Sand Country Ecology

Chairman: Mr. H. S. Gibbs

The Soils of the Manawatu Sand Country

J. D. Cowie

Soils from wind-blown sand cover an area of over 200,000 acres in the Manawatu, Horowhenua, and Rangitikei counties, and so form an important agricultural unit in the Manawatu district.

Of the five soil-forming factors; parent material, climate, vegetation, relief and time; parent material and climate are relatively constant in this district, vegetation is largely dependent on the other factors, while relief and time vary and it is the variation in these two factors that causes the major differences between the soils.

The Time Factor

Four distinct dune building periods can be recognized and these are reflected in the presence of four suites of soils which show increasing profile development with increasing age.

Taking the dune soils, the youngest suite is represented by Waitarere sand, a soil forming on the unconsolidated dunes bordering the coast. In this soil the sand is still unweathered and the only profile features that have developed are a browning of the top inch by decaying organic matter and a slight aggregation of the sand by plant roots. Waitarere sand is very susceptible to wind erosion once the plant cover is depleted and it would be best utilized for forestry.

Foxton dark grey sand represents the next stage in soil development on the dunes. A rather shallow topsoil of up to 6 inches has been built up and the subsoil is stained brown with iron oxides released from the decomposition or weathering of the mineral grains. Drainage is excessive in this soil and although pastures can be established they are poor and dry off early. The shallow topsoil is easily broken by stock to expose the underlying loose sand to wind erosion, and blowouts are numerous.

The next older stage is represented by Foxton black sand formed on the more consolidated dunes. The topsoil is very distinct and may be up to 14 inches deep, while the subsoil is browner in colour than Foxton dark grey sand as a result of greater weathering. Fair pastures can be maintained on Foxton black sand but because of the excessive drainage they dry off in summer. Blowouts are not so numerous as on Foxton dark grey sand.

Koputaroa sandy loam, formed under coastal broadleaf forest on well consolidated sands in the Horowhenua district, is the oldest member of the sequence. The topsoil is brown in colour in contrast to the black of the previous two soils, and reflects the change from scrub to forest melanisation. Both topsoil and subsoil are higher in silt and clay and have a better structure than the previous soils. Koputaroa sandy loam holds moisture well during dry periods and high producing pastures can be maintained. There is little danger of wind erosion on this soil.

Over this age sequence the main changes in the soils with increasing age have been: an increase in the total organic matter content; an increase in the amounts of finer particles such as silt and clay; and the development of better and more durable soil structure. These combine to give the soils better moisture holding capacities and reduce their susceptibility to wind erosion.

The Relief Factor

Within each age suite the main differences between members are due either directly or indirectly to differences in relief over the dune unit. At first sight the arrangement of the dunes appears somewhat chaotic but on closer examination a well defined basic dune form is seen to be present. This consists of two long and narrow parallel dune ridges or "wings" united at their eastern end to form an apex. The sand-plain the wings enclose slopes up from west to east towards the apex (Fig. 1). The water-table is low in the higher eastern part of the sand-plain but as the surface becomes lower, the water-table rises and in the extreme western part of the plain it is at or above the surface. Where the flow of this surface water away from the sand-plain is restricted by encircling dunes, peaty swamps or lakes have been formed.

This range of relief over the dune complex gives a wide range of micro-climatic conditions from the extreme dryness and high summer temperatures on the sunny faces of the dunes to the excessive wetness and lower temperatures in the peaty swamps. This range is reflected in the soils.

Taking the Foxton black suite we have the following soils formed: Foxton black sand on the dunes, Awahou loamy sand on the higher parts of the sand-plains, Carnarvon black loamy sand in the lower parts, and Omanuka peaty loam in the peaty swamps.

In Foxton black sand, which is excessively draining, the content of organic matter in the topsoil is low, and the subsoil has an even brown colour. In Awahou loamy sand, which is free-draining, the topsoil is slightly higher in organic matter, the subsoil is more yellow in colour and large reddish mottles are present in the subsoil. In Carnarvon black loamy sand, which is imperfectly draining, the topsoil is higher in organic matter, the subsoil is grey in colour, and both the topsoil and the subsoil contain hard concretions of iron-cemented sand. Omanuka peaty loam is formed where drainage is very poor, and because of the anaerobic conditions prevailing for most of the year partly decomposed organic materials accumulate as peat.

