4.8.3 Indigenous forest on the range and plateaus

The Kaimai forests were included in the National Forest Survey (NFS) of indigenous timber resources of 1946-55. The southern half of the ranges was systematically sampled in 1946-48 and the northern half sampled less intensively in 1951-52. These data were used for the compilation of forest type maps (Dale and James 1977). The northern ranges were further sampled by the Ecological Forest Survey in 1965-66, to provide data for more detailed ecological typing. Descriptions of vegetation composition and pattern on the range and plateaus are provided by Dale and James (1977), Clarkson (2002), and Burns and Smale (2002). Other vegetation maps are provided by Nicholls (1965, 1966a&b, 1967a&b, 1971a&b, 1974a, 1975). Further descriptive accounts are provided by Nicholls (1968, 1969, 1972, 1976a&b, 1978, 1983a-c, 1984, 1985a&b, 2002). Beadel (2006) provides a comprehensive overview of vegetation in the Otanewainuku Ecological District and also provides vegetation descriptions and vegetation type maps for privately-owned natural areas within the tract, such as at Te Waraiti and the Whaiti Kuranui Block. Humphreys and Tyler (1990) provide similar information for the Te Aroha Ecological District.

A broad representation of indigenous forest pattern is provided in Figure 9. Tawa and kamahi (*Weinmannia racemosa*) with scattered emergent rimu and northern rata dominates forests on the Mamaku Plateau (Nicholls 1966, Smale *et al.* 1997). Rimu increases in abundance southwards across the plateau, as the contribution of coarse rhyolitic tephra to soils increased (Smale *et al.* 1997). Beeches (*Nothofagus* spp.) (beeches) are present locally on the plateau (Nicholls 1966).

The following extracts are from Dale and James (1977), with species names updated where necessary:

"The Kaimai Ranges contain the most diverse forests ever encountered by the Forest Research Institute during Watershed (Condition and Trend) Surveys. The northern end of the ranges forms the southernmost extension of the kauri forests of the Coromandel Peninsula. These forests give way in the central and southern ranges to the tawa-dominant forests of the Mamaku Plateau. The ranges also contain the northernmost stands of silver beech and red beech."

"At mid-low altitudes the natural forest complexity has been accentuated by the effects of fires and logging."

"The results of the numerical classification of the present survey data revealed that the forest composition varies both altitudinally and geographically. We have made four major divisions of forest as follows:

(1) tawa/rewarewa forest of the northern Kaimais;
(2) kauri/beech/mixed broadleaf forests, also of the northern Kaimais;
(3) tawa forests of central and southern Kaimais;
(4) high-altitude forests."

"Tawa/Rewarewa Forests

Tawa and rewarewa dominate most of the forest stands in the northern Kaimais below 500 m altitude. These two species are associated with other mixed broadleaved and podocarp species, but there often appears to be a strong element of chance in the occurrence of a species in a particular stand. Nonetheless, altitude, physiography, and cultural disturbances produce some predictable species groups."

"In the first type, kohekohe and pukatea are frequent co-dominants, predominantly below 300 m altitude and on lower valley sides."

"The other type is basically an upslope transition from the first. The podocarps (rimu, miro, and occasionally kauri) are more frequent, whereas kohekohe and pukatea decline in importance. Still further upslope, kamahi and tawari also become frequent."

"The understorey of tawa/rewarewa forest is dominated by kiekie, supplejack, pigeonwood, mangemange, mahoe, rewarewa, hangehange, *Cyathea dealbata*, and *Blechnum filiforme*. In tawa-rewarewa/pukatea/kohekohe forest there are also nikau, *Macropiper excelsum*, *Asplenium bulbiferum*, and pukatea seedlings. In the higher tawa-rewarewa/miro/rimu forest, *Blechnum discolor* and *Coprosma grandifolia* are common.

"Highland Kauri/Beech/Mixed Broadleaf Forest

In the central portion of the northern Kaimais there is a complex forest containing species such as kauri and towai which are approaching their southernmost limits, and red and silver beech at their northernmost limits. The forest also contains a mixture of tawa, miro, hard beech, rimu, tanekaha, rewarewa, kamahi, tawari, and *Quintinia serrata*.

In an undisturbed state, these forests have large emergent kauri trees scattered among a much lower canopy of hard beech, rewarewa, and tawari. On occasions northern rata and rimu are present as emergents. At the upper altitudinal limits of kauri, more silver beech, miro, and quintinia are present.

These forests have been greatly disturbed by kauri logging and the aftermath is a scrubby forest of quintinia, tawari, tanekaha, and hard beech. The forest understorey has much less kiekie and supplejack than lower-altitude forests have. The main understorey species are *Metrosideros fulgens*, *Blechnum capense*, *B. discolour*, *Uncinia*, pigeonwood, *Leucopogon fasciculatus*, mangemange, and tawari seedlings."

