Chapter 10 South-west Highlands

Introduction

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The area termed the south-west Highlands in this chapter extends south of the Great Glen to the Highland boundary and from the central Grampians to the west coast, including the Kintyre peninsula (Figure 10.1). As elsewhere, there is a considerable range of environments in this region, which is reflected in its Quaternary history. Deposits older than the Late Devensian occur in southern Kintyre, but the main mountain area has been the major centre of successive episodes of ice accumulation and dispersion in Scotland (see Chapter 1), with the result that no deposits older than the Loch Lomond Stadial are known from the central part of the area. The often impressive features of glacial erosion, both in the mountains and in the fjord-like sea lochs, have developed through many periods of both ice-sheet and partial glaciation during the Pleistocene.

Only two glacial episodes are therefore clearly recognized, related to the Late Devensian ice-sheet and the Loch Lomond Readvance. Both are associated with ice flow principally to the west and south-west, radiating out along the troughs and valleys away from the central ice accumulation areas; during the Loch Lomond Readvance, the largest ice-field was centred over the southwest Highlands. The main themes of research in this area have focused on the geomorphology, chronology and vegetation history of the Lateglacial and the significance of the pre-Late Devensian landforms and deposits.

Around the southern Kintyre peninsula there are marine landforms and deposits that predate the last glaciation. These consist of rock platforms up to 10 m above present sea level (see Glenacardoch Point), and which are overlain by glacial deposits, and high-level shell beds at altitudes of as much as 45 m OD (see Tangy Glen). The rock platforms are thought to have been formed during interglacials (Gray, 1978a; Sissons, 1981a) although no direct evidence for this is available. The origin and age of the high-level shell beds have been controversial, there being uncertainty as to whether they are *in situ* or ice-transported (Horne *et al.,* 1897; Munthe, 1897; Jessen, 1905; Synge and Stephens, 1966; Sutherland, 1981a) and, if *in situ,* whether they were partly coeval with the last ice-sheet or were significantly older, or represent a glacial–interglacial–glacial cycle. Amino acid analysis of mollusc shells suggests that the deposits are older than the Ipswichian (Gray, 1985; D. G. Sutherland, unpublished data). Their exact position in the Scottish Pleistocene sequence awaits further work.

Studies of raised shorelines around the Scottish coast have indicated that the greatest isostatic depression resulting from the last ice-sheet was in the area of the south-west Highlands (Sissons, 1967a, 1976b, 1983a). That this was the area of thickest ice is also demonstrated by the transport of erratics such as Glen Fyne granite and Rannoch granite to both the east and the west (Sissons, 1967a; Sutherland, 1984a; Thorp, 1987).

Decay of the Late Devensian ice-sheet was accompanied by high relative sea levels (typically 30–40 m OD), marked by raised glaciomarine deltas, shingle ridges and beach terraces, such as occur at Glenacardoch Point. Particularly good examples of outwash terraces grading into raised shorelines occur at the mouth of Glen Scamadale and in the Ford–Kilmartin valley (Gray and Sutherland, 1977). During this period of ice retreat deposition of the fossiliferous Clyde beds began around the coasts (Peacock, 1975c), and dating of the included mollusc shells suggests that the greater part of the Clyde Sea area was free of ice by at least 13,000 BP (Sutherland, 1986). Analysis of the marine macro- and micro-faunas in the Clyde beds has indicated that after an initial relatively mild phase at the beginning of the Lateglacial Interstadial, sea temperatures along the west coast of Scotland were 2–3°C cooler than the present for much of the interstadial (Peacock, 1981b, 1983a, 1989b). Interestingly, there is evidence in the inshore marine palaeotemperature record for a brief warmer phase at the end of the interstadial (Graham *et al.,* 1990; Peacock and Harkness, 1990).

The change in terrestrial environments during the Lateglacial Interstadial has been studied by pollen analysis at a number of sites along the western coastal fringe, as at Drimnagall and Pulpit Hill (Donner, 1957; Rymer, 1974, 1977;

Birks, 1980; Tipping, 1984, 1986, 1989a, 1991b). During the interstadial these studies demonstrate that the vegetation was dominantly grassland interspersed with clumps of juniper, willow and *Empetrum.* As elsewhere in Scotland, certain sites suggest a brief period of climatic deterioration during the earlier or middle part of the inter-stadial.

The effects of the Loch Lomond Stadial climatic deterioration were particularly pronounced in the south-west Highlands. The extent of deglaciation during the preceding interstadial is not known but it seems probable that at least all the sea lochs were ice-free (Sutherland, 1981b). Thereafter, a major readvance of the ice occurred, with the principal ice mass being centred on the hills to the west of Rannoch Moor (Thorp, 1986, 1991a, 1991b) and in the mountains north of the Cowal peninsula (Figure 10.1). Outlet glaciers extended to the mouths of many of the sea lochs, overriding or eroding fossiliferous marine sediments, which has allowed the dating of the readvance, as at South Shian (Peacock, 1971b, 1971c; Peacock *et al.,* 1989). Impressive sequences of ice-marginal features were also formed by these glaciers, as with the kame terraces and outwash plains at Moss of Achnacree at the mouth of Loch Etive (McCann, 1961b; Gray, 1975a). Two separate groups of features largely dating from this time are of particular prominence in the south-west Highlands and deserve special comment. They are the Main Rock Platform and the landforms of the Glen Roy area.

