

THE RIVER ENDRICK - THEN AND NOW, MONITORING BY PHOTOGRAPHY

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Introduction

The River Endrick is one of the largest rivers flowing into Loch Lomond and is certainly the richest - both chemically and biologically. The mouth of the river and the marshes surrounding it is a National Nature Reserve and of international importance as a RAMSAR site. Accounts of various aspects of the River Endrick are available from the 17th century onwards (Franck 1658) and it is now one of the best known of Scottish rivers.

A major survey of the river was carried out in 1959-60, concentrating especially on the invertebrates and fish species and communities in the river (Maitland 1966). This survey was repeated three decades later in 1989-90 and comparisons were made of the fauna at the two times of sampling (Doughty & Maitland 1994). During both surveys, photographs were taken of all the sampling sites and the objective of the present paper is to compare some of these photographs and discuss the value of photography in studies of river ecology.

The River Endrick

Detailed descriptions of the River Endrick have been given by Maitland (1966) and Doughty & Maitland (1994). The source of the river, known as Mary Glyn's Burn, rises in the Gargunnoch Hills just south of Stirling at an altitude of 457 m and the river flows for 49 km, mainly in a westerly direction, to enter Loch Lomond in its southwest corner, just south of Balmaha (Fig. 1). The largest tributary, the Blane Water, joins the River Endrick near Killlearn, 16 km from the mouth.

The Endrick catchment has a total area of 264 km² (about one-third of Loch Lomond's catchment) and the long-term average flow is 7.1 cubic metres per second, measured at Gairdrew, two kilometres upstream of Drymen. The river has a fairly normal profile, with the upper reaches above Fintry characterised by a steep gradient, fast current and rocky bed. In the middle reaches, between Fintry and Drymen, the river is more meandering with regular pool and riffle sequences. Near Drymen, the river enters its floodplain and has a convoluted course with slow flow between unstable sandy banks. There are two waterfalls of note. The highest is the Loup of Fintry (Site 9, Fig. 1), where the river

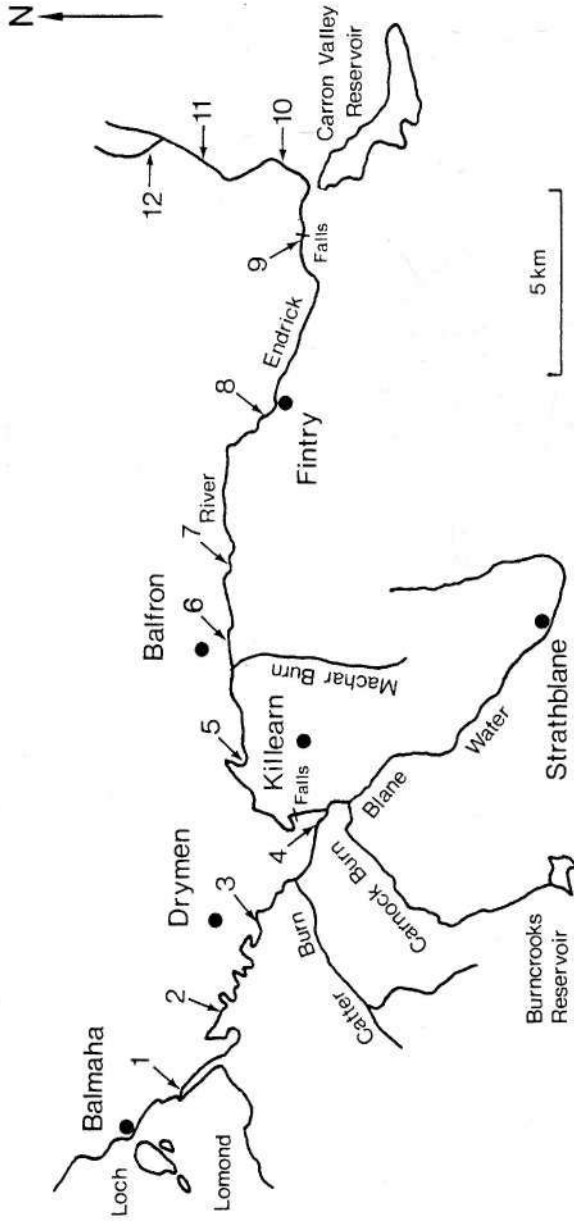


FIG. 1. An outline map of the River Endrick, showing the main stream network and the sites mentioned in the text.