"Tawa Forests

These forests are northern extensions of the podocarp/hardwood forests of the Mamaku Plateau."

"The largest type is the forest of the upper Whakamarama Plateau, and it also extends northwards along plateau-like sites into the northern Kaimai Ranges. It occurs over a

fairly narrow altitudinal range (450-600 m) and on easy slopes. It is a forest of abundant tawa along with scattered rimu, miro, rata, hinau, and pukatea. Both kamahi and tawari are common in the lower canopy.

The other subdivision is concentrated on broken upper slopes and exposed ridges, and along the eastern broken country in the vicinity of the Aongatete catchment. Tawa is again the dominant canopy species but occasionally it is secondary to a strong tawari, miro, and kamahi canopy. Rimu, rewarewa, and hinau are also canopy species.

The understorey of podocarp/tawa forest is composed principally of kiekie, supplejack, mangemange, tawa, *Coprosma australis*, and pigeonwood seedlings. *Blechnum discolor* is also common to both types."

"High-Altitude Forests

Increase in altitude brings a decline of species complexity in the Kaimai forests, but greater site specialisation has led to more distinct communities at high altitudes. Three main types are recognised."

"The first is silver beech forest, in association with tawari, kamahi, mountain toatoa, quintinia, and *Dracophyllum latifolium*. This forest caps the highest points, e.g. Mt Te Aroha and Mt Ngatamahinerua. These sites commonly suffer gale-force winds and fog from both westerly and easterly directions. The forest canopy there is a dense understorey containing regeneration of all the canopy species, and also *Blechnum novae-zelandiae*, *Phormium cookianum*, *Senecio kirkii*, and *Leucopogon fasciculatus*.

Amongst the silver beech forest and further south towards Thompsons Track there are high-altitude stands of kamahi, tawari, quintinia, red beech, miro, Hall's totara, *Dracophyllum latifolium*, and *Griselinia littoralis*. Also, in a few places there are stands of pink pine. Immediately below the exposed ridges this mixed forest merges into the upper tawa, kamahi, tawari, hard beech, and miro forest. It is within both these high forests that most land mass movements have occurred. There have also been fires and severe animal damage.

South of Thompsons Track the high-altitude forests also consist of a variable mixture. There are stands of *Libocedrus bidwillii* and yellow silver pine, and other stands containing tawari, kamahi, silver beech, miro, *Dracophyllum latifolium*, quintinia, and *Pseudowintera axillaris*."

4.8.4 Other vegetation and habitat inventories

There is a vast amount of information available on vegetation and habitats throughout the project area. Beadel (1995) describes and ranks all indigenous vegetation within lands administered by the Department of Conservation in the project area. Brief overviews of key information sources are given below for each of the relevant ecological districts:

Tauranga Ecological District

All vegetation in the Tauranga Harbour has been mapped and described (Beadel 1992), along with saltmarsh bird habitats (Owen 1993). Dune habitats are subject to ongoing monitoring (Wildland Consultants 2004a) and all natural areas within Tauranga City have been documented and are subject to ongoing monitoring (Wildland Consultants 2009b). A natural area survey for all of Tauranga Ecological District has recently been completed by Environment Bay of Plenty (Wildland Consultants 2009). There are numerous one-off reports relating to protection lots within Western Bay of Plenty District, and Western Bay of Plenty District Council is now undertaking ongoing monitoring of protection lots (which also applies to sites in Otanewainuku Ecological District).

Otanewainuku Ecological District

Beadel (2006) provides descriptions of the climate, landforms, vegetation, and fauna, along with more detailed information on numerous Recommended Areas for Protection (RAPs) and protected areas, and lists of vascular plants and fauna.

Te Aroha and Waihi Ecological District

Humphreys and Tyler (1990) provide similar information for the Te Aroha Ecological District.

Hinuera Ecological District

The Matamata-Piako District Plan includes provisions for a 'Kaitiaki Zone' along the western flanks of the range, with controls on vegetation clearance to protect landscape and ecological values. The District Plan also includes a schedule of significant natural areas that have been field-checked and evaluated on a case-by-case basis, and information is held in a Council database.

Tokoroa Ecological District

A comprehensive assessment of natural areas has been undertaken by South Waikato District Council and Environment Waikato (Wildland Consultants 2009).

