, the date given for mitigation to be implemented is 2027. Why such a period is required is not known.

Further clarification of this position is also provided by SEPA:

"*We have set environmental objectives for this water body over future river basin planning cycles in order that sustainable improvements to its status can be made over time, or* ***alternatively that no further deterioration in status occurs, unless caused by a new activity providing significant specified benefits to society or the wider environment***"

The Upper Lochay is at the lowest classification anyway, so no further deterioration is possible. Further hydro abstraction would be classified as an "activity providing significant specified benefits to society …"
What this means is :

- The Lochay ***may*** be returned to good ecological condition by 2027
- But it may not …

We therefore cannot assume that the Water Framework Directive will ever address the lack of water in the river Lochay and, at present, Government will not force the issue. This is unfortunate, but it just so happens to be the reality at present.

The River Lyon
Within the Lyon catchment, the mainstem of the river and Loch Lyon & Loch an Daimh are all deemed to be at Good Ecological Potential, with the Allt Odhar at High.

The Allt Conait, Allt Buil a Muillin and Allt a Chobair are all at Moderate Ecological Potential, projected to rise to Good by 2027.

The Invervar, Allt a Mhuic and Keltneyburn are all at Bad Ecological Potential, and this is not projected to improve before 2027. These three tributaries all have a derogation under the WFD rules that allows for no improvement in condition where watercourses are abstracted for hydro generation because of the "*significant specified benefit to society*". There are 29 watercourses in Scotland that now have such a derogation, all associated with hydro electric schemes. While these derogations are supposed to be used only in exceptional circumstances, it would appear that they are now more or less the norm. However the effect in this area appears to be negligible as far as fish populations are concerned.
From a fishing point of view the latter three tributaries and the two lochs are of little interest.

The three burns at Moderate Potential do have some potential for salmon in their lower reaches and given their contours and accessibility of nearby estate tracks, all could potentially be stocked successfully above the natural point of access. Given that they would not be affected by the unnatural temperature regime in the main stem of the Lyon, the potential in improving these three tributaries must not be overlooked.

The big disappointment in the Lyon catchment is that the main river has been classified as being at Good Ecological Potential, this despite the fact that it was classified by SEPA as being at significant risk of failing to meet the WFD requirements in 2007 and, as is outlined later, the water temperature is unnaturally cold, the water chemistry has deteriorated, the invertebrate populations are compromised, the fish are stunted in their growth and a mystery algal growth is covering most of the river bed.

For whatever reason, these simple and readily understood parameters appear to have carried little weight in making this determination. An adequate compensation flow appears to have been the only criterion used.

Because the main river Lyon is deemed to be at Good Ecological Potential, the Water Framework Directive will not make any difference to this river either, unless this classification can be changed. It is vulnerable to being challenged.

The River Dochart
The classifications given to some of the water bodies on the Dochart system illustrate the apparent inconsistencies involved with this process.

Despite having a greater water flow than the Lyon, not being regulated as such and certainly not having a disrupted temperature and water chemistry problem, the East Dochart and Fillan are classified as being at Bad Ecological Potential compared to the Lyon, which is apparently good. The western part of the Dochart is described as Poor, the category above Bad.

The Auchlyne West Burn, which ***IS*** abstracted almost completely to Loch Lyon via a pipe, is described as Moderate.

Two other water bodies described on the Dochart are Loch Iubhair, classified as High, and the Luib Burn, classified as Good.

Finally, the Cononish River is classified as Moderate, with the pressure not being abstraction but potential pollution arising from mining/quarrying activities at the Cononish mine. SEPA are to ensure that this river has its' status improved to Good by 2015. As it now looks increasingly likely that commercial gold mining will become a reality at Cononish, this increased profile for that area is very welcome.

How to progress?

On the face of it hydro abstraction issues are not being addressed at present for two simple reasons:

1. Abstracting less water will involve a reduction in income for the energy companies involved
2. The Scottish Government will seemingly not contemplate any activities that reduce the output of renewable energy.

The picture in reality is however more complex. It helps to understand some of the pressures concerned and where there may be room for compromise and to progress these issues.

Glen Lochay
The TDSFB believe that the equivalent of one extra sizeable tributary being released would transform the flow regime in the Lochay, the equivalent of 1-1.5 wind turbines. The income foregone from this might be £2-3 million annually. This is a sizeable amount but no greater than the downstream fishing income that would be generated where there 2- 3000 salmon returning to the Lochay rather than less than 100, as at present. The many economic multiplier effects involved with fishing are indeed very considerable. If only 400-1000 fish were returning annually to the Lochay, possibly/ probably

Water pipe taking water to Loch Lyon

the more realistic estimates, then the value of energy foregone would almost certainly be greater than the potential income generated from fishing downstream, but the Lochay would also be at a much higher ecological potential than it currently is.

Could an energy company contemplate making this financial sacrifice? Is a sacrifice indeed required? On what basis might this be contemplated?

The Breadalbane Constructional Scheme was designed and established in the 1950's and based around 1950s rainfall patterns. We know these have changed in the 60 years since, with more rain now than then. This ***may*** mean that there is now an in-built buffer in the system that could be taken advantage of to release more water. The problem is that while rainfall data is publicly available, the exact abstraction regime and pattern is not and investigating this is not possible.

It is however almost certain that the power company will have done all these calculations themselves and ran a variety of different scenarios, to plan for the eventuality that the WFD would be a more substantive piece of legislation than it currently appears to be. They will have an idea of what compromises they might have been prepared to make and what their price for that would be.

Indeed, postponing mitigation measures beyond the 2009- 15 WFD river basin planning cycle can only be done on the basis that mitigation is "*disproportionately costly*". By implication, this suggests that mitigation possibilities have been identified and costed, otherwise how could they be shown to be "*disproportionate*"?
The first step in restoring a better flow regime to the Lochay must therefore be an analysis of the mitigation options examined to date, from which the potential benefits and energy production costs can then be deduced. The income associated with different flow regimes is now well understood and any issues surrounding commercial confidentiality can only be theoretical. There is no reason to have to wait seventeen years for this. It can be done now, in 2010.

