Chapter 12 Outer Hebrides

Introduction

D.G. Sutherland

The Outer Hebrides (Figure 12.1) occupy a critical position for studies of the extent of the Scottish mainland ice-sheet. In addition, their position on the maritime fringe of the country makes them of particular interest for investigation of past vegetation patterns and of palaeoclimate in general. However, despite an initial period of interest in the Quaternary history of the islands during the last century it has only been within the last fifteen years that this fascinating area has begun to be studied in detail.

The first to attempt a synthesis of the glacial history of the Outer Hebrides was J. Geikie (1873, 1877, 1878, 1894). He argued that the whole island chain had been overridden by the ice-sheet originating in the Scottish Highlands flowing from east or south-east to west or northwest. The apparent absence from many of the islands of erratics deriving from this ice movement was explained by Geikie as the result of the lower, dirtier layers of the ice being diverted to the north and south of the islands, whereas the relatively cleaner upper layers of the ice passed across the main area of the islands. Despite brief reports to the contrary (Bryce, in discussion of Geikie, 1873; Campbell, 1873; Milne Home, 1877), the general pattern of ice movement proposed by Geikie became established in the literature of the next 100 years.

Geikie also drew attention to the complex sequence of drift deposits to be found in the north of the islands at Port of Ness and along the north-west Coast of Lewis at Swainbost. These he initially (1874) considered to be the product of a single episode of sedimentation near a glacier margin, but later (1877, 1878) he introduced the concept of two glacial phases separated by an interglacial marine submergence. An early faunal list of the marine fossils contained in these deposits was given by Etheridge (1876).

Subsequent studies until recent years were largely the product of general geological surveys and added only details to the model suggested by Geikie. Thus Jehu and Craig in a series of papers (1923a, 1923b, 1926, 1927, 1934) accepted the dominant role of the Scottish ice-sheet in the glaciation of the islands and provided some detail as to the distribution of exotic erratics, particularly in the southern islands. The existence of erratics on the far-flung islands of Sula Sgeir (Stewart, 1933), North Rona (Dougal, 1928; Stewart, 1932; Gailey, 1959) and the Flannan Isles (Stewart, 1933) appeared to confirm the extension of the Scottish ice-sheet over much of the western continental shelf at maximum glaciation. Whether the ice-sheet reached St Kilda was, however, less certain (Cockburn, 1935; Wager, 1953).

The occurrence of shelly deposits was also reported at Garrabost and To1sta Head by Dougal (1928). Baden-Powell (1938) examined the fauna of the deposits of the north of Lewis and concurred with the general model of two glaciations separated by an interglacial phase. He considered that at Swainbost an interglacial beach was *in situ.* In a separate publication Baden-Powell and Elton (1937) recorded the occurrence of a raised beach along part of the coast of north-west Lewis. They assigned a Holocene age to the beach, as did McCann (1968) who noted that the beach rested on a wide rock platform from which it was separated, in places, by a till.

In the 1970s a complete revision of the ideas of glaciation of the Outer Hebrides resulted from the work of von Weymarn (1974, 1979), Coward (1977), Flinn (1978b) and Peacock and Ross (1978). These various authors noted that throughout the island chain the last movement of the ice as indicated by ice-moulded landforms, striations and erratic transport was towards the east along the eastern part of the islands. This was in direct opposition to the interpretation of Geikie (1873, 1878) and introduced the concept that the last phase of glaciation of almost the whole of the Outer Hebrides had been by a local ice-cap, and that Scottish mainland ice had only impinged on the extremities of the islands, if at all.

At the time this work was in progress, the complexity of the Pleistocene sequence of the area was also becoming apparent through the discovery of the interstadial sites of Tolsta Head (von Weymarn and Edwards, 1973; Birnie, 1983) and St Kilda (Sutherland *et al.,* 1982, 1984) and the possible interglacial site of Toa Galson (Sutherland and Walker,

1984), the unravelling of the sequence of sediments in northern Lewis (von Weymarn, 1974; Peacock, 1981a, 1984a; Sutherland and Walker, 1984) and the recognition that the raised beach sediments were not Holocene in age, but earlier, and could be used as a stratigraphic marker horizon in subdivision of the glacial deposits (von Weymarn, 1974; Peacock, 1981a, 1984a; Sutherland and Walker, 1984; Selby, 1987).

The Pleistocene sequence as presently understood in the Outer Hebrides may be summarized as follows. The earliest event known appears to be the erosion of the raised rock platform in northern Lewis. Subsequently there was a glacial event depositing the till on the rock platform, and it is possible that it was at this time that the exotic erratics were emplaced on the outer isles such as North Rona, Sula Sgeir and the Flannan Isles. Traces of similar erratics have been found, reworked in more recent deposits, on St Kilda (Harding *et al.,* 1984; Sutherland *et al.,* 1984), where the emplacement of those erratics has been suggested to pre-date the Devensian. Two sets of moraines have been found on the outer shelf to the north-west and north of Lewis (Stoker and Holmes, 1991) and the glaciation responsible for the earlier of these moraines may have occurred at this time. In north-west Lewis, the Toa Galson peat post-dates this phase of glaciation, and if it is indeed of interglacial origin as suggested by Sutherland and Walker (1984), this too would imply a pre-Devensian age for this glaciation.