The Main Rock Platform occurs widely around the coasts of the south-west Highlands where it is a prominent feature up to 100 m (occasionally more) wide, with a backing cliff typically over 10 m high. The platform surface carries numerous stacks (as the Dog Stone by Oban) and the cliffiine has many undercuts and caves (as on Lismore) (Gray, 1974a, 1978a). The platform is tilted, and declines in altitude away from the centre of isostatic uplift (Gray, 1978a; Sutherland, 1984a) from a maximum of over 11 m OD in the inner sea lochs to about present sea level along the Mull of Kintyre (see Glenacardoch Point). It was originally considered to be a Holocene marine feature (Bailey *et al.,* 1924) but subsequently was assigned an earlier interglacial origin (Gray, 1974a). Sissons (1974d), however, noted similarities with the erosional Main Lateglacial Shoreline of the south-east of Scotland and suggested, controversially, that the Main Rock Platform was formed towards the end of the Lateglacial, principally in the severe climate of the Loch Lomond Stadial. This view was accepted by those mapping the platform (Gray, 1978a; Dawson, 1979a, 1980b; Sutherland, 1981b, 1984a) although the possibility of inheritance from an earlier feature was pointed out (Peacock *et ca.,* 1978; Sutherland, 1981b). This latter idea was also put forward by Browne and MacMillan (1984), and the uranium-series disequilibrium dating of speleothems from caves and undercuts in the cliff backing the platform on Lismore (Gray, 1987; Gray and Ivanovich, 1988) has also supported the concept (see also Dawson, 1989; Gray, 1989).

The Glen Roy area is quite outstanding for its assemblage of landforms and sediments related to the sequence of ice-dammed lakes when Loch Lomond Readvance glaciers blocked the mouths of Glen Spean, Glen Roy and Glen Gloy. These landforms have long been famous, the most detailed early work being that of Jamieson (1863, 1892); in recent years Sissons has added many details to the known sequence of events and the nature of the landforms (Sissons, 1978, 1979a, 1979b, 1979c, 1981d; Sissons and Cornish, 1982a, 1982b, 1983). Important results of Sissons' work are the clarification of the pattern of ice advance and retreat and the corresponding successive lake levels; the mode of formation of the shorelines; the fact that the shorelines in Glen Roy were formed principally during the rising lake sequence; the catastrophic drainage of the lakes; the warping and dislocation of the shorelines, particularly near ice-margins suggesting a glacio-isostatic influence; and the complex sequence of river terraces developed after lake drainage.

Glen Roy is not the only locality in the southwest Highlands where ice-dammed lake shorelines are of note, similar features having been formed by Loch Tulla during ice retreat at the end of the readvance (Ballantyne, 1979).

The severity of the climate during the Loch Lomond Stadial is reflected in a very reduced marine fauna of arctic affinity which inhabited the waters around the coasts of Scotland at that time (Peacock *et al.,* 1978; Peacock, 1981b; Graham *et al.,* 1990; Peacock and Harkness, 1990). Periglacial processes were particularly active on the mountain summits, resulting in a clear differentiation between the ice-moulded cols and mountain slopes buried by the readvance ice and the frost-riven and shattered bedrock surfaces that extended above the ice surface (Thorp, 1981a, 1981b, 1986, 1991a).

The decay of the readvance glaciers has been studied by examining the basal sedimentary sequences in enclosed basins inside the glacier limits (Lowe and Walker, 1981; Walker and Lowe, 1981; Tipping, 1988, 1989b). The basal pollen assemblages become progressively younger towards Rannoch Moor and this implies progressive deglaciation in that direction. A particularly valuable site is that at Kingshouse (Lowe and Walker, 1976; Walker and Lowe, 1977), where a