Emphasizing the obvious

Any proposal designed to improve the ecological potential of the River Lochay must by necessity require the release of a greater proportion of the natural water supply within the glen. There is no other option.

A careful study of the two photographs above right, will hopefully emphasize this point. One of these flow regimes allows for greater overall biodiversity, including fish, than the other. There is no need to look beyond the obvious in determining what is required to improve the condition of the river Lochay.

It should also be emphasized that restoring water to the Lochay will not require expenditure on infra-structure, nor will it require protracted research, for the reason given above.

Dry gravel

Gravel with added water

Restoring water to the Lochay ***may*** cost the energy company a great deal of money, to the order of magnitude already stated, but this money will be income foregone, not additional costs. No public funds will be required. These distinctions are important. Additional water could be released at any time should it be in the wider interests of the energy supplier to do so.

The options

There are really only two options for a new abstraction strategy in Glen Lochay:

1 Achieving a better outcome within the existing catchment/scheme.
2 Looking at Glen Lochay in a wider renewable energy context.

Within the existing catchment

1 There ***may*** be a buffer in the existing scheme which allows a greater release of water, however there is no way of knowing this at present. In theory, this option should be possible, due to changing rainfall patterns but the order of magnitude is unknown.

2 Instead of taking all of the water from upper Glen Lochay to Loch Lyon, it would be possible to generate power from one or two of the abstracted burns on the south side of the river or at the very top end of the river. Unless this could be done within any buffer that exists as in (1), this would result in lost income to the developer, both in terms of income foregone and the developer then having to pay the landowners for the electricity produced. It would however produce no overall decrease in renewable energy produced from this glen and may even increase it. The advantage for the Lochay from run-of-river schemes would be that the water will end up in the Lochay, not Loch Lyon, and therefore be able to sustain fish stocks.

3 Is it possible to install an additional power station at the top of Glen Lochay to take advantage of the head of water coming down from Glen Dochart in the pipe, generating power from this and then still sending it to Loch Lyon to be stored and re-used a second time? An equivalent or even lesser water supply could be released directly in to the river from the top of the glen, giving maximum benefit to the river along its entire length.

These ideas may or may not be possible, either physically or financially, and they would affect the amount of water reaching Loch Lyon, but they appear to be the only strategies possible within the catchment itself.

The wider context

It is probably the wider context that holds the key for restoring the river Lochay. Companies involved in hydro generation are involved in a full range of production systems, renewable and otherwise. All have to go through the planning system, often a laborious, tedious and expensive procedure. We have as yet no real joined-up national strategy for energy production in this country. If we did and power companies could see a more certain way forward, then addressing issues such as the Lochay would not be so much of a problem. Losing energy production might well appear significant in the context of an individual glen, but the income foregone that would be required to re-instate the Lochay is very small beer on a national level, or even within the individual company concerned. Scotland would be awash with renewable energy if all the current proposals in the planning system gained consent.

Perhaps the price required for restoring the Lochay and other rivers like it is for more environmental and community organizations to make the case for having a more effective overall renewable energy strategy that could facilitate a bit of give and take.

Energy companies will ultimately be persuaded to make compromises if it is in their interests to do so. They will know the price required even if we don't. This, really, is the only possible angle to pursue if we are to resolve these issues. The good thing about pursuing such a strategy is that they ***may*** be quite happy to discuss such issues well within the seventeen year period.

Glenlyon & Glen Dochart

While it may ultimately be possible to restore a better flow of water to the river Lochay, the unnatural water temperature and changed water chemistry in the Lyon will be another matter entirely, as outlined in the section "Cold Water", below.

It would appear however, that the WFD classification that the Lyon is at Good Ecological Potential must be very vulnerable to challenge. Overturning this classification would then at least allow resources to be spent in further analyzing these problems, building on the TDSFB report by David Summers in 2001 (See below) and it may then be that possible mitigation procedures could arise from improved knowledge arising from this.

The first necessary step in Glen Lyon therefore, is that the current WFD classification be challenged and overturned. The Lyon cannot be left for seventeen years to decline further without a start being made on this.

In this context SSE should be invited to participate positively, as good stewards, and as they bring on line additional assets such as Glen Doe, other planned pumped/and storage schemes, wind turbines on and off shore, and other technologies, all of which will reduce pressures on current hydro assets, this should allow for new thinking in water management and generation.

In the context of these three glens together, as the headwater tributaries of the Tay river system, it is suggested here that the Dochart be given least priority with regards to abstraction and full attention given to these other two rivers.

The importance of Stronuich Dam

Stronuich Dam lies three miles below the main Lubreoch Dam in Glenlyon. The main purpose of Stronuich is to divert water from the Lyon back in to pipes which carry water through the hills to the main power station at the bottom end of Glen Lochay. Its construction in the 1950's underlines the ambition and optimism of that time.

Stronuich

Stronuich Dam

There is a Borland lift and fish counter at Stronuich allowing access to another three miles of the river upstream, with some of the best spawning/ juvenile habitat on the whole river. Lubreoch Dam then prevents any further migration upstream. 150-300 salmon typically passed through the Stronuich counter in a season going back to the 1960s, although the total in 2009 was only around 60 fish, a very poor return by any account. There have been other historic lows from which the counts have recovered. (Count records, TDSFB annual reports)

While fish can access up through the Borland lift at Stronuich, it has long been suspected that smolts would have difficulty in negotiating the dam successfully when they went to leave the river without entering the pipes leading to the turbines in Glen Lochay. Smolt screens are in place for part of the spring period, but it is not known how effective these are. A review of this and a reporting process would be welcomed.