4.9 Flora

Species Records and Diversity

Lists of vascular plants for three of the ecological districts relevant to the project area are provided by Beadel *et al*. 2009 (there are no similar published records for the Waihi, Hauraki, Hinuera, Maungatautari, or Tokoroa Ecological Districts). The following numbers of indigenous species are known to be present:

Ecological District	Indigenous	Naturalised
Tauranga	393	525
Otanewainuku	550	295
Te Aroha	509	318

The Kaimai-Mamaku has a diverse range of habitats for vascular and non-vascular plants and this is reflected in the number of species recorded, with the total vascular flora for the Kaimai Range being in the vicinity of 500 taxa or more. Druce (1982; 1992 revision) compiled a reasonably comprehensive species list for the Kaimai Range, which included the following:

Taxonomic Class	Species Number
Gymnosperms	14
Monocot trees and shrubs	6
Dicot trees	62
Dicot shrubs	59
Monocot lianes	2
Dicot lianes	19
Psilopsids and lycopods	10
Ferns	104
Orchids	26
Grasses	21
Sedges	49
Rushes	8
Other monocot herbs	19
Composite herbs	18
Other dicot herbs	62

There are numerous other lists of vascular plants that have been compiled for various parts of the project area (see Figure 10). A database of species lists is held by the Department of Conservation.

The diverse flora reflects the great diversity of habitats present within the project area and includes many threatened vascular plants (as per de Lange *et al*. 2009) or regionally uncommon species, as listed below. National level threat rankings are given where appropriate.

Species	Threat Ranking
Asplenium lamprophyllum	None
Brachyglottis kirkii var. *kirkii*	At Risk-Declining
Cyclosorus interruptus	At Risk-Declining
Dactylanthus taylorii	Threatened-Nationally Vulnerable
Desmoschoenus spiralis	At Risk-Relict
Deyeuxia aff. quadriseta (AK 252511; Volcanic Plateau)	None
Dianella haematica	At Risk-Declining
Drymoanthus flavus	At Risk-Naturally Uncommon
Hymenophyllum atrovirens	At Risk-Naturally Uncommon
Ileostylus micranthus	
Juncus holoschoenus var. *holoschoenus*	Threatened-Nationally Critical
Lepidium oleraceum	Threatened-Nationally Vulnerable
Myriophyllum robustum	At Risk-Declining
Olearia cheesemanii	At Risk-Naturally Uncommon
Olearia pachyphylla	Threatened-Nationally Critical
Ophioglossum petiolatum	Threatened-Nationally Critical
Peperomia tetraphylla	At Risk-Naturally Uncommon
Peraxilla colensoi	At Risk-Declining
Peraxilla tetrapetala	At Risk-Declining

Species	Threat Ranking
Picris burbidgeae	Threatened-Nationally Endangered
Pimelea arenaria	At Risk-Declining
Pimelea tomentosa	Threatened-Nationally Vulnerable
Pisonia brunoniana	At Risk-Relict
Pittosporum kirkii	At Risk-Declining
Ptisana salicina	At Risk-Declining
Ranunculus urvilleanus	None
Rorippa divaricata	Threatened-Nationally Vulnerable
Sicyos australis	At Risk-Naturally Uncommon
Sonchus kirkii	At Risk-Relict
Sticherus flabellatus	None
Syzygium maire	None
Tetragonia tetragonioides	At Risk-Naturally Uncommon
Thelypteris confluens	At Risk-Declining
Thismia rodwayi	At Risk-Naturally Uncommon
Tupeia antarctica	At Risk-Declining
Utricularia australis	Threatened-Nationally Endangered
Utricularia dichotoma	At Risk-Relict

Source: Data supplied by Department of Conservation.

Known threatened plant occurrences are shown in Figure 10, based on records held by the Department of Conservation.

4.9.1 Weed Impacts

Weed invasion around the periphery of the Forest Park and within many of the isolated remnants within the Tauranga Basin has become a concern (Wildland Consultants 2008). Some of this weed invasion can be attributed to the dumping of garden waste containing environmental weeds within and on the edges of reserves and remnants. Dumping not only facilitates the spread of dispersal-limited weed species such as tradescantia (*Tradescantia fluminensis*), and results in the establishment of additional weed species in remnants, but may also be a major source of new weed populations. Species spread primarily by these means include tradescantia, montbretia (*Crocosmia ×crocosmiiflora*), mignonette vine (*Anredera cordifolia*), and jasmine (*Jasminum polyanthum*). Other invasions can be attributed to the aggressive, unassisted spread of weeds with bird-and-wind dispersed seeds, including cotoneaster, tree privet (*Ligustrum lucidum*), woolly nightshade (*Solanum mauritianum*) English ivy (*Hedera helix*), artillery plant (*Galeobdolon luteum*) and Japanese honeysuckle (*Lonicera japonica*). The proximity to Tauranga City means that this pool of actual and potential weed species has the potential to continue to increase. More than 500 exotic vascular plant species are already known from the Tauranga Ecological District (Beadel *et al*. 2009.)