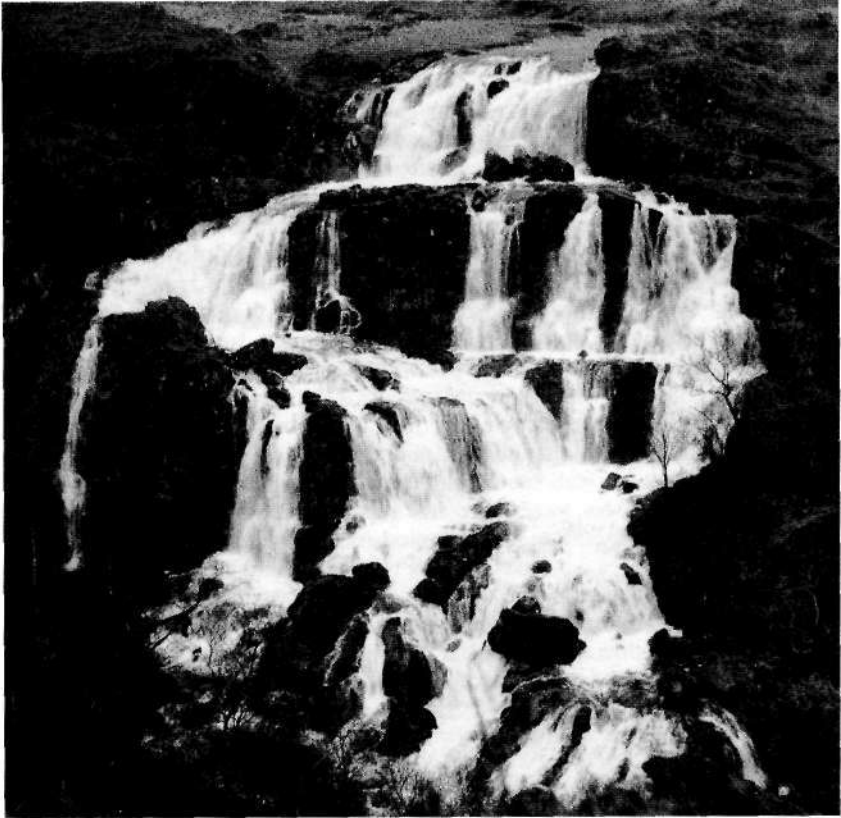


FIG. 2. The River Endrick: the Loup of Fintry, looking upstream at site 9, where the river cascades down over 30 metres. This is the approximate junction of the upper and middle reaches and a complete barrier to migratory fish. Very old photographs indicate that the river has changed very little here over the last 100 years.

plunges over 30 m in a broken series of waterfalls (Fig. 2). At the Pot of Gartness (near Killearn), the drop is only 2 to 3 m, but the waterfall here is a local attraction in the autumn when Atlantic salmon *Salmo salar* and sea trout *Salmo trutta* are leaping.

Surveys in 1959-60 and 1989-90

Full details of the two main surveys carried out in 1959-60 and in 1989-90 are given by Maitland (1966) and Doughty & Maitland (1994) respectively. Twelve sites on the main stem of the river, from source to mouth (Fig. 1), were sampled for invertebrates on each occasion, using standard timed handnet collecting. At two of these sites (Woodend (Site 2) and Drumtian (Site 6)) quantitative studies were carried out (Maitland 1964).

Photographs of all sites on the main river (and others elsewhere) were taken in 1960 and these were repeated in 1990. In addition, a third series was taken during 1995. Some of these photographs are shown in pairs in Figs 3 to 11.