Below the dam at Stronuich is a gauging station run by SEPA and SSE and, at the constriction built to measure the flow, it is possible to install a smolt counter to determine just how many smolts are actually leaving the upper Lyon.

Unfortunately, in recent years, efforts to do this have been frustrated, partly because of the distance having to be travelled by TDSFB staff and partly because of difficulties in securing the necessary permissions on time.

Stronuich Dam is important because if smolts cannot safely negotiate it, then effectively any salmon accessing the upper river, other than what might be caught above the dam with rod and line, are going to waste. Some of the lower Lyon proprietors feel that salmon now increasingly run the middle river quickly to get to the upper river, exacerbating the significance of the situation.

Glen Lyon needs to know what is happening here and TDSFB needs the necessary consents to research this properly. It could be that even a single year of counts will indicate what is going on. Assistance will be sought to implement this count as soon as possible.

Whether any loss of smolts can be mitigated against or not, by engineering or other means at the dam, remains to be seen but the priority is to check whether this loss is in fact occurring and this needs to be addressed as a matter of priority.

One solution if there is a problem might simply be to close the Borland lift so that salmon cannot access the upper river at all and force them to spawn further back downstream, where it is over a mile to the nearest spawning fords. This would deny those upper proprietors their fishing, and effectively lose four miles of the upper Lyon to salmon, however this may well be a necessary action to take in the interests of the river as a whole if there is indeed an issue at Stronuich.

Until we find out though for sure, the discussion is rather academic.

Cold water

One of the most valuable research projects undertaken on the Tay river system in recent years was conducted by Dr David Summers of the Tay District Salmon Fisheries Board (TDSFB) in 2000/1, looking at the water temperatures in the upper Lyon and how this related to fish productivity. A full account is given on the TDSFB website: http://www.tdsfb.org/ under Current Projects. The article is called *"What has gone wrong with the River Lyon?"*

Water from Lubreoch dam at the top of the glen is released from the bottom of the reservoir and is much cooler than would naturally be expected. During the study, in early summer, the temperature of water leaving the dam was often a mere 8 degrees Celsius compared to 15 degrees some 10 miles downstream. Fish will not feed until the water is 7 degrees, and will not feed most effectively until the water is 16 degrees. The water in the lower Lochay is also cooler than would naturally be the case, a consequence of the large proportion of it which is diverted there from Stronuich.

Little surprise therefore that the growth rates of fry and pre-smolt salmon in the upper Lyon are the poorest in the Tay catchment and this poor growth means that most smolts are three years old when they migrate to sea, compared to two elsewhere. This means that juvenile habitat must be occupied for longer and consequently, turnover and overall productivity of the river is less. The adjacent tributaries did not show this effect.

Pre-smolt weights in the Lyon were still less than expected, even after the water had warmed up after Meggernie, suggesting that temperature alone was not the only factor involved and perhaps there were other issues at play.

Studies of the invertebrates that fish would feed on revealed that the mix of species that would be expected was significantly compromised, with certain valuable groups either missing or severely reduced in numbers. This effect was not noticeable in adjacent tributaries. This might be partly a factor of the temperature regime but the final part of the picture is the algal growth that affects the Lyon, from the dam downstream for almost twenty miles, in some years not a single stone is clear of it. Again the tributaries are unaffected. The algae has been shown to be non-toxic, but leaves a black residue rich in iron and manganese, metals often associated with rivers below artificial resevoirs as a result of chemical deterioration of the water. There is a suggestion that this "slime", which first appeared from the 1960's onwards, is disrupting the feeding habits of favoured invertebrates, reducing their numbers, and this is showing up in reduced fish weights, which then has the above mentioned knock-on effects on fish stocks.

It should be emphasized that cause-and-effect has not yet been proven and greater research will still be required but all this does raise an interesting question. If a river has been shown to have an abnormal temperature regime for up to 15 miles, its invertebrate populations are apparently compromised, it is smothered in a mystery algal growth that is not really present anywhere else and fish growth is obviously shown to be severely stunted, how then can that river be regarded as being at "good ecological potential"?

The SEPA determination that the Lyon is at "good ecological potential" must be challenged on the grounds that these very obvious parameters suggest that it is not. There is a certain simplicity in just examining the obvious first, before more complex but spurious parameters are considered.

New small scale hydro developments

Since the end of our survey work in 2008, several hydro developments have been undertaken in the TWCP area.

In Glenlyon, including at Keltneyburn, eight schemes have either been given approval and are in the process of being installed, or are awaiting approval. On the Dochart, two schemes have been installed and a further five are being developed. These are in addition to several smaller private schemes that have been in existence for many years, and the existing SSE abstraction points and infra-structure associated with the Breadalbane Constructional scheme. Virtually everything that could be abstracted in Glen Lochay has been abstracted already, but there is significant government pressure to develop renewables and it might be expected that smaller schemes will start to be developed once the larger burns have been accounted for.

The new schemes are "run-of-river" schemes. Water is abstracted at a high point on the main watercourse, run through a power station and returned to the same watercourse downstream of this. In all these schemes to date, the abstraction takes place above the limits of fish accessibility and, while the outflow might in some cases potentially affect accessible habitat, the threat has been assessed as being low in all cases in this area to date through the planning process.

Issues might arise in future if a policy decision was taken that more artificial stocking was going to be undertaken in these headwater rivers and that greater use of the tributaries should be made. Tributaries accessible for this purpose are very much in the minority (eg Allt a Mhuic) and a compensation flow is provided in all cases which should be sufficient for juvenile salmon, albeit they would be more suitable with a natural flow.

In the TWCP area the vast majority of these schemes will be genuinely benign as regards fish populations, but these schemes are still required to jump through hoops to gain planning permission, often involving issues which are only of marginal or theoretical relevance. All this takes time and, when SEPA are involving themselves in matters of detail on these small schemes, bigger issues like the Lyon or the Lochay do not get addressed.