The general pattern of weed invasion is replicated in gully remnants throughout the Tauranga Harbour catchment. At the lower end of forested gullies heavy infestations of weeds including Chinese privet (*Ligustrum sinense*), tree privet (*Ligustrum lucidum*), kiwifruit (*Actinidia deliciosa*), and Taiwan cherry (*Prunus campanulata*)

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Figure 10: Vascular Plant Records for the Kaimai – Mamaku

0 7.5 15 km

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Wildlands

Scale: 1:280,000
Date: 09/12/09
Cartographer: FM

have become numerically dominant and have replaced indigenous vegetation in some places. Further up gullies, the edges may be heavily invaded in places but they retain intact indigenous canopies (Wildland Consultants 2008). In upper catchments, the level of weed invasion around forest edges is generally low.

The Department of Conservation maintains databases of weed locations and control activity. Examples of known weed locations are shown in Figure 11 and species records within particular catchments are listed in Appendix 1 of this document.

4.10 Indigenous forest ecology

Upland Forest

Vegetation decline and slope failure in the Ranges was attributed to possum browse damage by Dale and James (1977), who argued that a high degree of site specialisation exists for browse-susceptible species. Dale and James noted that kamahi within mid-altitude tawa forests appeared to exhibit a preference for sites alongside upper watercourses and slope depressions. As kamahi are weakened and killed by persistent possum browse, the canopy loses aerodynamic conformity. Forests then become more susceptible to wind throw by the gale force easterlies and westerlies that intermittently buffet the ranges. Dale and James (1977) predicted widespread forest collapse around Ngatamahinerua as a function of this mechanism.

Mortality in the upland forests described by Dale and James (1977) has, subsequently, been analysed in more depth and described by Jane & Green (1983b). Aerial photographs and dendrochronology were used to date the onset of the most recent mortality to 1946 and an earlier episode to 1914, coinciding with severe droughts in the region (Jane and Green 1983d). At any given locality, mortality occurs above a particular altitude, similar to that noted for increased landslide intensity. Above that altitude, mortality is not confined to any particular forest type, and all vegetation shows some damage and decline. Jane and Green (1983b) concluded that introduced browsing animals were not important causes of mortality, and that the main factor was drought (Jane and Green 1983d).

Jane and Green's (1983a) investigations of the upland vegetation of the Kaimai Range revealed widespread mortality affecting a wide range of species and forest types. Although the mortality is not caused by introduced browsing mammals, they can be shown to have slowed forest recovery following drought-induced decline. Within the decline zone a considerable range of forest damage is present. Continued ill-thrift in the surviving vegetation and slow growth in the seral forests is the result of complex causes which include changes in soil water table, increased exposure of residual trees, low nutrient status of the soils, and attacks by pathogens. On steeper slopes the mortality appears to have contributed to a period of increased erosion.

This early widespread forest mortality (post-1914 and 1946) has not been repeated in more recent times. Field observations indicate that vegetation recovery is occurring at all three upland sites most affected.

Figure 11: DOC Weed Records for the Kaimai – Mamaku

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0 7.5 15 km

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Wildlands

Scale: 1:280,000
Date: 27/10/09
Cartographer: FM

Jane and Green (1986) also showed that stand dominants are well represented in induced seral vegetation, and that overall species composition of the upland forests is not likely to change following the initial decline.

Significance of Fog

A cloud cap and related fog is a common and characteristic feature of the Kaimai Range, and high fog occurrence coincides with the decline zone producing soil waterlogging and generally poor growth conditions. The following extracts from Jane and Green (1984a) relate specifically to the influence of fog on vegetation dynamics:

"Fog has wide-ranging effects on climate and consequently on plant growth. The fog types of longest duration and most ecological significance are related to prolonged periods of wetter weather resulting in high soil moisture contents or frontal systems associated with rain. As a result a very considerable reduction in fog frequencies occurs during drought periods.

Fog modifies the hydrological regimes by increasing precipitation and reducing evapotranspiration, leading to long-term soil flooding in the Kaimai Ranges. This results in a severely restricted rooting zone for trees and shrubs and in some of the species to adaptation to permanent waterlogging (Jane 1983). Fog also lowers mean temperatures, delaying the spring flush (Jane 1983) and lowering potential carbon fixation. Reduced light exacerbates the growth deficiencies and not only reduces the ability of plants to respond to stresses but also results in a number of shade tolerant shrubs assuming dominance (Jane 1983).

On the other hand, in the prolonged absence of fog, the shade-tolerant species are placed under severe stress (Green and Jane 1983a) and many other plants with restricted root systems have a limited ability to respond to water stress (Green and Jane 1983b)."

The high cloud frequencies markedly reduce light levels and consequently photosynthesis. Cooler temperatures will affect growth and frequent leaf wetting may impede stomatal gas exchange. It is also known that soil waterlogging, by restricting root systems to the upper soil horizons, places the plants at a higher risk during drought (Jane and Green 1983c; 1984a.)