Minor changes can be seen at all sites - some to the river channel itself, others to the riparian zone or neighbouring catchment. In general, there have been few changes in the upper reaches where the river channel is made up of bedrock and boulders in many places and grazing is relatively light (Figs 3 to 5). In the middle reaches, however, there are relatively few places where boulders occur and the channel and river bank are potentially much less stable. Where trees are well rooted in the riparian zone and grazing is light the river is stable (Fig. 6), but where trees are absent and there is intensive grazing pressure, sometimes accompanied by ploughing almost to the river bank, massive changes can take place (Figs 7 and 8). These usually take the form of extensive widening of the river channel accompanied by a loss of riparian soil, gravels and vegetation, swept downstream. In the lower reaches where the current slows there can be large deposits of such gravels (Fig. 9). Here too, however, where the banks are unprotected by tree roots and exposed to intensive grazing there can be substantial erosion and channel changes.

Changes due to natural events and human activities

It is unlikely that most of the larger changes which have taken place within the river system are due to human activities in the catchment - though it is always difficult to relate cause and effect with any certainty. However, there are some notable "natural" changes; for example, there is evidence of a 25% increase in annual mean rainfall (presently about 1400 mm) over the period 1970 to 1990. Over the same period, the annual mean flow of the Endrick at Gaidrew increased by 36% (Curran & Poodle 1992).

Taking the River Endrick as a whole, changes to the invertebrate fauna (as measured by family richness, classification and ordination) have been minor (Doughty & Maitland 1994). However, there have been some changes in community composition at certain sites. Some of these are probably due to local physical changes; others are difficult to account for but may reflect the additive effect of changes which have taken place within the catchment in recent years.

The fish community of the lower reaches of the Endrick (and of Loch Lomond) has changed dramatically in the last three decades, with the establishment there of five alien fish species - believed to have been introduced by coarse fishermen releasing livebait (Maitland & East 1989). Such introductions may be more important locally than any of those predicted to follow in the wake of global warming (Maitland 1991).

Monitoring by photography

The sites used for photographic comparisons in this account were not chosen originally for that purpose but as appropriate places on the river from source to mouth to study its ecology. The original photographs were intended mainly to aid descriptions of the river at these places. Nevertheless, the pairs of photographs now available have proved of interest and value and some lessons have been learned in relation to the selection of sites for any future photographic studies.

The season during which photographs are taken can be important. Although photographs taken during the vegetative season are clearly of value ecologically, much of the river can be obscured at this time - especially if there are many riparian trees and shrubs (Fig. 6). Ideally, photographs should be taken at more than one season of the year. This is especially true if photographs are intended for site evaluation in future years, perhaps in relation to synoptic limnology (Maitland 1979) or conservation evaluations such as SERCON (Boon et al. 1994).

Obviously the weather is highly relevant to photographic studies, not only for the actual taking of the photographs but also in relation to river flow which, ideally, should be the same in any pair of photographs.

In any long-term monitoring studies using photography, the position from which each photograph is taken is a major factor to be considered, for it is often difficult to locate from the previous photograph alone, the exact spot from which it was taken (especially after several decades have passed!). Places to be avoided in particular are those where vegetation is likely to grow up and obscure the view or where only a small part of the river can be seen. If the river has changed dramatically in intervening years and critical landmarks such as large trees have disappeared, then repeat photographs are difficult to obtain.

The ideal spot to choose from which to take standard photographs is an exact point which is likely to be permanently recognisable and from which a good (preferably slightly elevated) view of the river is possible. Stone or concrete bridges are often ideal for this (Fig. 11 was taken from a bridge over the Blane Water, near Killearn Smiddy), or alternatively, large boulders or elevated bedrock are also ideal (Fig. 4 was taken from the top of the same steep ground to the right of the photograph). The view should ideally include



FIG. 3. The River Endrick: upper reaches at site 12 (source) in 1960 (upper photo) and 1990 (lower photo), looking upstream. The river has changed little here over recent decades and several small headwater burns like this arise among *Juncus* and *Sphagnum* bog.