A strong argument can be made that if some of these smaller schemes could be fast-tracked and unnecessary costs cut out, allowing that essential fish and biodiversity interests are safeguarded, then we would be in a better position to achieve genuine improvements in relation to the main rivers, be that more water in the Lochay or mitigation of the effects of reduced temperatures in the Lyon. SEPA would have more time to devote to analyzing the issues, and developers would save massively on costs, savings which could allow the release of more water in other areas.

The hidden cost of over-analysis of many of these smaller schemes is the more serious failure to address the big issues elsewhere. SEPA don't have time to address the Lochay or the Lyon, but they apparently do have time to investigate many smaller watercourses where the impact on fish will be negligible at best.

It does not really make any sense.

River basin management planning on Tayside

A priority consideration for this project has been to identify what we thought were the most relevant issues for inclusion in this management planning process within the Tay catchment area.

To date, this process has not impacted in any meaningful way with either local landowners or the local community in this area and remains very much a strategic concept for Government agencies and other allied organizations; well meaning and with government backing perhaps, but as yet without any practical relevance at any level within these catchments themselves.

A way must be found of making this process more locally applicable.

Access

In the context of this report, access can be delineated into those taking access to the river for fishing and those taking access for other recreational activities.

In the former case, it was actually very difficult to work out how people were accessing the rivers for fishing and that simple projects needed to facilitate this would have to be devised on a site specific basis in conjunction with the various parties involved. Simple infra-structure improvements or some clearing of bankside trees may well be of benefit. On the Dochart, paths to and from the river seemed more obvious, however it did appear that in many cases that access along river banks was actually quite difficult. Some examples included commercial forestry right up against the river, forcing people to take detours, deep ditches that had to be traversed with care, or fences with no easy means of crossing them.

The best way of forwarding small scale infra-structure improvements would be to provide local professional back-up and co-ordinate input. This ties in with the concept of river wardens discussed below. The majority of work could be carried out by angling club members, but this additional input could supply key skills such as chain saw use, make sure appropriate assessments and permissions were sought and ensure that only projects of genuine need and priority were being undertaken.

With regards to wider recreational use, several camp sites were being used close to the rivers, many of which were ideal for this use. Recently felled trees being burned on camp fires were noted in some cases. Cars parked along roadside verges were fairly common in good walking weather and better co-ordinated facilities might well be beneficial. In Glen Lochay, for example, the major parking area half way up the glen at the pipeline was essentially in the middle of a cattle wintering site and not at all suitable for that particular use.

On the Dochart system, it was noted that cars were parked at the side of the busy road for those walkers accessing Benmore. This did not appear to be a suitable or safe arrangement.

Connected to the recommendation of employing river wardens (below), it is obvious that an element of additional ranger work will be beneficial in each of the glens concerned.

River Wardens

During the course of our catchment survey work, the issue of available man-power to carry out a range of tasks arose and the lack of a local co-ordinating input in regards to a number of issues quickly became apparent. On Tayside, responsibility for management of the riparian environment is extremely fragmented. For example, the TDSFB manage migratory fish, the freshwater angling clubs and the TLC manage freshwater fishing. All use the same rivers, however communications are often poor.

Within the public sector, there are two local authority areas, two SNH offices, two police forces, and the Loch Lomond & Trossachs National Park Authority covers the Dochart but not the rest. The administrative boundaries cause problems, especially in and around the Killin area and Loch Tay. This is all one river catchment.

In all three glens the rivers themselves are very accessible and all have a road running nearby. Some-one travelling up and down these glens on a regular basis will very quickly come to know them and the various owners and occupiers well and would be well placed to fulfill a number of functions, some related to fishing, some of a rangering nature, others relating to biodiversity. The concept of "river wardens" was born: practical full-time employees working for a single organization, funded from a number of sources and providing a range of outputs, but all connected either directly or indirectly with these river corridors.

A number of ranger/ bailiff/ wardens position already exist in this area. LLTNPA run a ranger service, TDSFB run water bailiffs, the TLC run volunteer freshwater wardens. Each has a very specific function, each are under funding restrictions to a greater or lesser extent. Often, the different roles can contradict one another, or an employee can not address a simple issue not under their own immediate remit.

A key recommendation of this report is to achieve greater co-ordination between these functions, create one single employer and a more streamlined communications system and eradicate the internal boundaries which only complicate the picture unnecessarily.

As a non-governmental organization but with a recognized remit throughout the whole area, we are recommending that TDSFB (or specifically the associated Tay Foundation) are the most suitable employers of such wardens.

A summary of this recommendation is set out in the box (opposite).

The strategic location of these glens, lying either within or between the two National Parks, can be used to obtain the necessary external funding to be able to do this by focusing on wider biodiversity issues as well as the obvious need for more effective local rangering input. The initiative combines the water environment, community participation, control of invasive species, catchment management, a range of priority & iconic species, education & training, strengthening local communications and local community capacity building.

The focus will be on streamlining and improving existing service provision, almost certainly at a lower overall cost.

We foresee four "river wardens", operating in two pairs:

- *The first pair will cover Glen Lyon and the Rannoch/ Tummel system.*
- *The second pair will cover the Dochart/ Lochay and around Loch Tay.*

Much of the work carried out by these wardens will not be directly related to the rivers, BUT, crucially, the wardens will be available for salmon and habitat related work as needs materialize. At present the salmon interest/ rates alone in these catchments does not merit this level of investment, only by incorporating these wider issues can the overall package be made to work in the short term.

Being a non-governmental organization, TDSFB would be a suitable employer for such wardens in that they would have the confidence of local landowners as well as public agencies. These extra personnel will strengthen communications on the ground and allow existing TDSFB staff to operate over a smaller and more manageable area elsewhere within the district. Such a proposal would involve extra administrative burdens on TDSFB, the command and control of such personnel and their exact remit would need to be given very careful consideration.