Tawa-Dominant Forest

Smale *et al*. (1997) analysed stand dynamics in podocarp (rimu, matai)/kamahi-tawa forest in the Mokaihaha area, adjacent to the southern boundary of the project area. They found that the mean age of sampled stems differed significantly between gap (13 yr), building-phase (68 yr), and mature forest (252 yr), which comprised 10%, 50%, and 40% respectively of the area and persisted on average for 20 year (gaps) and 60 year (building phase). Tree ferns - mostly *Dicksonia squarrosa* and *Cyathea smithii* - were numerically dominant throughout, and dominated basal area in younger (<80 yr) forest. *D. cupressinum* dominated basal area in older (>80 yr) forest. Emergent *D. cupressinum* and *P. taxifolia* sampled were aged between *c.*400 and *c.*1,000 years; established seedlings of both species were rare. Shade-tolerant *P. ferruginea*, *B. tawa*, and *I. brexioides* regenerate continuously in the understorey of

high forest, although *P. ferruginea* requires some canopy opening to develop beyond sapling size. Less tolerant *G. littoralis, D. squarrosa, C. smithii*, and to some extent *W. racemosa* are gap invaders. *D. squarrosa, C. smithii,* and *W. racemosa* also continue to establish during the building phase. *Elaeocarpus dentatus* maintains a pool of 'advance growth' which develops rapidly if light levels increase, as in gaps.

Deer and Goats

Deer and goats (and cattle), can cause considerable modification of forest understories and be significant impediments to vegetation recovery on disturbed sites, altering species assemblages and successional trajectories. Over the last 100 years or so these animals have removed palatable species from accessible sites throughout much of the forest. A notable exception is the Opuiaki area, in northern Mamaku, where they have never attained high numbers and palatable species are still common in the understorey. The impacts of deer and goats across the Kaimai-Mamaku relate to their distributions and relative densities. See Section 4.2 for further discussion.

Possums

Historical impacts of possum browsing within Kaimai-Mamaku Forest Park appear to have varied with altitude. Rata dieback was initially confined to forests above 700 m. In 1950, National Forest Survey parties recorded that, although rata was a common emergent tree in forests above 700 m, most were standing dead. In contrast, rata at 600 m were recorded as being dominant and healthy in 1950 (Dale and James 1977). Northern rata mortality has occurred below 700 m since the 1950s and northern rata is now absent or rare throughout much of the southern Kaimai-Mamaku but the northern Kaimai forest contains scattered localised populations of northern rata, reaching relatively moderate densities in some catchments (e.g. Pohomihi basin, Wairoa Stream). These differences may have been related to the availability of other species which are targeted preferentially by possums over rata (c.f. Brockie 1992).

Foliar Browse Index (FBI) data for the northern Kaimai (Willems 2000) indicates that kohekohe is in good condition with little browse damage. Forty kohekohe tagged for FBI monitoring remeasured in 2009 indicate average canopy cover score of 55%. Approximately 40 tagged FBI kohekohe trees are to be remeasured in 2010 (B. Angus, Department of Conservation, pers. comm.). Casual observations localised poor health of kohekohe at Aongatete, for example, but healthy stands elsewhere.

4.11 Indigenous fauna

4.11.1 Avifauna - historic

Historical observations record the widespread occurrence of large forest birds including kākā (*Nestor meridionalis*), yellow-crowned kākāriki (*Cyanoramphus auriceps*), red-crowned kākāriki (*Cyanoramphus novaezelandiae*), kokako (*Callaeas cinerea*), brown kiwi (*Apteryx mantelli*), North Island weka (*Gallirallus australis* ssp. *greyi*), and blue duck (*Hymenolaimus malacorhynchos*). Sub-fossil evidence from elsewhere in the North Island and contemporary populations on offshore islands indicates that other extant species formerly present within the project area included hihi (*Notiomystis cincta*), kakapo (*Strigops habroptilus*), tieke (saddleback;

Philesturnus carunculatus), taiko (black petrel; *Procellaria parkinsoni*) and snipe (*Coenocorypha barrierensis*). There would have been substantial petrel colonies along the main range.

