VEGETATION HISTORY

The following description of the vegetation history of Otanewainuku Ecological District was compiled largely from Nicholls (1965b).

There is good stratigraphic evidence in the Central North Island and Bay of Plenty indicating that from about 30,000 years ago there was deterioration in climate, leading to a widespread erosional hiatus at about 20,000 years ago. Stability was not re-established in many places, particularly those above 300 m, until about 14,000 years ago.

For the following several thousand years prior to Polynesian settlement the ecological district would have been almost entirely forested (c.f. Vucetich and Pullar 1963 & 1964) with few exceptions, for example: foredunes, some wetlands, landslide scars and clearings created by natural fires caused by lightning strikes. The forests would have been similar to today's unlogged forests, i.e. predominantly rimu/tawa forest. There is no evidence to suggest that any forest outside the Okataina Volcanic Centre[1] was destroyed through volcanic action during the Holocene period (last 10,000 years).

Following Polynesian settlement of the Bay of Plenty Region large areas of forest were destroyed by fires, as the land was cleared for occupation, fortification, cultivation, forage and travel. Low fernlands and scrub with rare pockets of tall forest replaced extensive forest tracts. This clearance was most drastic on the coastal lowlands but also extended to about 200 m altitude on the plateaus and the Rotoiti breccia fan. When burning of the fire-induced shrub and fernlands waned in the 19th century, secondary forest developed widely on the high forest margins.

European settlement on a significant scale began on the Tauranga and Te Puke lowlands in the 1870s and soon extended over open country further inland. The major clearings of forest in the Whakamarama, Kaimai and Oropi areas and south-west of Te Puke had been made by 1900. Between 1900 and 1920 many blocks were opened and farmed about Ngawaro and Kaharoa. Although many ventures were initially unsuccessful, many abandoned farms were re-occupied in the 1950s and 1960s. Much secondary forest was cleared alongside State Highway 33 in the 1960s for farming.

Virtually all unprotected forests and some recently protected forests have been logged for podocarps and broad-leaved species. Before 1945 only softwoods were felled, but since then some of the more numerous hardwoods have also been extracted. Logging started about Whakamarama in the early 1900s, and continued until about 1970, leaving untouched only the forest above 500 m in the western quarter. Apart from very minor light operations, logging did not begin on the northern Mamaku Plateau before 1920 where until 1945 logging was confined largely to forest on the plateau segments within reach of tramways and steam-driven log haulers. This included felling of red beech for fencing and mining timbers. Over the ensuing 30 years, most of the previously logged

1. In the Rotorua Lakes Ecological District.

forest was roaded and re-logged, as were many once inaccessible areas, including broken country in the north-west quarter of the Mamaku Plateau and the west side of the Papamoa Range.

Much of the forest, about and north of Manawahe was logged and then cleared in small operations between 1900 and the early 1920s. Rotoehu forests east of that area were logged between 1934 and 1958.

Some features of the forest pattern appear anomalous and can be elucidated, rather tentatively, by recourse to knowledge of a past different environment.

The limitation of red and silver beech to relatively small areas in the upper Mangapapa and Mangorewa catchments (on the northern Mamaku Plateau) and total absence on the southern half, seems most probably related to fortuitous spot survivals during several thousand years of very cold and windy climate. During this cold period (20–15,000 years ago) erosion of earlier soil cover and deposition of sterile loess (wind-blown sands) to considerable depth occurred, resulting in a generally depauperate, treeless, vegetation over at least the higher, most exposed parts of the plateau (Kennedy 1994). Podocarp/tawa forest reappeared by *c.*13,500 years ago, with climate amelioration and vastly improved soils brought about by deposition of volcanic ash at intervals up until 1850 years BP. The reasons remain obscure as to why red beech and silver beech became together confined to their present localities; how they continue to thrive there; and why there are no signs of any expansion into rimu/tawa forest.

Hard beech, on the other hand, not only occurs within the red beech-silver beech stands, but also wherever to be expected, lining gorges and on sharp spurs where soils are generally very shallow and comparatively stony and dry.

From the distribution pattern of the rare small stands and lone trees of kauri, all close to the present forest fringes of the Whakamarama and Mamaku Plateaus and the Papamoa Range, it appears that these represent the uppermost altitudinal limit of a former fairly common occurrence at low altitudes, in the Tauranga Ecological District.

Northern rata has quite rapidly become an historic relic in the forests of the Otanewainuku Ecological District. Large to very large trees of epiphytic origin (mainly on rimu but occasionally on other trees) previously occurred frequently, almost throughout. Dieback was first recorded in the 1930s, and mortality increased thereafter until few northern rata survive today. As research has failed to discover any pathogens, it may be surmised that the trees succumbed to heavy possum browsing.

