The Geomorphology, Soils, History, and Archaeology of Findhorn Dunes

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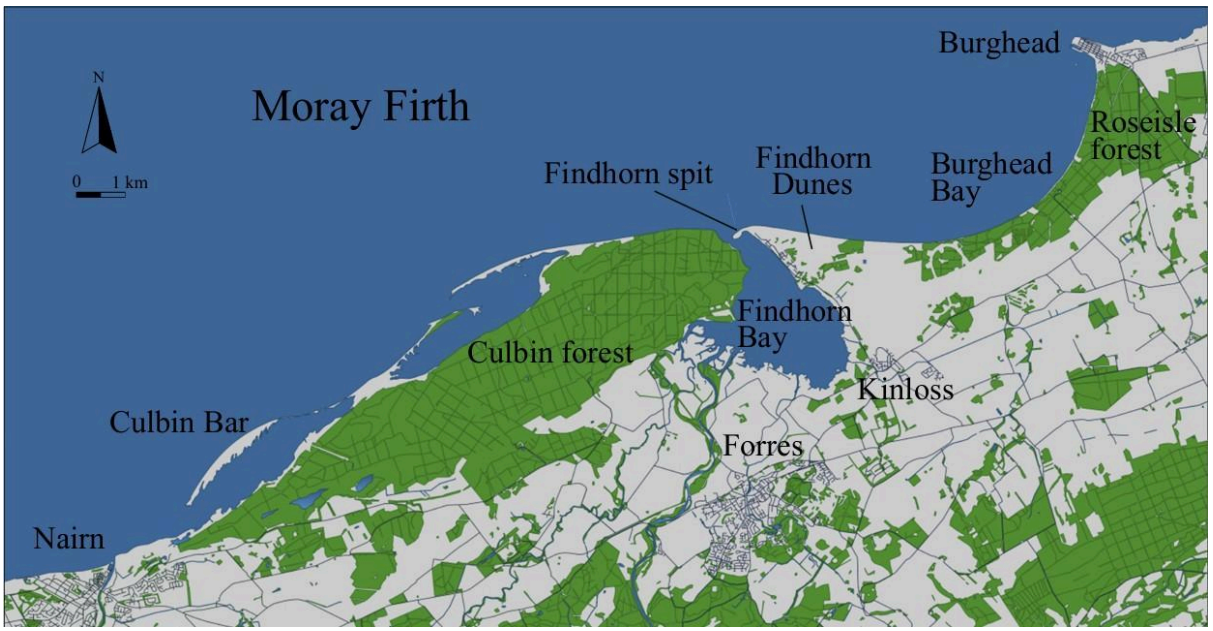
Geomorphology, soils, history

Culbin Sands, Culbin Forest and Findhorn Bay, form one of the most extensive areas of stabilised blown sand in Britain, containing unique systems of intertidal flats, sand and shingle bars, dunes, dune slacks, saltmarsh, heath, freshwater bodies and scrub woodland. There is no comparable site in Europe that matches the scale, complexity and preservation of coastal geomorphological features found here (Hansom 2003; NatureScot 2019).

The wider area, including the hinterland of Burghead Bay to the east, including Roseisle Forest (Map 1), was once the one of the largest sand dune systems in Europe, covering more than 5,000ha (50km^2). At around 130ha, Findhorn Dunes are a tiny fragment of this once huge dune system. Though small in comparison to the original extent of the dunes, Findhorn dunes is significant, representing around 0.1 % of the total Scottish resource of 15,014ha (excluding machair) (Dynamic Dunescapes, 2024).

Fig.1. Geographical context



Courtesy of M. Sharpe

The size and scale of the mobile dunes which once existed can be seen in the forest-covered dunes at Culbin, to the west. Dunes here are among the largest of their kind in Europe, with the 'Lady Dune' at over 30m high, and parabolic dunes reaching a height of 15m, with flanks up to 400 m long and a maximum width of c. 400m, (NatureScot 2019, Steers). The scale of

the dune system here is indicative of an extremely abundant sediment supply, combined with exposure to strong onshore winds (Dynamic Dunescapes, 2024).

The dunes are formed of glacial material washed down from the mountains into the sea in the last ice age. These deposits were worked-over by marine and coastal processes and then exposed as sand and gravel ridges and raised storm beaches as the land rebounded, after the ice had melted, starting around 6,500 years ago (Hansom 2002, Dynamic Coast, Steers)**.**

Much of the glacial source material for the dunes came from as far away as the River Spey, 30km to the east, a huge marine channel once funnelling material along the coast. This channel became blocked as the land rose, from around 6,000 years ago, and sediment supplies from rivers gradually reduced (Comber 1993). Since then, the shore of Burghead Bay and the Culbin headland have been eroding, with material being carried west by longshore drift and deposited in the Bar area of Culbin (Hansom, Steers). Much of the beach between Burghead and Findhorn is eroding at around 1m a year, whereas the spit at Culbin is growing by around 15m a year, leaving a broad salt marsh in its lee (NatureScot 2019, Steers, Hansom, Dynamic Coast).