Pollen analysis indicates that the Toa Galson peat formed during a period when vegetation changed progressively from a maritime grassland to an acid heath, and the pollen spectra are comparable to those from Sel Ayre, in Shetland (Sutherland and Walker, 1984). They are quite distinct from the spectra from the Tolsta Head and St Kilda interstadial sites, both of these being associated with finite radiocarbon dates implying their attribution to a Middle Devensian inter-stadial.

The Toa Galson peat is overlain by a periglacial slope deposit representing a period of cold climate, and that is directly overlain by the sediments of the Galson Beach. There is some dispute as to the precise stratigraphic relations of this beach in north Lewis and whether there were one or two periods of beach formation. However, it is generally accepted that in the Galson/Toa Galson area the beach is only overlain by periglacial slope deposits and its upper horizons are periglacially disturbed. To the south, glacial deposits of the last Outer Hebrides ice-cap overlie the beach. Von Weymarn (1974) and Peacock (1981a, 1984a) consider that, to the north, beach sediments overlie the deposits of the last glaciation, whereas Sutherland and Walker (1984) consider them to underlie the glacial sediments, regarding those gravels that occur within or on the glacial deposits as erratics. Radiocarbon and amino acid dating of the included mollusc shells in the glacial sediments of Lewis allowed Sutherland and Walker (1984) to establish the glacial phase post-dating beach formation as Late Devensian in age. The till overlying the Middle Devensian Tolsta Head interstadial deposits also dates from this episode. It is unclear whether the younger set of moraines on the outer shelf north of Lewis is also of this age (Stoker and Holmes, 1991).

During the Late Devensian, therefore, the Outer Hebrides were glaciated by a local ice-cap, with external ice impinging only on the northern tip of Lewis. A small ice-free area existed along the north-west coast of Lewis. On St Kilda a small local glacier existed at this time (Sutherland *et al.,* 1982, 1984). There has been considerable discussion as to the ability of the Outer Hebrides ice-cap to become established on the low ground of the Uists and Benbecula (Flinn, 1980; Peacock, 1980a; Sissons, 1980c). Sissons (1980c) suggested that it was in fact a remnant of a once more extensive Scottish mainland ice-sheet that had become isolated during ice retreat by calving in the deep waters of the Minches to the east. However, this explanation does not allow for the period of beach formation both in the north and the south of the islands (Peacock, 1980a, 1984a; Selby, 1987) prior to expansion of the local icecap. Later, Sissons (1983c) proposed that mainland ice crossed the Outer Hebrides during the Early Devensian and that the ice margin subsequently stabilized to the east of the Outer Hebrides during the Late Devensian, allowing the independent development of an Outer Hebrides ice-cap at this time. On present evidence it therefore seems that during at least part of the Late Devensian the climate was sufficiently severe for the ice-cap to become established on low ground.

Features of deglaciation formed during the decay of the ice-cap have only been discussed in general terms (von Weymarn, 1979; Peacock, 1984a). Particular note has been made of the glaciofluvial deposits in the Uig area of west Lewis (Jehu and Craig, 1934; von Weymarn, 1979; Peacock, 1984a), where eskers, kames, kame terraces, glaciolacustrine deltas and meltwater channels, including the remarkable Glen Valtos, were produced. It is notable that the direction of meltwater drainage indicated by these features was from west to east, implying thicker ice immediately

