Allt Mor (River Nairn), Highland

[NH 635 235] and [NH 635 265]

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Highlights

As the headwaters of the River Nairn emerge from an upland to a lowland environment, they undergo a remarkable and very rapid metamorphosis from a straight, steep, coarse-grained and unstable channel to a narrow, incised, meandering and stable channel. This transformation occurs within a few kilometres, making this a fine example of a discordant channel (see section on fluvial processes in chapter introduction) in which the hydraulic geometry undergoes a very sudden transition.

Introduction

The rapid adjustment from an upland to a lowland stream occurs where the steeply sloping tributary valley of the Allt Mor emerges into the wide gently sloping main valley of the River Nairn. The latter has been enlarged by glacial erosion, with the result that the present River Nairn for most of its course is an underfit stream meandering across a disproportionately wide valley floor. This situation is not unusual in upland Scotland. However, the degree and rate of channel adjustment is rarely as dramatic as at this site.

Description

The headwaters of the River Nairn drain the middle part of the Monadliath Mountains in the northern Grampians. These mountains are formed from Moinian schists overlain by a cover of glacigenic sediments locally in excess of 10 m thick. The river rises to the west of Carn Ghriogair (805 m), flows to the north-west and reaches the main valley at the point at which it passes under the B851 road. Within a few kilometres of this location the river has undergone a metamorphosis from a straight, steep, coarse-grained and unstable channel (Figure 2.38)(a) to a narrow, incised, meandering and stable channel (Figure 2.38)(b).

In its upper reaches the Allt Mor is a boulder-bed mountain torrent 9–10 m wide, with a D_M of bed material around 700 mm, and a slope of 0.08. Typical width : depth ratios are 12–13 and the channel is often multi-thread at low flow and slightly sinuous (Steel, 1984). Like its namesake in Glenmore (McEwen and Werritty, 1988), the upper Allt Mor is entrenched for much of its course within glacial and glaciofluvial deposits (Figure 2.39). These are locally subject to rapid mass-wasting on account of slope failures caused by basal undercutting by the Allt Mor during major floods (e.g. September 1981). The pattern of failures often conforms to the so-called 'pseudo-meandering' observed in laboratory experiments (Hickin, 1969), where the focus of undercutting alternates down the channel. Once a major slope failure has been initiated it typically becomes further enlarged by frost heave, surface wash and rilling (cf. the processes operating at Allt a' Choire), thereby generating a steady supply of sediment from the slopes on to the valley floor. However, not all of the valley floor is reworked during a major flood; nor are all the adjacent slopes, many of which are stable and vegetated, potential sites for slope failure. Bouldery lobes of coarse flood deposits are also found above the general level of the valley floor in the uppermost reaches of the channel.

Progressing downstream there is a steady widen ing of the valley floor and, as the bed material fines, there are extensive areas of unvegetated gravels denoting the zone of the active channel. Immediately prior to a sudden increase in the width of the valley floor, the river briefly becomes rock-controlled and passes through a small gorge (Figure 2.39). On being released from this confinement, the channel takes on the appearance of a complex alluvial fan. This part of the channel was especially active during the September 1981 flood when many new distributaries were initiated. One of these channels served to re-establish a former course of the stream down the valley of the Allt a' Ghlinne Bhig (Figure

2.39). In order to maintain the pre-1981 course, substantial river training was found to be necessary near the apex of the alluvial fan (T. Inglis, Scottish Environment Protection Agency, pers. comm.). From this location the next 2 km of channel have been subject to repeated dredging and straightening in an attempt to stabilize the channel and alleviate the local flood hazard (Figure 2.39).

On reaching the main valley floor of Strath Nairn, the river undergoes a metamorphosis. Downstream of Tyrich river channel training ceases, and the hydraulic geometry of the channel now becomes that of the typical lowland, inactive meandering river (Figure 2.38)(b). Thus the width is 7 m, the width : depth ratio has become 5–6 and the gradient reduced to < 0.005. The D_{84} of the bed material is 20–40 mm, and the % silt-clay content in the banks is around 15–25%. The channel has not increased its cross-sectional area commensurate with the increase in drainage area, with the result that overbank floods are common. For the next 20 km the River Nairn provides a good example of an 'underfit' stream, i.e. a stream the present size of which is disproportionate to the size of the valley in which it flows (Dury, 1964).