As the post-glacial land rose, and the sea level fell, a shallow bay developed at the mouth of the river Findhorn, which slowly dried out as the land continued to rise, forming a delta and exposing gravel, sand flats, mobile sand, and areas of fertile sediment, including peat (Steers). Peat layers from eroding sand cliff sections at Burghead Bay, corresponding to former freshwater habitats, have been radio-carbon dated, to between 10,000 and 2,000 years ago, with a sample from Culbin being dated at around 10,500 years ago (Comber).

Areas of fertile alluvial soil - still farmed today around Findhorn Bay - are likely to have been the focus of agriculture within the current Culbin forest area, before being buried by sand in the seventeenth century (Gillen 1993, Ross 2019). Surveys of today's soils at Culbin Forest show that these are mostly infertile podzols, developed through rain-leached sand - as is the case at Findhorn (Gauld 1981, Gillen1993, Forest Enterprise 2018,).

It is not clear when, and to what extent, the sand dunes at Findhorn were stable or active. Many sand dune systems in north west Europe were activated during the 'Little Ice Age' (1300s to 1850) during a period of increased storminess (Dynamic Dunescapes 2021, 2024). It seems likely that this is also the case at Findhorn dunes, but that mobile sand dunes also existed here before this period.

Major periods of sand instability, interspersed with periods of stabilisation, are known from around 4,500 years ago in North East Scotland, and the first documented reference to sandstorms at Culbin was in 1097 AD, by which time some dunes must have been well-established. Parish records also mention sand storms in the thirteenth century and many settlements were described as having been lost to sand by 1586 (Hansom, Comber, Steers).

The presence of well-developed buried soil ('palaeosol') at Culbin - unusual in large dune systems, which tend to become remobilised regularly - suggests that some of the dunes at least remained stable until relatively recently, supporting a vegetation cover that prevented sand-blow (Hansom). A paleosol, showing signs of burning, is also visible on Findhorn dunes, indicating vegetation cover here, possibly during the same period as at Culbin (Appendix 1. Fig.1). Samples are being prepared for radio carbon dating at the time of writing (M. Sharpe, pers. comm.).

A series of sandstorms were recorded at Culbin between 1670 and 1695, most notable of which was the great sandstorm of 1694, which buried farmland and buildings, and forced people from their homes (Steers, Davies, McKenzie 2014). Jutland, in Denmark, is recorded as being affected by similar events, indicating wider environmental shifts around the North Sea at the time (Culbin Stories).

The Culbin area is sometimes referred to as being the 'granary of Moray', before the great storm of 1694. There may be some confusion around this, however, Culbin possibly being confused with the much larger 'Laich of Moray' – the area of rich farmland which still exists between Forres and Elgin (NatureScot 2019). While the Great Storm undoubtedly had a huge impact on the local human population of Culbin, the extent of loss of agricultural land may have been much less than has often been reported (Ross, Steers). At the time, agricultural holdings were much smaller than today, supporting much higher numbers of people per hectare. Apparently, there was confusion in the records of the time, between number of holdings and numbers of people, and also suggestions that the Estate may have exaggerated the extent of agricultural loss to maximise financial relief from the state (Ross). It may be that agriculture at Culbin was always relatively marginal.

The history of Culbin gives a valuable impression of the scale and dynamics of natural sand dune processes once in operation in the area. While the historic ratio of infertile sand/gravel and agricultural land at Culbin may be unclear, it is known that sand movement has long been a concern in the area, as indicated earlier. Even today, sand storms can have an agricultural impact and sand can spread across roads south and west of Findhorn Bay.

A recent find of two grain grinding stones at Findhorn, indicate that agriculture may also have taken place at Findhorn dunes, over a long period of time, from the Neolithic to possibly the post-medieval period. It is not possible to say whether this was a well-established land use, or periods of farming interspersed with periods of mobile sand. Archaeology is considered in more detail in 2.2, below.

The first attempts to stabilise the shifting sands at Culbin was in the west, the area of coastal deposition and source of blowing sand, in 1839 (Forestry Commission 1951, 1955). A massive thirty-year afforestation programme was started by the, newly established, Forestry

Commission, in the 1920's – and at Roseisle from the 1930's. At this time, the whole Culbin area was mostly mobile sand dunes. Once again, planting started in the west, to cut-off the sand supply. Planting often first targeted areas of stabilised sand, between sand or gravel ridges, to shelter the surrounding mobile sand from the wind and encourage the spread of sand stabilisation. Brash from forestry operations elsewhere was brought-in to lay as a thatch cover on mobile sand and Corisican pine was planted on the more mobile sand areas.