Before disturbance by Polynesians or Europeans along the Otamarakau-Matata coastline, spinifex and pingao would have dominated foredunes with local hinarepe (*Austrofestuca littoralis*). This would have graded back to *Ficinia nodosa / Muehlenbeckia complexa* vineland and then into forest dominated by pohutukawa and houpara. Primary podocarp/broadleaved forest would have extended down on to the dunes.

WILDLIFE HISTORY

The native wildlife of the district has been severely reduced in numbers, distribution and diversity through habitat destruction, introduction of mammalian predators and browsers, and direct exploitation by humans (*vide* Innes and Hay 1991). Many native species are now nationally extinct, including the huia, bush wren, and piopio (native thrush). Other birds have disappeared from the Otanewainuku Ecological District, but still occur at a few sites elsewhere in the country, for example kakapo, saddleback and stitchbird (Williams and Given 1981).

A number of species are now rare in the district (including North Island brown kiwi, North Island kokako, bats, and Hochstetter's frog) and these are discussed in more detail in Section 4.5.

Moa remains have not been directly recorded from within the Otanewainuku Ecological District but they are known from surrounding districts. Moa-hunter sites were excavated at Tokoroa (Law 1973) and at Whakamoenga Cave, Lake Taupo (Leahy 1976), so there is evidence available that the moa inhabited the podocarp forests of the central Volcanic Plateau, which had re-established themselves after the Taupo eruption. Moa bones have recently been found in Ohiwa Harbour (K. Tatton pers. comm.). The absence across the Volcanic Plateau of further material and sites which contain moa bone is probably a reflection of the lack of site survey and the general difficulty in finding these sites under heavy vegetation cover (R. McGovern-Wilson pers. comm.).

Very little is known of the precise wildlife history of the ecological district, however, the following extracts from Atkinson and Millener (1991) apply to mainland New Zealand in general.

"Evidence from cave deposits and rat-free islands indicates that skinks and geckos were originally very abundant in lowland and coastal forests (Whitaker 1973, Daugherty *et al*. 1990). Nocturnal and diurnal skinks were largely restricted to the ground but some geckos foraged arboreally. Tuatara (*Sphenodon* spp.) were also widespread on the mainland and may have been eaten by some bird predators. Subfossil evidence and island distribution of living species of leiopelmatid frogs suggest that these also were a potential food, particularly since they lack a free-living tadpole stage. Three species of small nocturnal bats were originally widespread in lowland forests and roosted in caves or hollow trees. Birds themselves provided prey for raptors.

"The invertebrate life of lowland forest was once characterised by an abundance and variety of large (>20 mm) flightless insects occupying habitats from the forest floor up into the canopy. These included wetas (giant wetas, tree wetas, ground wetas, and cave wetas). More than half of the known insect fauna of New Zealand are beetles, and this group was also very common in forest, particularly the flightless ground beetles and large flightless weevils. Other formerly abundant invertebrates include veined slugs of the family *Arthorocophoridae*, amphipods, litter-feeding caterpillars of moths, and large (up to 20 mm width) pill millipedes (Watt 1975). Perched leaf litters among epiphytes and in tree cavities provide

important habitat for caterpillars, ants and amphipods. The numbers and variety of all these groups of animals have been greatly reduced since the advent of mammalian predators in New Zealand, particularly rats and mice." (Atkinson and Millener 1991)

INTRODUCED ANIMALS

Introduced animals comprise a sizeable element of the fauna of the district (listed in Appendix 5). Native wildlife and vegetation evolved largely in the absence of mammalian species. Those introduced have irreversibly affected the composition of the forests, and other vegetation types, and thus reduced food and shelter available for native wildlife. Kiore have been present for at least several hundred years and Europeans accidentally introduced three more rodents – the Norway rat, ship rat and house mouse. Dogs, domestic and feral cats, ferrets, stoats, weasels and possums also kill native wildlife. The lakes, rivers and streams have not been exempt from modification by introduced invaders. Five species of introduced fish established in the Bay of Plenty have had a significant impact on the native fish they prey upon and compete with.

The deliberate releases of larger animals (goats, pigs, two species of deer, rabbits, hares, possum and wallabies) by Europeans have had detrimental impacts on the forests. Pigs were probably the first introduced, and by the early 1800s were common in open country near the coast. Numbers fluctuate considerably, even where they are rarely hunted. Feral cattle probably inhabited large areas of forests for about 140 years preceding 1955, particularly on the eastern side of the Whakamarama Plateau and the north-western section of the Mamaku Plateau.

Pockets of feral goats occur throughout the district and there is ongoing re-invasion of indigenous vegetation from farmed stock. Red deer were released in the Bay of Plenty in 1907 and 1922 (Nicholls 1965f). However, whilst moderate numbers occur in forests on the eastern side of the district, numbers are low on the western side. Fallow deer were released on the Papamoa Hills in 1880 (Nicholls 1965f). They are now locally common there, but increasingly rare to the south where they extend to the Mangorewa Stream.