Interpretation

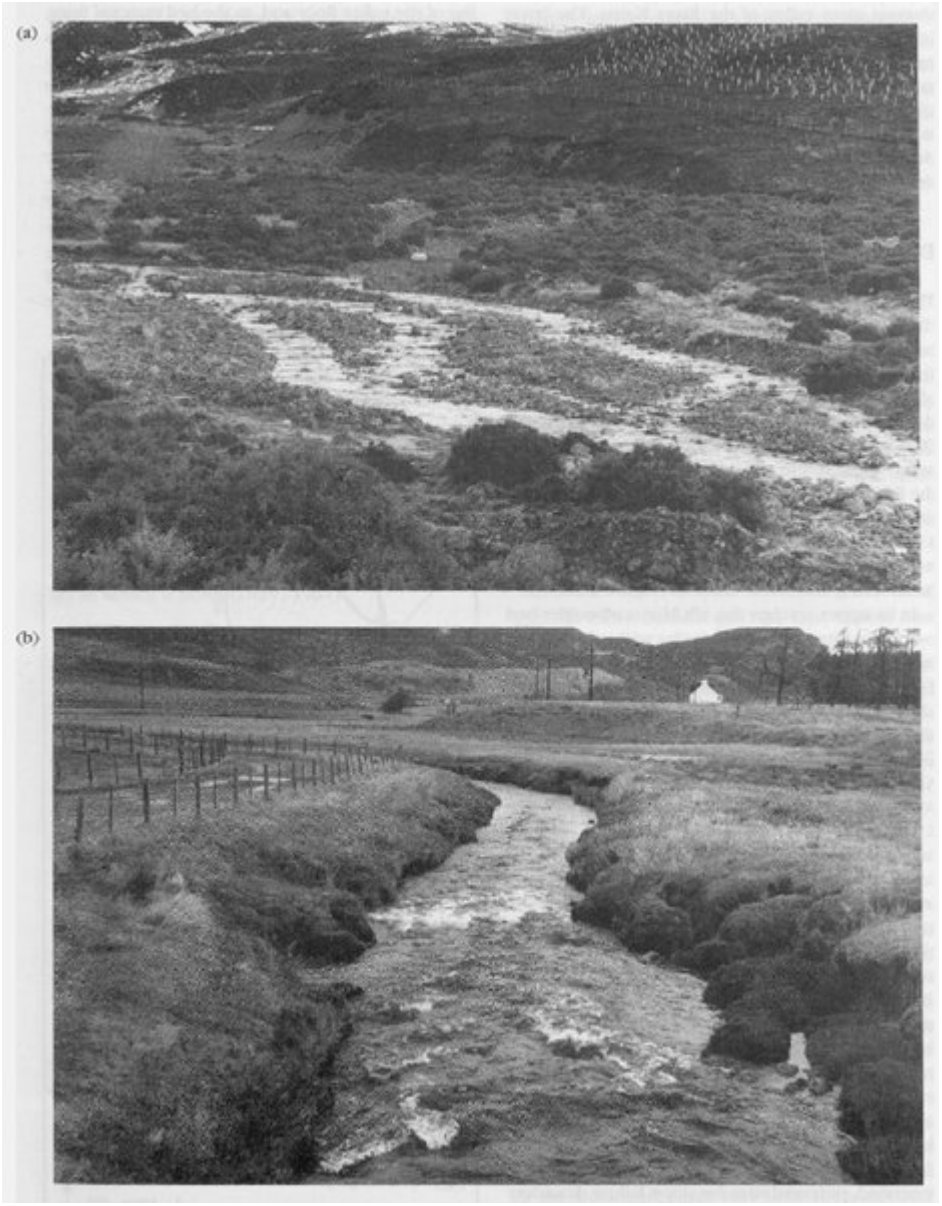
The headwaters of the River Nairn provide a noteworthy example of a discordant channel system. At the point at which the channel emerges from the uplands on to the main valley floor, the channel undergoes a remarkable discontinuity in terms of its downstream hydraulic geometry. It is likely that other examples of such a transition occur, but at present this is the only known example of its kind in Scotland.