Key to understanding the ecology of the Findhorn dunes is the fact that the Findhorn spit once extended much further west (around 8km), to Culbin (Appendix 1, Fig. 2). This long spit was breached twice, most recently during a storm in 1702, forming the current mouth of the river, and causing the destruction of an earlier village of Findhorn. The present Culbin Bar has developed since that point, slowly becoming connected to the land by sand dunes and saltmarsh (Steers).

Until the breaches of the former long spit of Findhorn, particularly the breach of 1702, the dunes between Culbin and Burghead would have been strongly connected as a single sand dune system. It is likely that sand movement formed a cycle within a 'coastal cell', with a plentiful sand supply from the Culbin sand deposition area, blowing eastwards to Findhorn and Roseisle, from where it was eroded and transported back to Culbin by longshore drift (Hansom).

Most sand supply to the Findhorn and Roseisle dunes probably stopped in 1702, when the Culbin bar and dunes became separated from the Findhorn Dunes by the new river mouth. If so, the wider Findhorn dunes have probably slowly stabilised since then, under natural processes, developing areas of dune heath, gorse, and latterly encroaching pine trees. This theory, of stabilisation as a result of reduced sand supply, would be consistent with the fact that it takes three hundred years of leaching for sand to become suitable for dune heath development (Sand Dune Managers Handbook 2024).

Most of the shore of Burghead Bay/Findhorn Dunes is eroding, with deposition at the Findhorn spit. It seems likely that the active Findhorn primary/foredunes of today are still supplied with sand from the spit, drying sand at low tides being blown westwards along the beach to supply the still active, though somewhat restricted, foredunes (Sand Dune Managers Handbook 2021, 2024).

Aerial photographs from the 1940's show a 'skeleton' pattern of gorse, on the dune ridge tops reflecting the current 'fleshed-out' pattern, was well-established (Appendix 1, Fig.3). It seems logical that the dune ridge tops, most exposed to leaching, would have been the first areas to develop acid-loving dune heath, and that the heath slowly developed the soil into which gorse could be established. Gorse-covered ridges are likely to have then sheltered the lower ground between from the wind, causing it to stabilise and establish consistent rain

leaching, thereby allowing more dune heath to establish and create the condition for gorse to spread.

The theory that Findhorn Dunes had largely stabilised by the 1940s could be further substantiated by the fact that it was not planted with forestry in the early part of the twentieth century in order to stabilise sand - apart from at Wilkies Wood, in the early 1960's. The western part of Wilkies Wood shows clear dune formations, which have been planted with Corsican Pine - the chosen species for mobile sand at Culbin and Roseisle – indicating that while mostly stabilised, there were still small areas of mobile sand at that time.

While sand stabilisation at Findhorn is likely to be partly as result of natural processes, at a wider scale the impact of human activity in the last one hundred years is far more significant, destroying around 99% of the former sand dune ecosystem between Nairn and Burghead, as follows:

- Culbin and Roseisle around 3,700ha
- The MoD base at Kinloss 900ha
- Findhorn Village, Park Ecovillage and Wilkies Wood removing around 150ha.

In addition, between 1926 and 1939 around 20ha of natural dune habitats at Findhorn were covered with topsoil in the creation of a golf course (Shand). The course was abandoned in the 1930's, and later largely subsumed by an expanding Findhorn Village and caravan park, but around 6ha of the former golf course - now gorse-covered - can still be seen on aerial photography, between the edge of the village and the 'Dunes Road' (Appendix 1, Figs.3,4).

Archaeology

The coastal plain of Moray and Nairn is unusual when compared to other parts of northern Scotland in that there is a range of material from the Neolithic period, from areas near Roseisle, Fochabers, and Buckie, as well as from the Culbin and the Findhorn Sands. Polished stone axes suggest the clearing of woodland, although they may also have been symbolic (NatureScot 2019).

Local archaeologist, Michael Sharpe, has discovered objects from multiple periods, ranging from the Mesolithic to the second world war, including: fire-cracked stone (used for cooking), flint tools, hammer stones, a Neolithic axe, pot sherds, beads, copper alloy objects, burnt bone, a midden, two grain grinding stones ('querns'), and at least one Bronze Age cremation site. He suggests that at least some of these findings may be ritual objects, the area possibly long being considered as a 'liminal place', of spiritual significance (Sharpe, 2023).

The two querns are particularly interesting in that one, a saddle quern, characteristic of between neolithic to early Iron Age; and the other, a rotary quern, could date from the iron age right up to the post-medieval period. These finds may indicate cultivation over a long period of time, possibly sporadic due to wind-blown sand.

