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THREE

Wetland patterns

Most wetlands are not uniform but contain several different plant communities. Two or more wetland classes may occur adjacent to one another, or one class may be contained within another. Some wetland complexes can even extend over more than one hydrosystem.

The spatial arrangement of wetland classes, vegetation structural classes, and also wetland forms will often produce a readily discernible pattern. A wetland can be described as being patterned when its features are arrayed in a repeated fashion, often most obvious on aerial photos. Sequences of several vegetation structural classes, such as sedgeland to scrub to forest, can usually be interpreted as lying along some environmental gradient, in this example probably from wet to drier ground. One clear type of pattern is the zonation of vegetation types, as can be seen beside a lake or estuary, where water fluctuation is obviously the strongest environmental influence. When several environmental factors are interacting, the patterns of spatial distribution can be more complicated, and will often provide a challenge for interpreting how they have arisen.

Because factors such as substrate type, wetness, and nutrient status vary along gradients, the resulting vegetation types seldom have distinct boundaries, but instead merge with each other, the transition zones being called ecotones. Patterns can occur at many scales. Many wetland types are difficult to delimit or map because they occur as patches or fingers among a matrix of dryland vegetation, or else as narrow elongated strips adjoining a lake or river.

Some examples of wetland pattern have already been illustrated in Section 2.6 on wetland forms. The six further examples in Sections 3.1 to 3.6 have been selected to demonstrate the following points:

- the relationship between hydrosystems, wetland classes, and vegetation structural classes;
- correlations between substrates, hydrology, and vegetation types;
- working examples of how wetland patterns can be interpreted;
- the usefulness of vertical and oblique aerial photos for revealing wetland features;
- means of portraying patterns: habitat and vegetation maps, diagrams, profile drawings;
- patterns at both a broad and a fine scale.

3.1 Hydrosystems and wetland classes on a coastal plain

Vertical aerial photos are an ideal way to perceive broad-scale patterns of landforms, wetland patterns, and vegetation. Bodies of water usually show dark, with different tones depending on water depth and clarity. Vegetation types can be discerned from their textures, tones, and colours, though the last two of these can vary between seasons. This example (Fig. 98) shows a coastal plain where wetlands have developed behind a series of former beach ridges, laid down over several thousands of years, as the coastline has prograded – moved seawards – in conjunction with a relative drop in sea level. Boundaries of hydrosystems and wetland classes are shown in Figs 99 and 100.

Fig. 98 This vertical aerial view embraces 2 × 1.5 km of a wetland complex on the coastal plain near Haast, south Westland. Beach ridges with podocarp forest have parallel intervening swales of bog. On the inland side (right) are swamps associated with the dark meanders of the Maori River. The pale area (top right) is the bed of the more flood-prone and sediment-loaded Waita River.

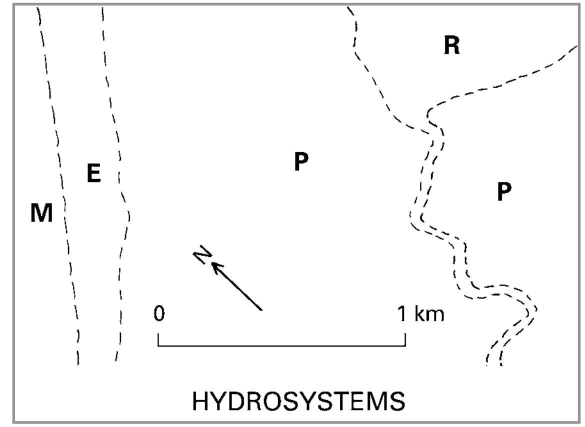


Fig. 99 Diagram relating to Fig. 98, showing the distribution of four hydrosystems: M = Marine; E = Estuarine; P = Palustrine; R = Riverine.