Summary

Tay District Salmon Fisheries Board (TDSFB) to employ, through external funding, up to four River Wardens in the western catchments area and Loch Tay, incorporating migratory and fresh water bailiffing duties, special constable responsibilities, co-ordination of mink and other predator control, habitat management, potential broodstock and hatchery work.

Rationale:
To increase the amount of project work that TDSFB can undertake in relation to fisheries and habitat management in the Tay headwater catchments, to facilitate better communications with community organizations in those areas and to help develop and support their capacity to make an effective contribution. This will allow more effective delivery of important Charter Principles such as broadening participation, promoting responsible behaviour and delivering improvements in learning development.

To support and strengthen the existing river security provided by TDSFB bailiffs and Freshwater Fishery Wardens.

Timescale:
Potentially to implement by autumn 2010 or spring 2011, subject to funding package being in place.

Funding:
Likely cost £120-150,000 per annum. Potential funders include 2 x National Parks, an EU LIFE mink eradication bid, local authorities, LEADER, private charitable trusts, private investment, Scottish Rural Development Programme.

Existing initiatives are described and the relevance to this concept outlined below:

LLTNPA Ranger Service

The Dochart is the only one of the western Tay catchments within the LLTNPA area. LLTNPA already deploy a significant ranger service. During 2009, this service has become more focused on anti-social camping and related problems and work programmes and training have been redefined to this effect. The most high profile change has been the closer working relationship with local police forces and the use of special constable powers by LLTNPA rangers. There may be a role for this TDSFB initiative in forwarding LLTNPA objectives within the Dochart catchment, by delivering an equivalent or greater rangering service in a different manner.

It is anticipated that the approximate remit of the post would be equivalent to current LLTNPA objectives in that area, but that the ranger involved would also fulfil a bailiffing role, co-ordinate mink eradication efforts which we believe to be a particular issue and be responsible for salmon stocking and protection issues. TDSFB would seek to create an equivalent position covering the neighbouring Glen Lochay and around Loch Tay through additional external funding. This individual would also lend support within the Dochart system when required to deliver the additional responsibilities and vice-versa.

Crossing the boundary
The west end of Loch Tay falls within the jurisdiction of two local authorities - Stirling Council and Perth & Kinross Council. The Dochart and lower part of Glen Lochay are within the National Park, Loch Tay and areas further east are not.

Discussions with local angling clubs, Killin Community Council and others suggests that a number of issues within that general area are not effectively addressed simply because these administrative boundaries tend to divide management responsibility for them.

These areas are ALL however within the catchment of the TDSFB, who have a statutory role within that whole wider area.

Using TDSFB as an employer of such river wardens simplifies management responsibilities throughout the western Tay catchments, and creates the single point of contact which is currently missing. Herein lies the main strength in this proposal.

Potential benefits to LLTNPA
The proposal :-

1. Allows an alternative and effective mechanism for delivering the current LLTNPA ranger service in Glen Dochart and an equivalent service around the northern buffer area of Loch Tay and Glen Lochay. The proposal would extend a common regime and working ethos through to the Cairngorms National Park boundary.

2 Suitably aligns the working ethic of TDSFB with the current focus on upkeeping the law which LLTNPA wishes to pursue.

3 Allows greater scope for delivering LLTNPA objectives on private land as TDSFB are a non-governmental employer. They are however a recognized statutory body with well defined powers and the necessary administrative and fundraising capacity.

4 Demonstrates partnership working and allows LLTNPA to exert influence outwith current boundaries.

5 Contributes to River Basin Management Planning on Tayside. Rivers are a UKBAP and LLTNPA BAP priority habitat and this will help protect the status of the River Tay SAC.

6 Provides a local mechanism for eradicating invasive species.

7 Eradicating mink will help consolidate water vole populations in the northern part of the Park and help deliver this important aspect of the LLTNPA Biodiversity Action Plan. Such personnel are also ideally placed to dealing with grey squirrel incursions, another key species in the LLTNPA BAP.

Rannoch Conservation Association Rangering Scheme
For the past three seasons a scheme has been in operation to deal with irresponsible camping in the Rannoch/Tummel area. A dedicated ranger is funded through sales of fishing permits and through PKC and the Forestry Commission. The initiative has the full backing of Tayside Police and is widely viewed to be successful and innovative in providing a local solution to camping problems in that area. The initiative requires the equivalent of c20% of a full-time post, concentrated in the March- Oct season, with the most effective input being required at weekends.

The existing initiative provides an effective local rangering service from March- October, although it is highly dependant on the warden himself to make things work. The initiative is well supported and accepted locally and is showing demonstrable results. There is a demand for expanding such functions, both in the neighbouring glens and also further down the Tummel catchment around Faskally, however more resources would be required to do this.

- An organization such as TDSFB would be a suitable vehicle through which to channel the necessary additional funding and they could deliver the necessary administrative support which is essential to making such an initiative effective in the longer term.

- Creating a full-time position would allow the scope of the current RCA scheme to be extended and, during the quieter winter months, time could be used successfully to get on top of the necessary preparations and infra-structure for the busier summer season. It was felt that one employee could cover the Rannoch/Tummel system upstream of Pitlochry

- Additional input could be provided when necessary from the warden in the adjacent glen. This would also allow proper breaks to be taken, weekends off etc, which is not always possible at present. The Tummel/ Rannoch warden would also have to support the one in Glenlyon when required.

- A scheme funded for 5 years would allow longer term planning. The current scheme simply rolls forward on an ongoing basis. This would give a higher degree of security to those organizations who benefit from the initiative and to the person carrying out the duties.

TLC freshwater fishery wardens
These wardens police the fresh water fishery. They work as volunteers and their strengths are that they know the areas very well. There is no suggestion of replacing this input, but it has been suggested that a greater co-ordinating presence would be very useful, giving full-time professional back-up when required and providing an opportunity for ongoing training opportunities.