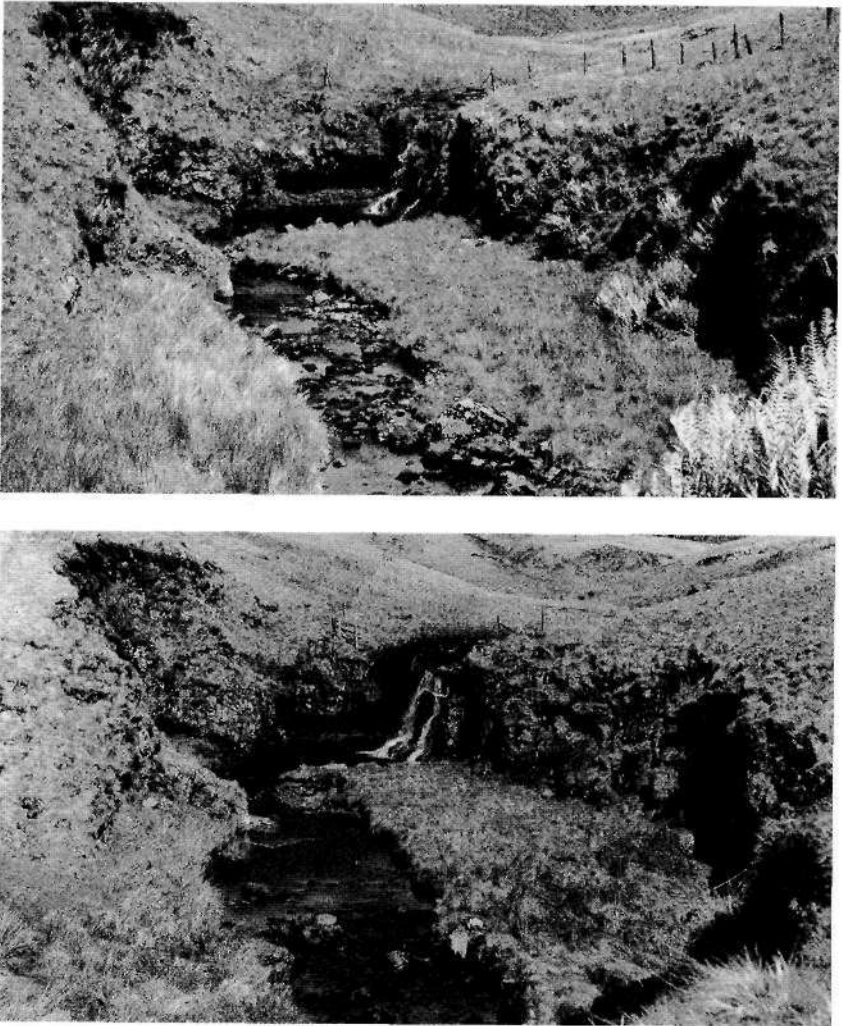


FIG. 4. The River Endrick: upper reaches at site 11 (Burnfoot) in 1960 (upper photo) and 1990 (lower photo), looking upstream. Note the subtle changes in the river channel, with slight erosion in some places and bank encroachment in others.



FIG. 5. The River Endrick: upper reaches at site 10 (Cringate) in 1960 (upper photo) and 1995 (lower photo), looking upstream. Changes are few here over 35 years and more obvious on land (with encroaching gorse *Ulex europaeus* in the middle distance and the collapse of a nearby wall) than in the minor riparian changes beside the river.



FIG. 6. The River Endrick: middle reaches at site 8 (Culcreuch) in 1990 during winter (upper photo) and summer (lower photo), looking upstream. Note the lesser flow but poorer view of the river during summer.



FIG. 7. The River Endrick: middle reaches at site 6 (Drumtian) in 1960 (upper photo) and 1990 (lower photo), looking downstream. Note the extensive erosion on the right bank, including the loss of numerous riparian trees further downstream.