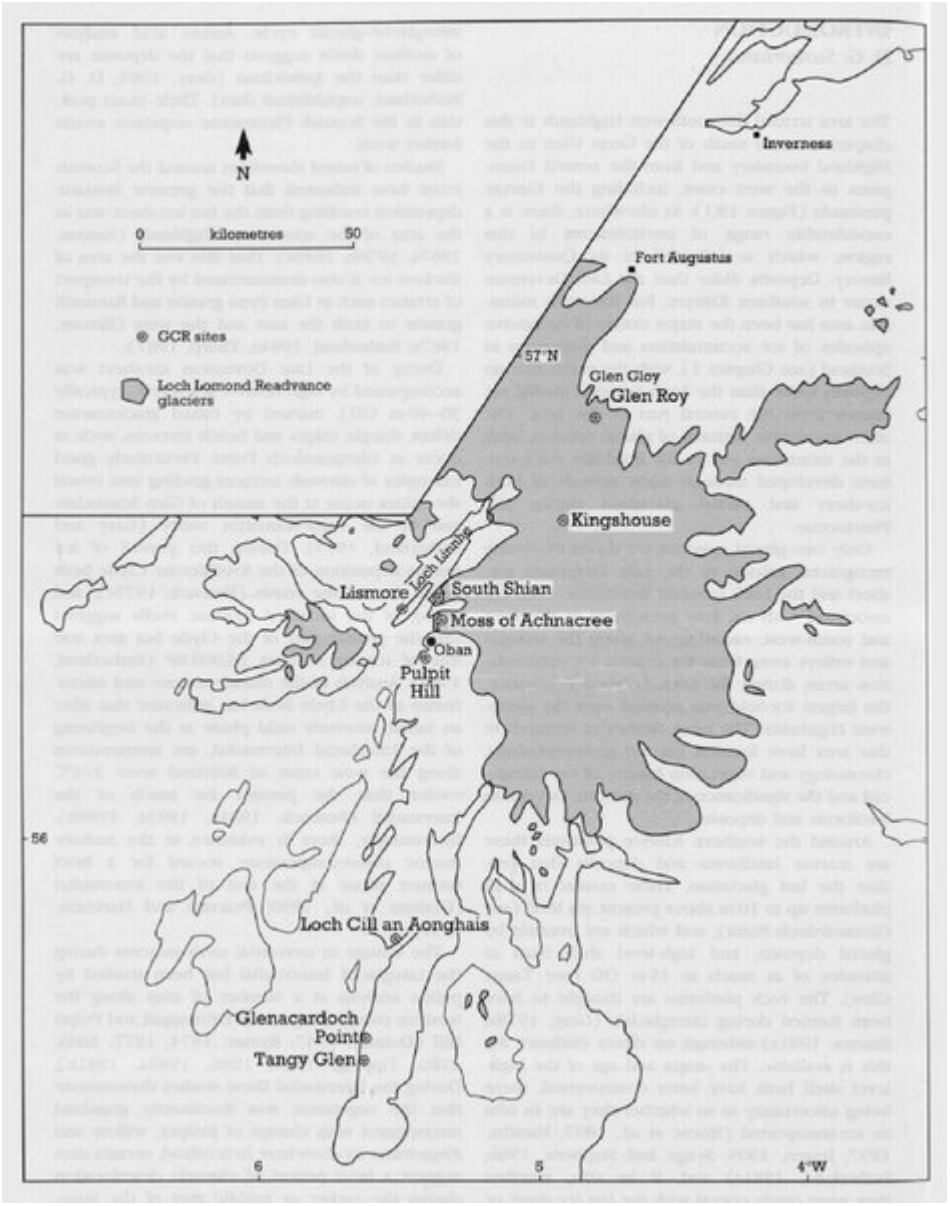
radiocarbon date on moss fragments suggests that this area could have been deglaciated as early as 10,200 BP. The pollen zonation at the base of various enclosed depressions confirms deglaciation by the time of widespread expansion of juniper shrubs, but radiocarbon assays on this characteristic and widely recognized phase in the vegetation development are not sufficiently accurate to provide a clear limiting date on deglaciation (Tipping, 1987).

In the south-west Highland region two distinct zones of forest development are recognized during the Holocene. In the western coastal areas oak forest with birch developed (Loch Cill an Aonghais), whereas to the east, in the mountainous zone, pine became the major element of the forest during the middle Holocene (Birks, 1977; Bennett, 1984). The pine appears to have expanded after 8000 BP, following a phase of birch–hazel woodland dominance, and after about 4000 BP blanket bog expanded at the expense of pine. Human impact on the vegetation has been inferred from the time of the elm decline and possibly earlier in Kintyre (Nichols, 1967; Edwards and McIntosh, 1988).

Following low relative sea levels during the early Holocene, the Main Postglacial Transgression reached its climax, probably between 7000 and 6000 BP and a distinct, isostatically tilted shoreline was formed, equivalent to the Main Postglacial Shoreline of the east coast (Gray, 1974b; Sutherland, 1981b). Subsequently, as sea level fell towards its present level, four (Gray, 1974b) or five (Sutherland, 1981b) lower shorelines were formed.

The mountainous nature of much of the southwest Highlands has resulted in the rivers having a very 'flashy' regime and alluvial fans are common in many of the valleys. Although parts of these fans are active today, they typically have a complex history of development during the Holocene, as is illustrated by Eas na Broige in Glen Etive (Brazier *et al.,* 1988). The radiocarbon dating of the debris-flow and alluvial-fan deposits there indicates two periods of activity, one during the early to middle Holocene when glacial debris was available for reworking, and the other in recent times initiated by either climatic deterioration or overgrazing (Innes, 1983b; Brazier *et al.,* 1988).

References



(Figure 10.1) Location map of the south-west Highlands.