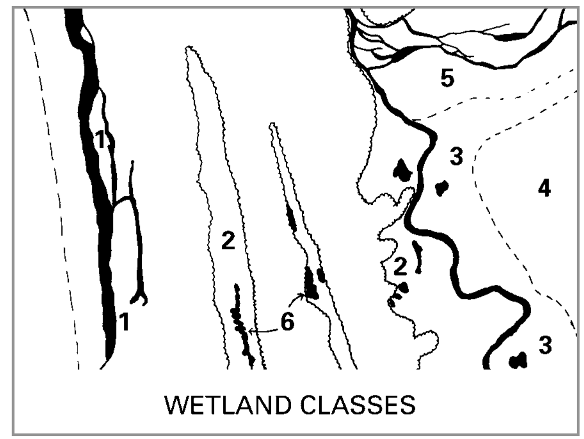
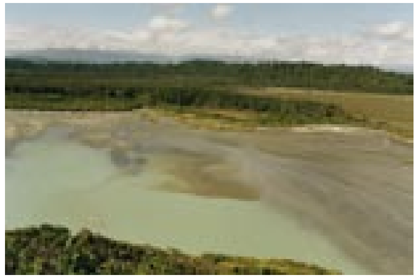


Fig. 100 Diagram relating to Fig. 98, showing the distribution of six wetland classes:

1. Saltmarsh on margins of river mouth lagoon;
2. Bog in swales between dune ridges;
3. Swamp infilling depression behind innermost dune ridge;
4. Fen on gentle slopes leading down to swamp;
5. Marsh on damp alluvium of river terraces;
6. Shallow water of bog and swamp pools, rivers, and coastal lagoon.

3.2 Linking hydrosystems to wetland classes and vegetation

Only a few wetland systems have a convenient nearby hill for an overview of the components. At the Wanganui River mouth in Westland the moraine hillock of Mt Oneone provides a panoramic view (Figs 101, 102, and 104) demonstrating hydrosystems, wetland classes, and structural classes.



Figs 101 and 102 The mouth of the Wanganui River and the gravel bar that encloses its small estuary. Note the patterns of water movement in the braided river and the various types of sediment in the estuary: a complexity that has its unseen counterparts in wetlands that are covered with vegetation.

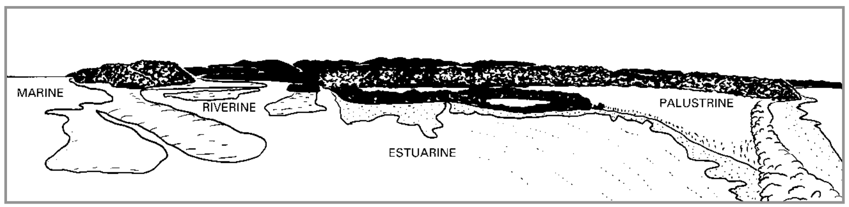


Fig. 103 Diagram showing the hydrosystems represented within Figs 101, 102, and 104.

Fig. 104 This palustrine wetland is called Doughboy Pakihi, but is best classified as fen plus swamp. It is a peat-filled hollow bounded by a coastal dune and the forested moraine ridge beyond.

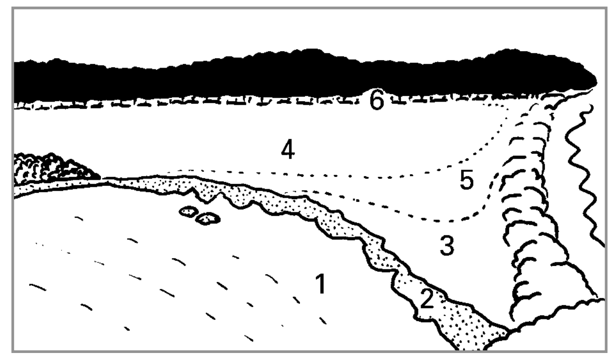


Fig. 105 Diagram relating to Fig. 104, showing the distribution of hydrosystems, wetland classes, and structural classes:

1. Estuarine mudflats;
2. Estuarine saltmarsh with zones of turf and rushland;
3. Palustrine swamp with flaxland;
4. Palustrine fen with sedgeland;
5. Palustrine fen with scrub (this zone recently burned);
6. Palustrine fen with treeland and forest.