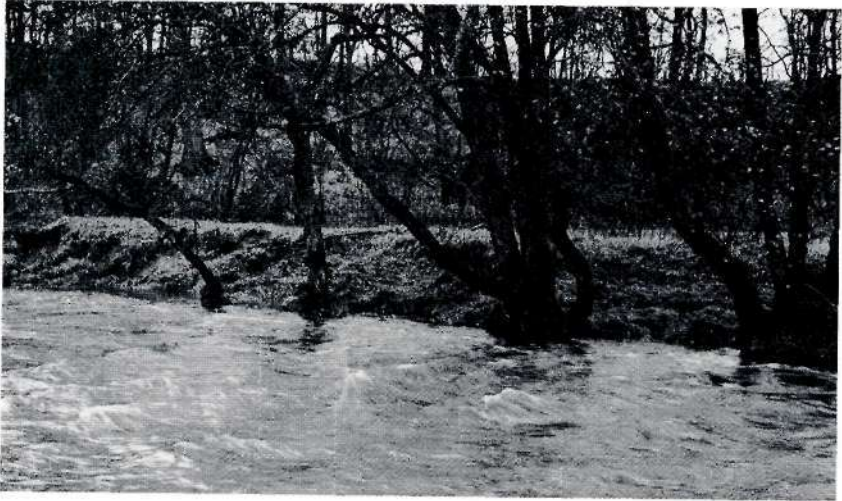


FIG. 8. The River Endrick: middle reaches at site 6 (Drumtian) in 1960 (upper photo) and 1990 (lower photo), looking across the river to the left bank. Note the stability here over three decades in contrast to that on the opposite bank (Fig. 7).

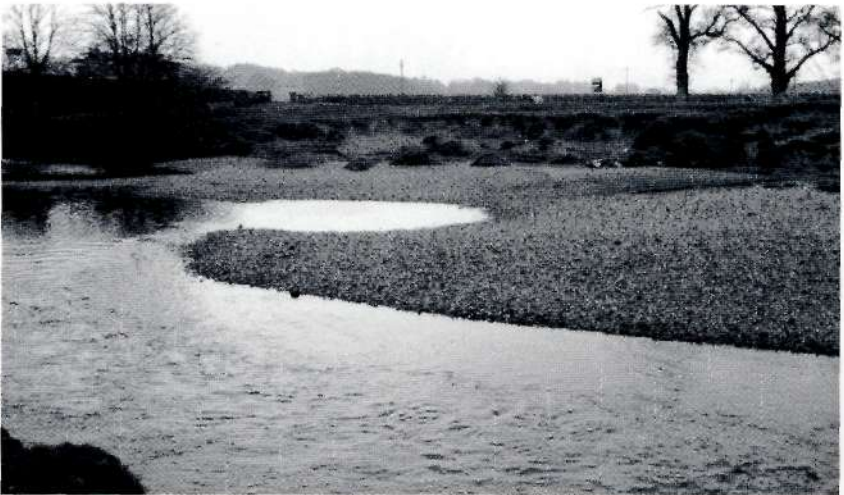


FIG. 9. The River Endrick: lower reaches at site 3 (Drymen) in 1960 (upper photo) and 1995 (lower photo). Note the continued erosion here on the far bank and the extensive deposits of gravel brought down from upstream.