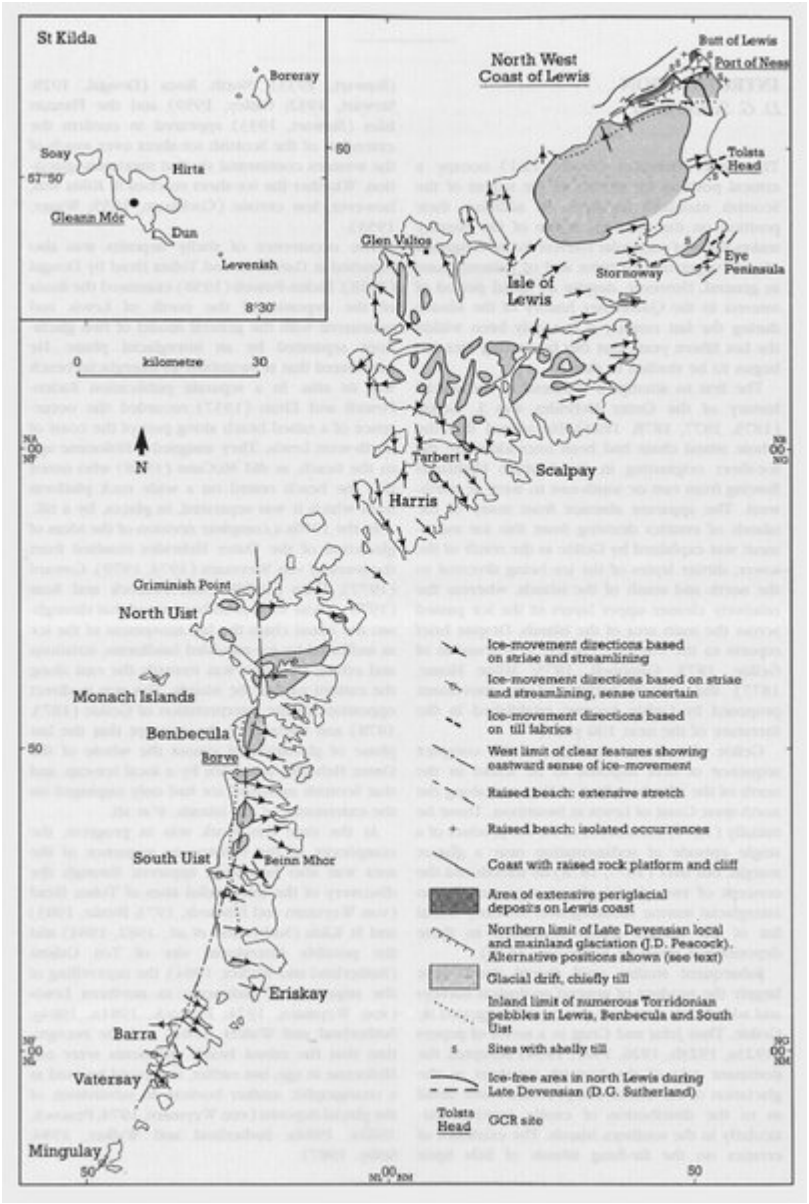
offshore at this stage of the glaciation.

Within the hills of Lewis and Harris there are abundant moraines, which have been referred to a period or periods of local glaciation (Geikie, 1878; von Weymarn, 1974, 1979; Peacock, 1984a; D. G. Sutherland, unpublished data). More than one phase of glaciation is apparently represented, the last being the Loch Lomond Readvance.

No studies have been published of the Lateglacial vegetation of the Outer Hebrides, and only a limited amount of information is available on the Holocene vegetational history (Lewis, 1907; Erdtman, 1924; Blackburn, 1946; Heslop Harrison and Blackburn, 1946; McVean, 1961; Ritchie, 1966, 1985; Birks and Madsen, 1979; Walker, 1984a; Wilkins, 1984; Angus, 1987; Bohncke, 1988; Whittington and Ritchie, 1988; Bennett *et al.,* 1990; Birks, 1991). Pollen analyses from Little Loch Roag in Lewis (Birks and Madsen, 1979) suggest that the island was essentially treeless throughout the Holocene. However, the recovery of birch, pine and willow macrofossils from the blanket peats of Lewis (Wilkins, 1984), together with pollen records of *Betula, Corylus, Salix, Sorbus* and *Populus* at Callanish (Bohncke, 1988), implies the presence of scattered pockets of woodland in sheltered locations (Bohncke, 1988; Birks, 1991). By way of contrast, a detailed pollen record from Loch Lang in South Uist (Bennett *et al.,* 1990) indicates the presence there of areas of relatively diverse woodland dominated by *Betula* and *Corylus,* but also including *Quercus, Ulmus, Fraxinus exelsior* and *Alnus glutinosa.* On St Kilda, Walker (1984a) found that the middle to late Holocene vegetational changes reflected the broad climatic variations of this period, Man having an apparently negligible impact on the vegetation in this isolated area.

The history of sea-level changes in the outer islands is quite distinct from that in the Inner Hebrides and the greater part of the Scottish mainland by virtue of the relatively minor glacio-isostatic downwarping of the former area. Eustatic rise in sea level only impinged on the present coastal areas of the Outer Hebrides during the middle Holocene. This has resulted in peat cropping out in the present intertidal zone in many areas. The best documented example is at Borve (Ritchie, 1966, 1985), where at least 5 m of sea-level rise has occurred in the last 5000 years. Contemporaneously with this rising sea level, the coastline has evolved through the development of sand dune and machair systems along lengthy sections of the west coasts of the islands (Ritchie, 1966, 1979) and exceptionally on the eastern coasts (Ritchie, 1986; Whittington and Ritchie, 1988).

References



(Figure 12.1) Location map and principal Quaternary features of the Outer Hebrides (from Peacock, 1984a).