TDSFB water bailiffs
TDSFB employ a team of full-time bailiffs whose primary function is to protect salmon and sea-trout stocks. The team is very small for the size of the Tay catchment and it is widely held that the TWCP area is not adequately covered. This creates issues for fisheries protection, delivery of habitat projects and also has harmful effects on effective communications on the ground. This initiative would seek to give TDSFB four extra staff with which to rectify these problems.

Tayside & Central Scotland police
During 2009 a recruitment campaign for rural special constables was launched to increase police presence in such areas using local people as an additional source of delivery. We envisage our river wardens having special constable powers, to make them as effective as possible in a range of circumstances.

Potential problems

During 2009 Scottish Native Woods researched the need for and likely acceptance of such an idea with a range of groups within the area, and have been trying to identify the required funding package. The main reservation about the idea centred on whether TDSFB were a suitable employer. They were rarely seen in parts of the catchment and were unknown to some organizations, although this initiative was designed to counteract that problem. They were very salmon-orientated (as per their remit), but their new board was focusing on widening this remit and delivering a range of outcomes, albeit all centred on the riparian resource. Efforts were being made to create a closer working relationship with the Tay Liason Committee (responsible for fresh water fishing) and it was anticipated that current legislative changes surrounding

By the Lochay (left) and Glen Lyon in winter (right) – both glens are relatively remote an not conducive to fly-tipping

fisheries management will create a unitary body in future to deal with a wider range of issues, not just salmon. Representatives from freshwater fishing interests were now present on the Board of TDSFB.

The local acceptance of TDSFB is therefore a significant issue but hopefully one that can be overcome without any perceived feeling of loss of control or accountability.

The exact remit of such wardens would have to be very clearly defined, with a different mixture of duties in the different areas. It is suggested, for example, that mink control would not be such a significant issue on the Rannoch/Tummel.

The type of individual would be crucially important, having to be responsible for their own day-to-day working priorities, albeit within this wider framework. They would have to be discreet and be well respected members of the local community and overall command and control would be crucially important. They would become very attractive, worthwhile positions.

An essential function of this report is to help us pull together the necessary overall funding package to allow this initiative to go forwards.

Rubbish

Unlike many other river systems which can often be found littered with shopping trolleys, fridges, old dumped cars, farm plastic and the like, these three glens are almost entirely free of such problems, with the only significant dumping of rubbish being alongside the Keltneyburn on the Lyon system. This did however appear to include a number of old oil or chemical drums which could have had a particularly serious effect had any of this got in to the water.

Both Glen Lyon and Glen Lochay are relatively remote and not very conducive to fly-tipping. The Dochart system holds the greatest population within the three glens, but the local angling clubs have a strong presence on the ground and LLTNPA also employ a ranger service. It would appear therefore that such presence is preventing significant issues from taking hold.

Farm steadings can very often be a source of rubbish ending up in watercourses, but during the course of this survey no such obvious problems were encountered throughout the three glens.

It did appear on the Dochart however, that dumping of soil or garden waste was introducing invasive plant species, with areas of Japanese knotweed, rhododendrons and the garden plant Lambium being clearly associated with such activity in the recent past.

Rubbish in Keltneyburn

Light coloured water vole

Water voles in the Tay Western Catchments Area

Summary

The pilot survey of Glen Lochay in 2007 highlighted a number of populations of water voles, and, although not part of the original survey protocol, it is now considered that information relating to these little animals may indeed now be the most strategically important, both to this project and to the various agencies involved, including the two national parks. Indeed, the water vole data subsequently became our main justification for going far out into these catchments and up to higher altitudes and such effort required the greater part of our funding to be successfully completed.

Water voles were found in all three glens, but the top end of Glen Lochay, surveyed in 2007, remains the principal area of focus for this species. Very poor and prolonged weather conditions in late summer in 2008 dramatically affected the quality of data that we could collect on the Dochart system.

In Glen Lochay there were 8 sightings of water voles, droppings found at 29 different locations and burrows found at an additional 35 locations.

In Glen Lyon, there were 2 sightings of water voles, droppings found at 21 different locations and burrows at a further 30 locations. Records were distributed throughout the length of the glen.

On the Dochart there was 1 sighting, droppings were recorded at only 5 locations, with 17 burrows located in 6 main clusters. Weather conditions severely disrupted our survey work on the Dochart.

American mink were located in all three glens in 2008. We are aware of up to 16 animals being killed on the lower Lyon and 6 in Killin. Mink were also reported at Kirkton on the Dochart and at Kenknock Farm on the Lochay in 2008. Tracks were located at various locations throughout the Dochart and on the lower Lyon.

Limitations of data

Our surveyors were essentially self-taught in finding and recording water voles in 2007, although subsequent tuition from the CNPA Water Vole officer suggested that the 2007 protocol was in fact very sound. If anything, the protocol was simplified in 2008.

In one regard the data is actually very strong. Surveyors had reason to visit watercourses throughout the catchments for a variety of reasons, not just those where water voles were likely to be present. As a result, water vole signs were in fact located in habitat and locations in which water voles might not have been expected.

The survey was designed to record ***distribution*** of the species, not ***density*** of water voles.

There were two problems encountered in 2008:

1. The weather was extremely wet from late July onwards and, although this did not affect the Glen Lyon survey, the Dochart survey was badly disrupted. The main issue was that heightened water levels would wash away droppings and burrows too would become obscured. For a significant part of the Dochart survey therefore, we were limited to recording the locations of potentially good habitat, without the presence of water vole signs to re-inforce this information.

2. Suitable water vole habitat on the Dochart and Lyon in particular was very fragmented and water vole habitat and signs were often to be found on side streams and not on the actual watercourses that were digitized for survey work. A number of signs were recorded in areas that might not be regarded as classic habitat, but where better habitat might have been available close at hand. Trying to quantify suitable habitat therefore became increasingly problematic and simply recording those survey lengths which were themselves suitable was obviously misleading. For the Lyon and Dochart catchments therefore, we did not seek to provide the same level of habitat information as we did previously at the top half of Glen Lochay.