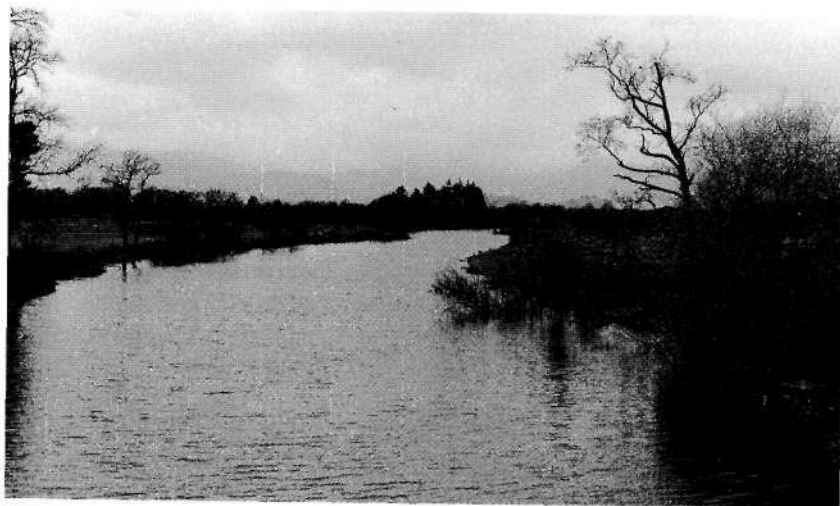
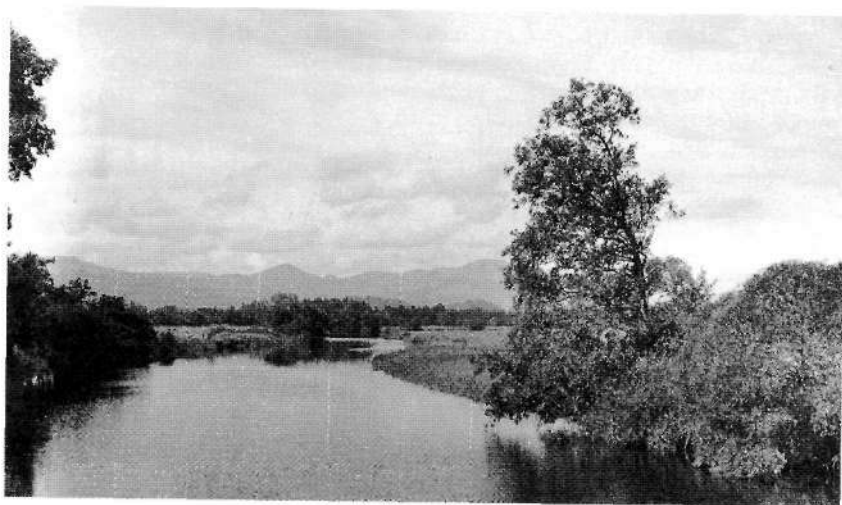


FIG. 10. The River Endrick: lower reaches at site 2 (Woodend) in 1960 (upper photo) and 1990 (lower photo). The changes here have largely been in the riparian zone, with the growth of some trees and the death of others – notably the alder *Alnus glutinosa* in the right foreground.



FIG. 11. The Blane Water (just above its junction with the River Endrick): in 1960 (upper photo) and in 1990 (lower photo). Note the extensive erosion of both banks here – most notably that of the left bank where the main channel has moved sideways by many metres.

some feature which is likely to be permanent (e.g. a large boulder or some bedrock (as in Fig. 4) rather than a tree or a soft bank).

Finally, the relatively short working life of one scientist makes it imperative that, if photographs are intended to be of value for comparisons in the future, then appropriate prints and negatives (suitably labelled with dates, grid references and other location details) should be archived at a suitable location. It is intended that the present set (only a few of which are presented here) will be passed in due course, along with those for other rivers (e.g. the River Tay: Maitland & Smith 1989), to the University Field Station at Rowardennan on Loch Lomond.

Even when large numbers of photographs are taken along the length of a river, spectacular geomorphological events can be missed. One such took place only a few hundred metres below Drymen Bridge (Fig. 9) when, in October 1983, a large spate caused about six metres of the river bank to collapse (Mitchell 1994), leaving behind a characteristic ox-bow section, which is now completely cut off from the river and is the newest of several ox-bows on the flood plain, in various stages of succession. Photographic comparisons of unpredictable major events of this type can probably only be made by the use of aerial photographs taken before and after.

In conclusion, the value of comparative photographs of the same stretch of river should not be underestimated. Not only do they provide a record of the river and its riparian zone at specific points in time but they are also of great value in demonstrating to local landowners and farmers the long-term effects of insensitive local land management.

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