Species extinctions from the project area include the following:

- Hihi (stitchbird)
- Huia (*Hetera acutirostris*)
- Kakapo
- Piopio (New Zealand thrush; *Turnagra capensis*)
- Red-crowned kākāriki
- Snipe
- Taiko (petrel)
- Tieke (saddleback)
- Weka
- Yellow-crowned kākāriki

Historical records indicate that kokako (now confined to the Opuiaki Ecological Area) were widespread throughout the project area. A concentration of historical kokako records spanning the period 1939 through to 1970 exist for the Mamaku Plateau, in the vicinity of Mamaku township (Lavers 1978). Kokako were also reported from the Puwhenua, Waipare, and Kuhatahi catchments. There is a 1966 record of kokako from the Ngamuwahine Stream at Whakamarama (Lavers 1978). Eight birds were recorded in the Mangokataha Stream (Royal Forest and Bird Protection Society 1983). Historical kokako records from around Otawa trig and Waitao Stream in the early and mid-1980s (Beadel 1985), and for Oropi and Papamoa Hills in 1983 (Forest and Bird 1983). There are historical records of kokako within the Otanewainuku Conservation Area and many of these birds were translocated to Hauturu (Little Barrier Island). Kokako were also reported as being present in the Otanewainuku forest (Wallace 1988).

Kokako were recorded in the northern half of the Aongatete Scenic Reserve, between the Tuhua Track and Thompsons Track, and along the eastern fall of Te Hunga ridge (Ngatamahinerua) north of the Aongatete River, during Wildlife Service surveys in 1974 and 1977 (Wallace 1988).

In the north, kokako were recorded from the headwaters of the Tahawai Stream, and from between the Waitawheta River and the Wairoa Stream by the Wildlife Service in 1981 (Wallace 1988).

The stretch of forest between SH29 and SH5 apparently contained the largest continuous population of kokako in the Coromandel-Kaimai-Mamaku (Wallace 1988). Intensive survey work by the Wildlife Service in 1975 counted 151 birds, and Wallace (1988) suggested that the persisting presence of kokako throughout the northern Mamaku Plateau suggested that this population was stable or at least not declining as drastically as other areas. Kokako were reported as "still present" around Puwhenua by Wallace (1988). Kokako were found in the Waipare and Kuhatahi Stream catchments by the Wildlife Service Kokako Location Team in 1982 (Wallace 1988). The Waipari [sic] Ecological Area was proposed to preserve kokako habitat

(Nicholls 1984). The same Wildlife Service survey recorded kokako in both the Oraka and Takapuhurihuri Streams (Wallace 1988).

Kākā were recorded around the Waitao Stream in the early 1980s, and are still itinerant visitors throughout the project area.

Whio were recorded historically within the Mangatoi Stream, adjacent to the Otanewainuku Forest (Saunders 1983).

The Wildlife Service fauna survey undertaken in 1974/75 recorded kākā, yellow crowned kākāriki, karearea, kiwi, kokako, and whio in the southern Kaimai (Wildland Consultants 1999). As for kokako, these species have declined since that time. No breeding populations of kākāriki or blue duck are currently known within the project area.

Weka (*Gallirallus australis*) were naturally last present in the Karangahake Gorge around 1910. Reintroduction attempts in the 1990s failed due to losses to predation by ferrets and dogs. The attempt was eventually abandoned and the remaining twenty-nine birds were released onto Pakatoa Island.

4.11.2 Avifauna - current

Bird records are available for all of the area, from Wildlife Service surveys in the 1980s, from more recent surveys in selected areas (e.g. Opuiaki, Mokaihaha, Otanewainuku, Aongatete), from the Department of Conservation Bioweb Database, from OSNZ atlases compiled in the 1980s and 1999-2004 (see Figures 12a-c), and from a recent Royal Forest and Bird Society survey using five-minute bird counts.

It is evident that there are remnant populations of threatened species on the Mamaku Plateau:

- Falcon appear to be present throughout.
- Kākā are itinerant visitors throughout.
- Kiwi are now in very low numbers, with active management at Otanewainuku, and other small populations are present (it is possible that there is a small remnant population in northern Kaimai).
- Rifleman (*Acanthisitta chloris*) have been recorded above Katikati.

Kereru are widespread, but evidence from other areas suggest breeding success throughout the project area is low (Clout *et al*. 1995), with the obvious exception of sites where intensive possum and predator control is being undertaken. Ornithological Society of New Zealand (OSNZ) Bird Atlas records for common and less common forest birds recorded in the project area are shown in Figures 12a-c.

At Opuiaki, toutouwai (North Island robin; *Petroica australis longipes*) occur in high densities throughout, popokatea (whitehead; *Mohoua albicilla*) (Kaimai is northern limit) and karearea (falcon; *Falco novaeseelandiae*) are present and breeding within the area, and kākā (*Nestor meridionalis*) are present (Hudson 2005).