Similar sequences to that described above are found within the other suites. Waitarere sand has Hokio soils associated with it on the sand-plains, while Foxton dark grey sand has Himatangi soils on the higher parts of the sand-plains, Pukepuke black soils on the lower parts, and Omanuka soils in the peaty swamps. With Koputaroa sandy loam, only the dune soil is represented.

The sand country soils are potentially fertile, being well supplied with lime, moderately well supplied with phosphate, but they are low in potash.

Productivity of the soils is, however, largely dependent on the amount of soil moisture available during the growing season. Satisfactory pasture growth is only possible where the water-table is within reach of the plant roots and any extensive lowering of this water-table by drainage, although it may benefit some areas, will adversely affect other areas. Where possible, spreading a layer of sand from neighbouring dunes over wet areas would be more satisfactory than drainage.

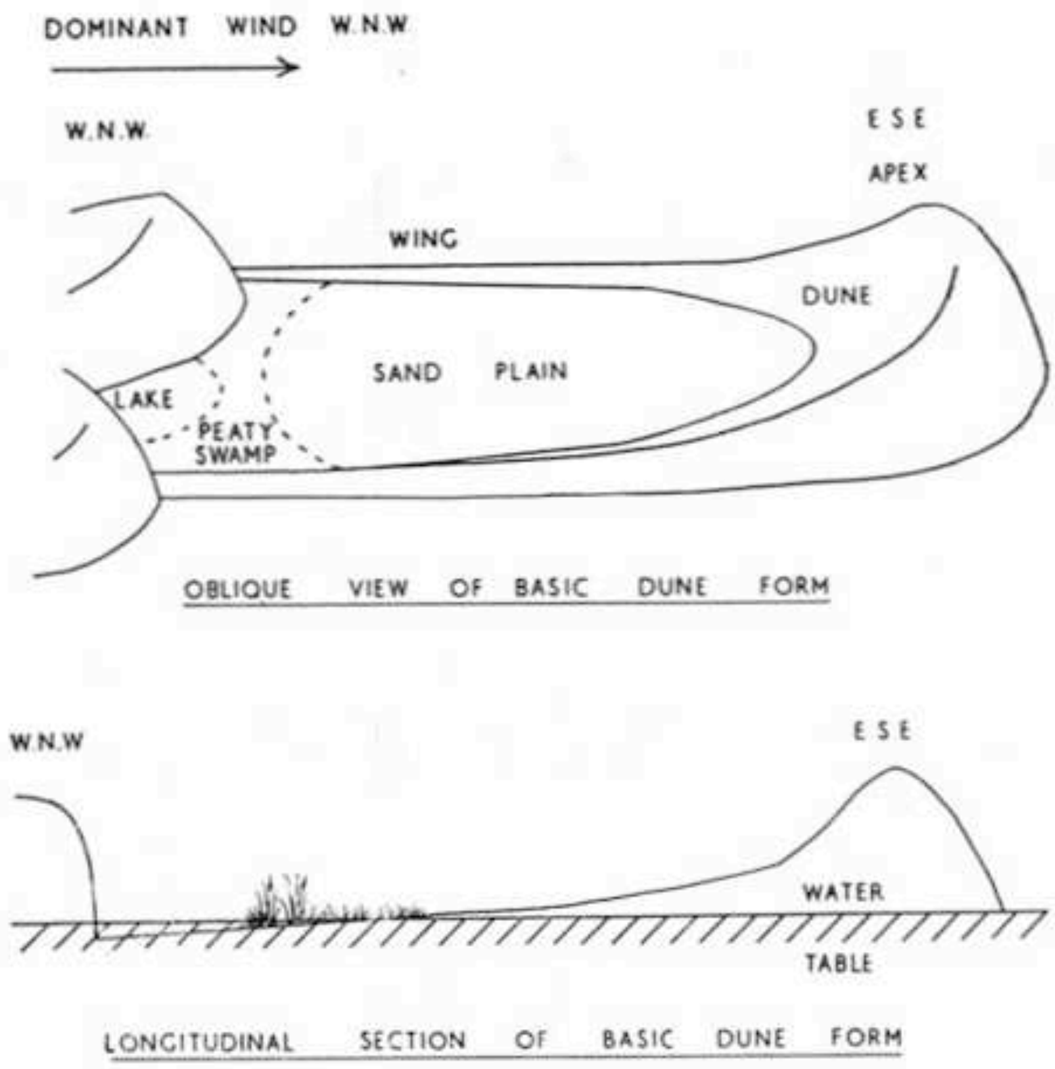

Figure 1.—*Typical dune structure.*