Dama wallabies were released near Lake Okareka, just south of Rotorua, in 1912 (Wodzicki 1950). They have spread through the south-east side of the Otanewainuku Ecological District, including Pokopoko Scenic Reserve and the Rotoehu Conservation Area.

Possums were released at Oropi in 1893 and probably at several other locations about the same time and for several years after (Pracy 1962). By 1947, although widely dispersed, they were not common except in the Kaharoa locality on the Mamaku Plateau where they were reported to be abundant (Wodzicki 1950). However, in subsequent years possum numbers have increased markedly and during the present survey possum sign was common throughout.

LANDSCAPE

Three separate landscape evaluations have been undertaken for the coastal margin of the Bay of Plenty Region, Western Bay of Plenty District, and Whakatane District by Boffa Miskell (1993a, b, and c respectively). That part of Otanewainuku Ecological District administered by Rotorua District Council has also been evaluated in a similar study by District Council staff. These studies identified landscape units, significant segments of these units, and proposed policies for landscape protection.

3. Methodology

FIELD SURVEY

The methodology used in the survey was based on Myers *et al.* 1987. Existing ecological information was compiled from published and unpublished sources (see Bibliography). Aerial photographs were obtained. Recent (1992 and 1993) 1:25,000 colour aerial photographs (stereo pairs) were available for most of the district. Black and white (1992; 1:42,000) photos were used for the south-west corner of the ecological district.

The boundary of the ecological district was delineated on NZMS 260 topographic maps. Eight land systems were identified, and four bioclimatic zones. Boundaries of these were refined during field survey. Protected natural areas were delineated onto topographic maps. Using existing information, the land system, bioclimatic zone, hydrologic class and vegetation structural class, were combined to give a set of ecological classes which describe the broad ecological patterns of the district. The adequacy of protection of these classes was then assessed to indicate priorities for survey.

Aerial photographs and topographic maps were studied to identify areas of unprotected natural vegetation. Schedules of sites of significant conservation values on unprotected lands of the Western Bay of Plenty and Rotorua Districts were checked. The minimum size of remnants surveyed was generally about 20 ha, but in land systems where little native vegetation remained (for example Otamarakau hills) smaller areas were surveyed. The survey was not designed to be an inventory of all natural areas and only unprotected natural areas that were potential RAPs were field surveyed. Ninety-five study areas were identified and then delineated on transparencies over aerial photographs (adjacent or nearby protected natural areas were also delineated). Existing ecological information was written on survey cards.

Study areas were surveyed using a modified form of the survey card in Myers *et al*. (1987) (see Appendix 11). Vegetation types were identified and mapped on transparencies on aerial photographs. Representativeness, diversity and pattern, rarity and special features, naturalness, long-term ecological viability, size and shape, buffering and surrounding landscape were assessed. Wildlife information was from Rasch (1989), Fauna Survey Unit unpublished data (1982), Department of Conservation (1993a-f), Beadel (1994b), and observations during the present survey. Assessments were made of threats and management requirements (for example: grazing, weeds, wild animals, drainage, erosion, fire, clearance, topdressing, fencing, protection). Details of fauna were noted for each study area. Plant species lists for the ecological district were compiled from previous vegetation surveys by the author; the present survey; and other existing species lists (refer to Appendices 3 and 4).

The field survey was carried out in February and March 1994, with a

further four days in May 1994. Two field teams were used during the middle part of the field survey. Each field team generally comprised two people, with field assistance provided by staff from Department of Conservation field centres and Rotorua Conservancy office. Landowners were visited or contacted to obtain permission for access onto their properties as the survey progressed.

An aerial reconnaissance of the district was conducted during the fieldwork to obtain a wider perspective and to check some sites for particular community types difficult to identify from aerial photographs (for example: small stands of maire tawake or kahikatea).

VEGETATION TYPES

Field survey data and existing information were sorted manually into vegetation types (Appendix 2) and these were then combined with the land systems to give ecological units (Appendix 1).

EVALUATION

Recommended areas for protection (RAPs) were selected on the basis of seven criteria:

a) Representativeness—the primary criterion

b) Diversity and pattern

c) Rarity and special features

d) Naturalness

e) Long term viability

f) Size and shape

g) Buffering and surrounding landscape

Ecological units provided the framework for selecting natural areas to recommend for protection. Where an ecological unit was not adequately represented in existing protected natural areas, one or more of the best examples of this unit have been recommended for protection, generally in conjunction with adjoining ecological units in order to identify a viable area with natural boundaries, adequate size and compact shape (c.f. O'Connor *et al.* 1990; Myers *et al.* 1987; Diamond 1975; Young and Mitchell 1994).

The rapid nature of the survey meant that it was not possible to find every locality of rare and endangered species, such as *Pimelea tomentosa* or bats, and it is likely that some small but important natural areas have been overlooked. Any future discoveries should be assessed for ecological values and management requirements.

It must be emphasised that although some natural areas have not been ranked highly, it does not imply they are not of significant conservation value. Only the most significant sites have been selected. Criteria used