Midden excavations from the middle of Culbin forest in the 1970s exposed the bones of cow, pig, and sheep or goat, as well as a few charred cereal grains and a pot. Radio carbon dating of charred wood showed that it was from the bronze age, around 3,500 years ago. Authors of the study considered that the area would not have been suitable for cultivation or animal husbandry, and that the animals from which the bone derived may have been rustled from land to the south (Archaeology Service Historic Environment Record).

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Appendix 1.

Fig. 1. Buried soils with burn layers, Findhorn Dunes (M. Sharpe)

Fig.2. Historic map showing the old course of the River Findhorn and the separation of Old Bar from Findhorn Dunes (from Steers, 1937)

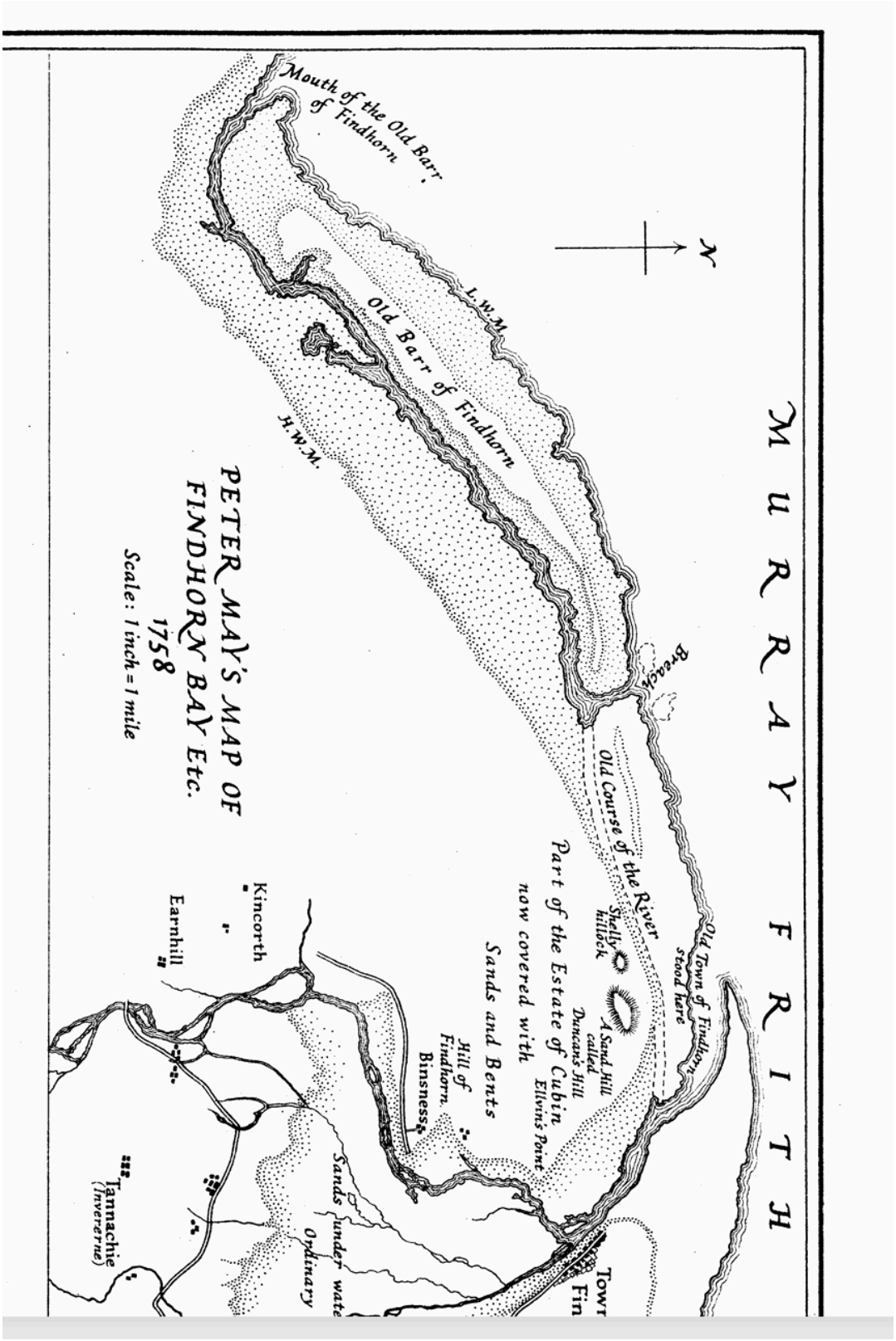

Fig.3. Aerial photo, 1946, showing the extent of bare sand, gorse, and a historic golf course (the vegetated ground adjoining the village and road)

Courtesy of M. Sharpe

Fig.4. Layout of the Findhorn golf course (Shand, Forgotten Greens of Scotland).