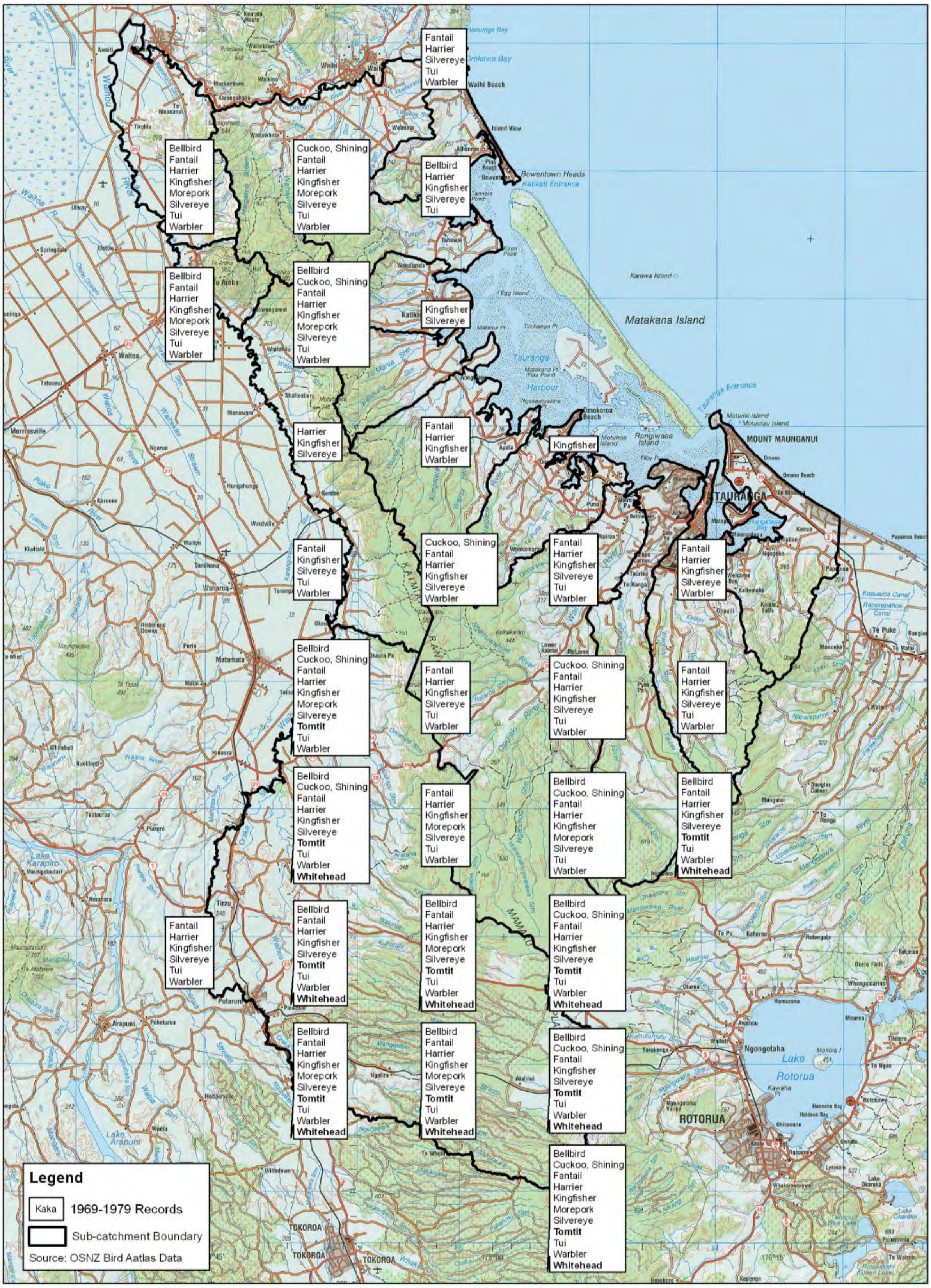

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Figure 12a: OSNZ Atlas Records 1969-1979 for Common Forest Bird Species in Kaimai - Mamaku

0 7.5 15 km

Wildlands

Scale: 1:270,000
Date: 09/12/09
Cartographer: FM

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Figure 12b: OSNZ Atlas Records 1999- 2004 for Common Forest Bird Species in Kaimai - Mamaku