Glen Lyon

The Glen Lyon survey took place in June and July 2008, and, although there were some wetter periods in July, it is not considered that this affected the quality of survey information recorded in any way. Water voles were recorded throughout the Lyon catchment, although never in the apparent densities that occurred at the top end of Glen Lochay. The main areas of interest were in the basin below Schiehallion, above Garth Castle on Keltneyburn, to the north of Pubil at the east end of Loch Lyon and to the west of the road at the top of the glen that crosses through to Glen Lochay. Although records were found elsewhere, significant areas of habitat were extremely rare, with the topography of the glen being completely different to the top end of the Lochay, for example. The upland corries are more effectively and naturally drained and large swathes of flat grasslands interspersed with standing water do not really exist to any great extent. Areas of good habitat appeared to be very restricted in their extent. However, a high percentage of these habitat patches did contain water vole signs, if only from the previous year. In some areas, eg in Glen Muillin, water vole signs were recorded within an extremely small patch of suitable habitat, seemingly well detached from the next available site. The value to the species of the sub-optimal (or seemingly unsuitable) habitat became increasingly clear, otherwise such small isolated colonies could surely never sustain themselves.

Water vole swimming across the Lochay

A number of records were made close to the main stem of the river.

The areas above the dams at Loch Lyon and Loch an Daimh were not surveyed as it had been considered at the outset (before water voles became a consideration) that there would not be sufficient grounds for looking at these areas. Based on the 2008 survey information, there will almost certainly be water voles present above Loch Lyon and local gamekeepers have suggested that they are also present above Loch an Daimh. It may be worthwhile surveying these areas in future but it is not considered to be a priority to do so.

Up to 16 mink were culled in the lower part of the Lyon in 2008, but no such records or indeed signs were forthcoming above the Pass of Lyon at Fortingall. However, it is considered that no co-ordinated efforts at controlling the species are made above this point and that the regular freshets that are released on the Lyon may simply have washed away signs on a regular basis. The main stem of the Lyon was surveyed in two days in a canoe and mink signs could easily have been missed.

Glen Lochay

The Lochay was surveyed in 2007, with the Drumchroisk burn and one tributary on the south side of the glen surveyed in 2008. The top half of Glen Lochay, above the hydro pipeline, is extremely valuable for water voles. It is an extremely grassy area, and appears to be under-grazed. It would seem that there was some sort of population explosion of all vole species up there in 2007. As well as the number of upland corries showing signs of water voles, there was potentially suitable habitat covering most of the bottom of the glen in this upper part. In summary, this is a very extensive, almost unbroken area of habitat suitable for the species. This

Classic water vole habitat

Water vole droppings

Mink prints

Black water vole

was tempered to some extent in that all the small tributaries to the north of the river above the pipeline were abstracted for hydro-power with little or no evidence of compensation flow and, therefore, many potentially suitable tributaries simply did not contain any water.

All the main corries south of the river contained signs of water voles. The basin of the Drumchroisk Burn below the Tarmachan ridge proved to be a particularly active spot in 2008.

It should be noted that we only decided to record water voles as part of our survey partway through 2007 when the survey was already underway. We would anticipate that, while our records north of the river portray an accurate picture of where water voles are distributed, on the south side of the river water voles may well be present further east than is recorded.

Glen Dochart system

About 20% of the Dochart was surveyed in 2007, with the remainder covered during late July-November in 2008. This period was extremely wet, causing us to miss a significant number of survey days and also having the effect of washing away water vole signs.

Areas of water vole habitat south of the Dochart/Fillan/Cononish appear to be extremely limited, and it is considered that this broad swath of ground will never be significant for the species. The topography in general simply does not allow for suitable areas of habitat to form. An area directly below Ben Lui was perhaps the only extensive area of classic water vole habitat found, where unoccupied burrows were recorded. It was however notable that water vole droppings were recorded in the upper part of the glen, in habitat that would not be considered at all suitable for the species. eg the Sitka Spruce plantation to the west of the Cononish. Water voles were recorded by the main River Fillan at Kirkton Farm. This was surprising in that mink were very obviously present in the same area. A limited area of habitat at the head of Kirkton Glen bordering Glen Lochay also contained water voles.

It is considered that the main areas of habitat on the Dochart lie north of the river between Auchlyne and Inverhaggernie, however the survey of these areas coincided with the wettest period of the summer, and very few signs were recorded. Anecdotal evidence from gamekeepers in 2007 suggested that this area did indeed have a significant population of water voles at that point. Wide sweeping searches of these areas were made to see if signs could be detected on more minor watercourses, pools or ditches, but to no avail. It is recommended that the 3-4 main areas marked north of the river be resurveyed. It is not considered that any other areas on the Dochart system are sufficiently valuable for the species to repeat the survey.

Unlike the other two glens much of the main stems of the Dochart and especially the Fillan are extremely slow moving and they have a very dense network of slow moving ditches leading in to them, albeit most are extremely badly choked up with vegetation. It is quite likely therefore that the valley bottom would provide a significant habitat for water voles had the apparent numbers of mink in the Dochart catchment not been so high. Except for the records at Kirkton, no water vole signs were located near the main river, although a high percentage of the side ditches were not included in our survey protocol. Much of this area is not classic water vole habitat and has not been recorded as such, however it is likely that the essential components are there and that water voles would almost certainly colonize the lower part of the catchment if they were allowed to do so.

It is worth noting that, as from winter 2010, there may well be no gamekeepers employed on the Dochart system and this therefore will have a significant bearing on how effective mink control might be undertaken.

Broken conifers. This type of partially failed forestry plantation has provided a welcome habitat for black grouse on the upper Dochart catchment.