3.3 Patterns on a river delta entering a lake

Most wetland patterns are a reflection not only of current environmental gradients, but also of landform genesis and human impacts. Lake Taupo is a huge, but relatively young lake, dating from the massive Taupo eruption of c. AD 186. Pushing into the south end of the lake, the Tongariro River has built a delta with coarse greywacke and pumice gravels on riverbank levees, and deposits of finer alluvium in the intervening hollows, where poor drainage is partly a result of ponding behind lake-shore storm-beach ridges.

Fig. 106 Wetlands on the delta of the Tongariro River, south end of Lake Taupo, with the town of Turangi just up-valley. There have been several human influences on this wetland system. Maori lived here, the Waitahanui Pa being situated on the left of the river's main mouth (left foreground). Farm development involved clearance of forest and scrub and attempts at drainage. Raising of Lake Taupo by c. 1 m in 1941 encouraged re-establishment of wetland vegetation. In the 1970s the Tokaanu Tailrace Canal was excavated through the wetland in right distance.

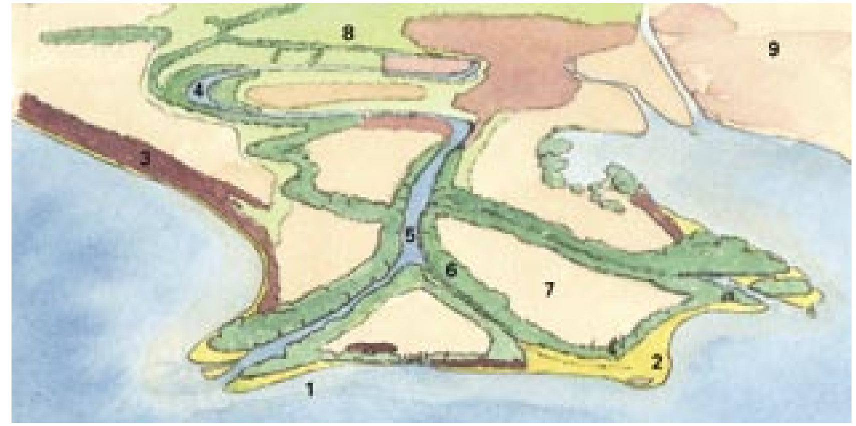


Fig. 107 Tongariro River delta: an interpretation relating to Fig. 106, showing the distribution of hydrosystems, wetland classes, landforms, structural classes, and vegetation:

1. Lacustrine shallow water, in bays and on delta shelf with submerged aquatic vegetation;
2. Lacustrine beach of bare pumice gravels, with turf and grassland;
3. Lacustrine storm beach with manuka scrub;
4. Riverine meander;
5. Riverine delta channel;
6. Riverine levee with crack willow forest;
7. Palustrine swamp with sedgeland, reedland, and flaxland;
8. Palustrine marsh with rushland and grassland;
9. Geothermal: localised fumaroles and hot pools near base of hill.

3.4 A dryland-to-wetland sequence on an alluvial plain

Patterns of wetland types are often caused by the way substrates of different-sized particles are deposited by gravity and along waterways. This example spans a sequence from dryland hillside habitats to progressively wetter wetlands. On a steep hillside large boulders and rocks tumble down to form well-drained talus slopes. During heavy rains, streams and rivers transport rocks and stones a certain distance down valley. Gravel, sand, and silt are carried a greater distance, to be deposited more slowly as substrates having progressively poorer drainage.

Fig. 108 Waiuna Lagoon, at Big Bay, south Westland, is a shallow, lowland lake that is being gradually infilled by the deltas of tributary rivers and streams.