This transition is similar in kind, but not in degree, to that reported by Nanson and Young (1981) for streams flowing off the Illawara escarpment in New South Wales. As these streams cross the coastal plain they register a downstream decrease in channel size and an abrupt change in channel morphology. A similar kind of hydraulic discontinuity occurs on the River Nairn as the geometry of the channel adjusts to a greatly reduced gradient and much finer-grained bed material (Steel, 1984).

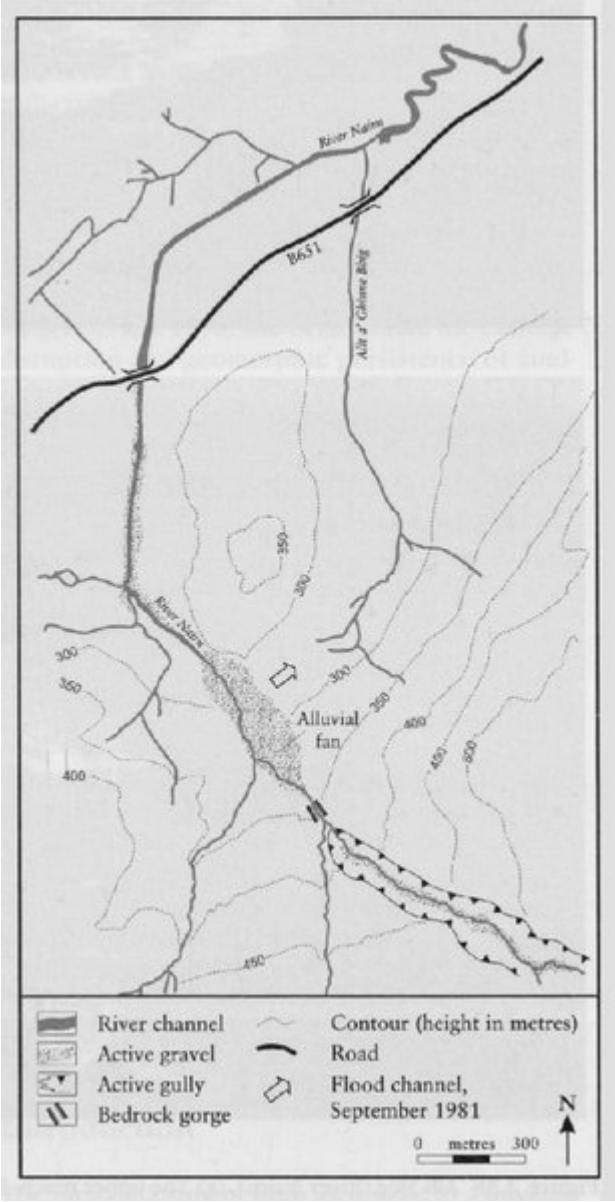
Conclusion

The headwaters of the River Nairn provide a notable example of channel metamorphosis. As the river emerges from an upland to a lowland environment it changes from a straight, coarse-grained unstable channel to a meandering, fine-grained stable channel. The rapidity of this transition and the hydraulic discontinuity thus created make this a remarkable section of channel within the Scottish Uplands.

References



(Figure 2.38) Allt Mor (River Nairn). (a) The upper reach, boulder-bed mountain torrent, highly divided flow around unstable bars. (b) The lower reach, stable sinuous channel in Strath Nairn. The two reaches are only 2 km apart, illustrating the 'discordance' and rapid change in channel morphology. (Photos: L J. McEwen.)



(Figure 2.39) The geomorphology of the Allt Mor (River Nairn).