Use for the information gathered

The information gathered will be used to focus attention on achieving a co-ordinated mink control programme in the upper catchments of the Tay, which will benefit a range of water fowl and fish species as well as water voles. Such a programme should be incorporated with other essential habitat and conservation work and be a corner-stone of our idea to promote the concept of river wardens in the areas concerned. In this context, the water vole information gathered will provide a base-line on which the success or otherwise of any such mink eradication programme can be measured.

Accessing the information

The information gathered on water voles has been passed to both the Cairngorms National Park and to the Loch Lomond & Trossachs National Park.

Other biodiversity

In this section a general description is given of the other different wildlife that we encountered during the survey. Because none of these species were being recorded in a structured manner, purely on an opportunistic basis, we make no specific claims here other than the following is a brief summary of some of the animals and birds that we happened to encounter during the process of conducting our 1000 mile survey effort:

Golden eagles were observed on 12-15 occasions throughout the area, one of which involved a male and female being in the air together at the same time and another occasion when a golden eagle and a sparrow hawk were engaged in a protracted aerial duel. There was no outright winner.

Other birds of prey included a peregrine falcon, red kites and two sightings of merlins. Buzzard sightings were numerous.

Dippers were observed high up in the hills on very many occasions, up to 2500 ft. Dippers are supposedly a sign of good water quality and they are not in short supply in this area.

We found one group of eight golden plover. Snipe and woodcock were also observed.

All four grouse species are present within this area. Capercaillie are resident in the lower Lyon catchment. Ptarmigan were observed on the higher hills on both the north and south of the Lyon but not in the other glens. Black grouse were only observed in the upper Dochart/Fillan area, with three main areas recorded and what appeared to be a new lek site at a location where black grouse had not been recorded for over 30 years. A number of areas of good habitat were present in the upper Dochart and these appeared to have been successfully colonized. Black grouse will undoubtedly exist elsewhere in the other glens but were not picked up during our survey efforts. Red grouse were conspicuous by their absence throughout much of the area, with only a few brace noted in Glen Lochay and none at all on the Dochart throughout the survey period. The only area with significant red grouse numbers was north of the Lyon in the middle glen.

Signs of otters were found throughout the three glens, sometimes on very minor tributaries and it is recognized

Dipper

Otter in the Lyon

Fresh water pearl mussels

Squirrel signs

that numbers are at saturation point throughout. Freshwater pearl mussels were recorded at numerous sites on one of the rivers. Whether they might have been present elsewhere is not clear, but it would be anticipated that, because of access difficulties for migratory fish in accessing the river Lochay, they are probably not there to any great extent, if at all.

It is considered that wildcat signs were observed in Glen Lyon at three different locations, throughout the length of the glen. Based on the experience of the surveyor, we believe this to be a credible claim. A pine marten was reported in the middle Lyon area.

Red squirrels were either observed or signs were recorded in significant numbers in all three glens, although they are only present at the very lower end of Glen Lochay. No grey squirrels were observed, although presence of this species should not be discounted.

Throughout the survey work, sites of other more minor species often formed the highlight of a day, be that a snake or reptile, a fox, cormorant or bird of prey. We saw deer almost every day and in Glen Lyon in 2008 it was the calving season when we were passing through and a number of red deer calves were observed being born and some good photographs obtained. ❖

Future monitoring and other considerations

Having undertaken this survey it is obvious that certain aspects will be worth re-surveying at regular intervals in future either on a formal or informal basis, both to monitor effectiveness of ongoing activities or to detect new or evolving circumstances. Local angling clubs and environment groups are well placed to fulfil such a role and many people have already expressed an interest in becoming involved in future.

An important part of the rationale of this report is to lay out how to go about doing this, how information can be best recorded and then how it can be stored and later presented. We are aware of a demand from other areas for support in simple habitat survey techniques. Much of this can be easily tutored, although computer skills and especially mapping capability will often require a more structured degree of training. The necessary skills can then be used for a wider variety of purposes.

One of the recommendations of this report is that there should be a training and education programme developed, based on the CNPA Land Based Training Programme and that TDSFB should establish an externally funded education and training programme to deliver relevant courses to beats and angling clubs at reduced rate or zero cost. Such activities might include marketing, computer technology, habitat management, survey skills, data collection and storage, bailliffing or boat skills, or promotion of suitable SVQ courses. eg those currently being developed by Angling for Youth Development (AFYD). ❖

Rationale:
To build the capacity of individual beats and angling clubs to manage their own business in particular and the fishery in general.

To establish TDSFB as an organization who can provide services of genuine benefit to those using the river, and build stronger working relationships with beats and angling clubs.

Timescale:
Establish the demand for such an initiative during 2010, and begin discussions with potential funders and training providers. Pilot courses in 2011, establish formal, funded programme by 2012.

Funding:
LEADER Programme or SRDP, other European funds, National Parks.
50% contributions from beats where applicable.

Sunset in Glen Lochay

Acknowledgments

Photographs

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Otter / page 94: **Gordon Wilson**
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SAC Report photos- / page 41 & 42: **Scottish Agricultural Colleges**

Wild cherry / page 96: Tarmachan ridge from along Loch Tay / page 43: Evening light on Schiehallion / page 45: **Kristina Hayward**

Production

Design and layout: **Helen Meek** / ardessie publishing

The front cover and photo of the Hole in the Wall Waterfall were photo-shopped by **Colin Riach**.

Text / editing: **Victor Clements** / Scottish Native Woods

Printed by: **Big Sky Print Ltd**

Wild Cherry

Bog cotton, Meall a Mhuic, Innerwick, Glenlyon

Twa boats at Cargill

As well as our many private funders, we would like to acknowledge the financial contributions and support provided by the following organizations:

TAY GHILLIES ASSOCIATION

Tay Liasion Committee

LOTTERY FUNDED

Europe and Scotland
Making it **work together**

Tay District Salmon Fisheries Board

LOCH LOMOND & THE TROSSACHS NATIONAL PARK

The river Lyon at Roro

Biscuit & Nellie surveying by canoe on the Fillan

Water abstraction infra-structure in Glen Lochay