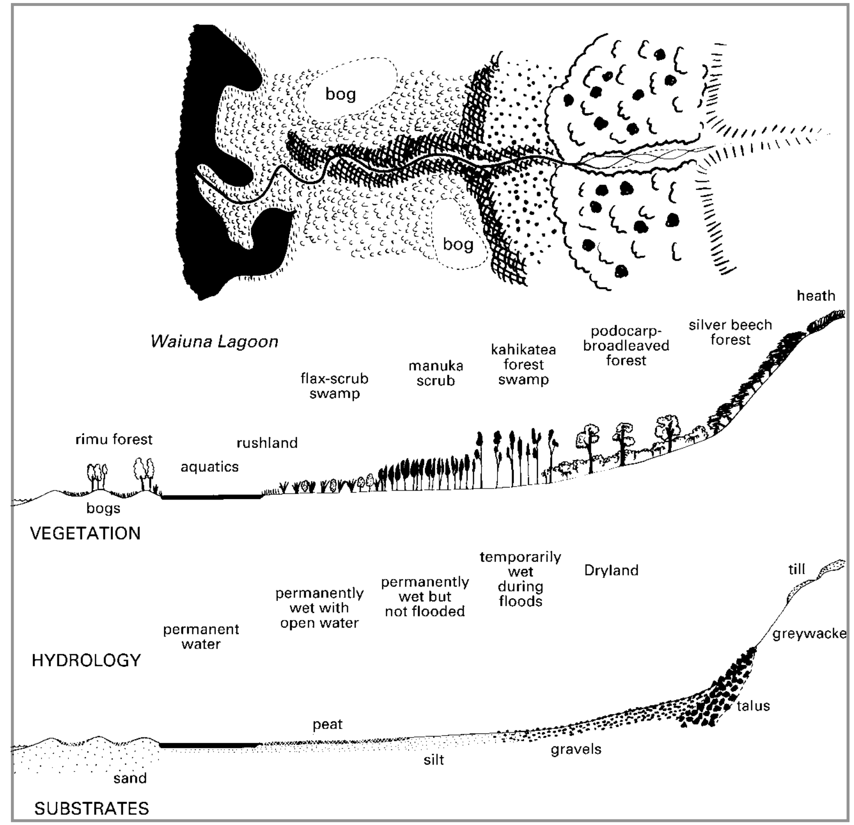


Fig. 109 Sketch map and profile diagrams of the alluvial plain and delta beside Waiuna Lagoon (see top right of Fig. 108). The gradient (right to left) of substrate materials and decreasing soil drainage is reflected in the sequence from forests to scrub swamp, bogs, marshes, then aquatic vegetation.

3.5 Zonation pattern on a lake shore

One of the more simple types of wetland pattern is a zonation, where a parallel sequence of wetland types arises in response to one dominant environmental influence. On lake shores strong zonation patterns are caused by water level fluctuation. Permanently aquatic zones are governed by the amount of light reaching different depths of water. Further upslope the zones relate to duration and frequency of submergence.

Fig. 110 Lacustrine shore zones, Lake Te Anau, Fiordland. This lake, glacial by origin, has a total fluctuation of 3.5 m. The turf zone (left) is under water about half the time. The zones of restiad rushes (centre), scrub, and forest (right) are submerged less often and for progressively shorter periods. At this site, stony shores of an exposed promontory meet the mobile gravels that belong to the end of a bay (foreground). These gravels display a stepwise set of low beach ridges, shaped by waves during successive storms through a period of falling lake level.

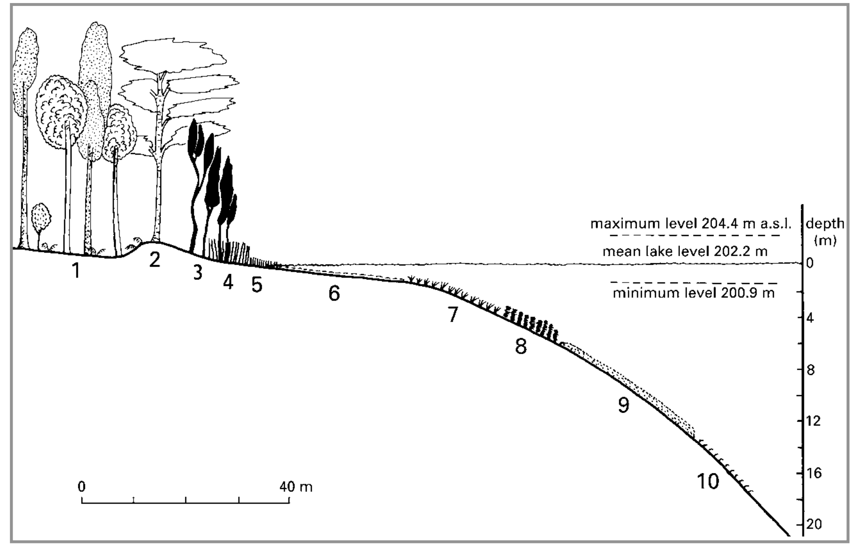


Fig. 111 Diagrammatic profile of a gentle, relatively sheltered shore at Lake Te Anau, Fiordland, showing the main vegetation zones in relation to fluctuating lake level:

1. Kahikatea (*Dacrycarpus dacrydioides*) - pokaka (*Elaeocarpus hookerianus*) forest swamp in poorly drained hollow behind storm ridge, sometimes ponded with floodwaters;
2. Beech (*Nothofagus*) forest on well-drained storm ridge, intolerant of inundation exceeding c. 50 days;
3. Manuka (*Leptospermum scoparium*) scrub marsh on silty gravels, tolerant of prolonged inundation by high lake levels;
4. Oioi (*Apodasmia similis*) restiad rush marsh;
5. *Carex gaudichaudiana* sedge marsh as a short sward;
6. Turf: several zones of turf marsh of different composition related to degrees of submergence and drying;
7. Aquatic herbfields: *Isoetes kirkii* beds and taller macrophytes (*Potamogeton* and *Myriophyllum* spp.), permanently submerged in the depth range of 2–8 m below mean lake level;
8. Canadian pondweed (*Elodea canadensis*) to 1.5 m tall, at 1–7 m depth;
9. Charophyte meadows: beds of *Chara* and *Nitella* spp. reaching 15 m depth;
10. Bryophytes: sparse mosses and liverworts to 17 m depth.

3.6 Pattern in a fiord-head marsh

Where a river enters the sea the pattern of wetland habitats is governed not only by river processes, channels, and sediments, but also by the gradient of salinity up the estuary and into the tidal stretch of river. In Fiordland the marshes at the heads of long fiord arms are less saline than in estuaries elsewhere. This is because the very high rainfall results in a surface layer of relatively fresh water that overlies, and does not readily mix with, the underlying seawater of the fiord.

Fig. 112 Estuarine saltmarsh where the Camelot River enters the head of Bradshaw Sound, Fiordland. The steep-sided valley was sculpted by a glacier. Since the end of the last glaciation, river alluvium has partly filled the valley floor and formed a delta at the fiord head. This photo was taken at about low tide.

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Fig. 113 Map showing pattern of habitats and vegetation types at the Camelot River mouth, Fiordland.

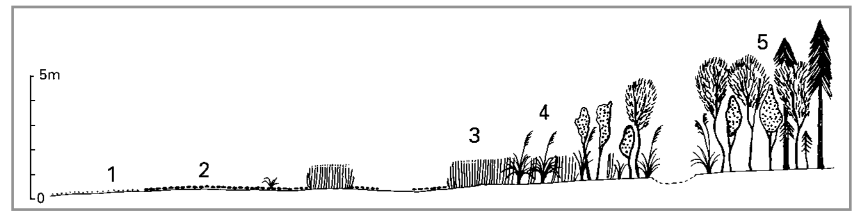

Fig. 114 Profile diagram showing habitats and vegetation types at the Camelot River mouth. The numbered features (see also Fig. 113) are:

1. Gravelly mudflats with algae in lower intertidal zone;
2. *Samolus repens* turf saltmarsh with *Poa astonii* tussocks, intertidal;
3. Oioi (*Apodasmia similis*) restiad rush saltmarsh, upper intertidal;
4. Toetoe (*Cortaderia richardii*) grass saltmarsh in uppermost intertidal zone;
5. Scrub marsh of *Carmichaelia australis*, *Coprosma propinqua*, and young kahikatea in supratidal zone, often flooded by river;
6. Forest of kahikatea, silver beech, and rimu (*Dacrydium cupressinum*) on river levees and alluvial flats;
7. Backswamp with flax - *Carex* spp. swamp;
8. Broadleaved forest (non-wetland) on steep stream fans;
9. Silver beech - kamahi (*Weinmannia racemosa*) forest (non-wetland) on very steep hillsides.