0 7.5 15 km

Wildlands

Scale: 1:270,000
Date: 09/12/09
Cartographer: FM

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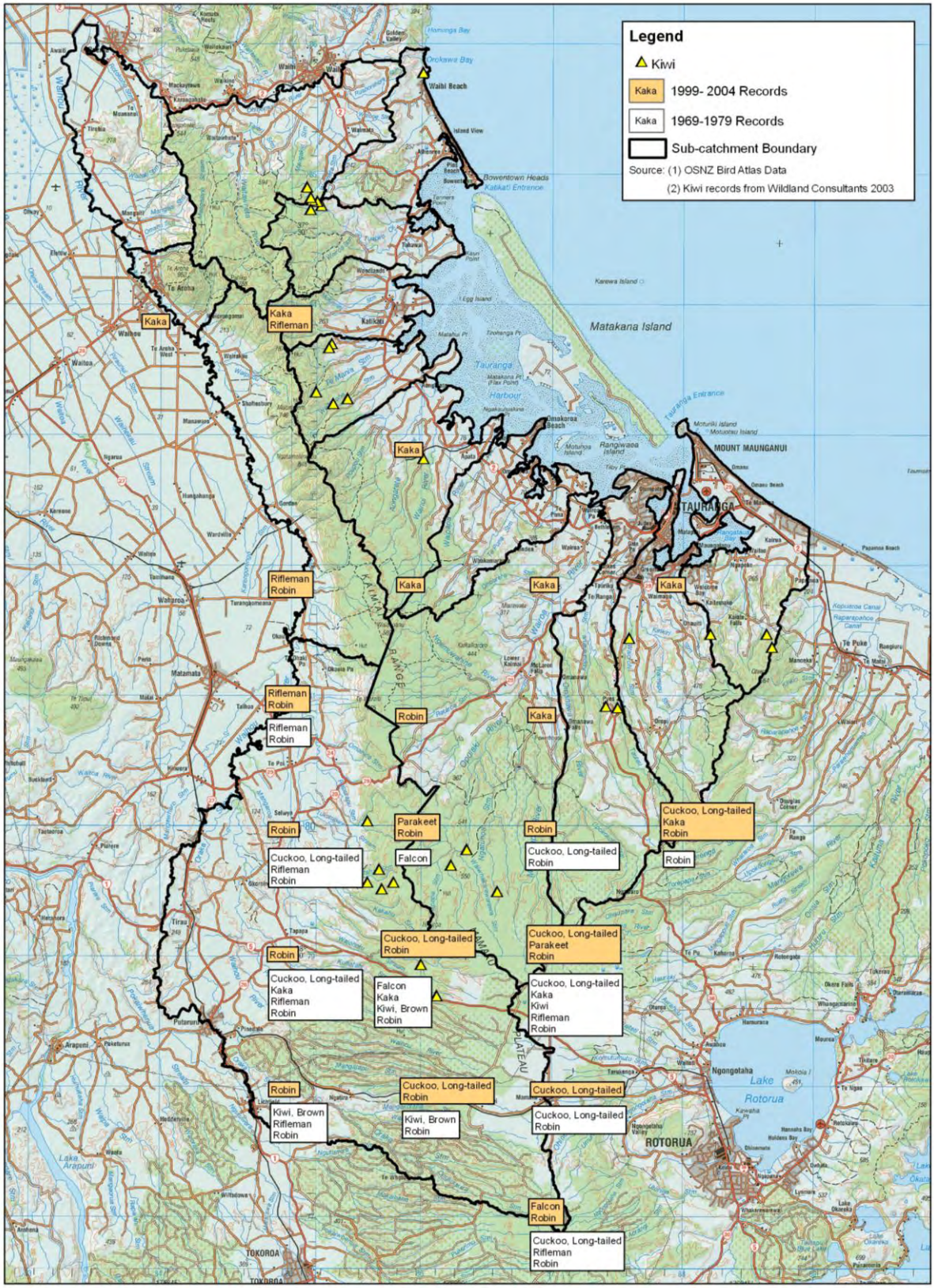

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Figure 12c: Kiwi Records and OSNZ Atlas Records of Less Common Forest Bird Species in Kaimai - Mamaku

0 7.5 15 km

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Wildlands

Scale: 1:270,000
Date: 09/12/09
Cartographer: FM

An overview of the current status of indigenous bird species in the project area is shown in Table 12 and distributions across the various sub-catchments are summarised in Table 13.

Table 12: Current status of indigenous avifauna utilising forest habitats within the Kaimai-Mamaku project area.

Common Name	Scientific Name	Current Status Within Project Area
Kahu (harrier)	*Circus approximans*	Common throughout.
Kākā	*Nestor meridionalis*	Breeding in Opuiaki and possibly Kaimai. Itinerant throughout.
Kākāriki (parakeet)	*Cyanoramphus auriceps auriceps*	Present on Mamaku Plateau.
Karearea (falcon)	*Falco novaeseelandiae*	Utilises entire range. Breeding, at least at Opuiaki.
Kawau (black shag)	*Phalacrocorax carbo*	Local use of streams.
Kereru	*Hemiphaga novaeseelandiae*	Widespread.
Kiwi (North Island brown)	*Apteryx australis*	Probably less than 20 birds, confined to Opuiaki and Otanewainuku.
Koekoea (long-tailed cuckoo)	*Eudynamys taitensis*	Present on Mamaku Plateau.
Kokako	*Callaeas cinerea*	Largely confined to Opuiaki Ecological Area. Remnants of former populations remain as scattered individuals, i.e. one bird known from Otanewainuku.
Korimako (bellbird)	*Anthornis melanura*	Widespread, common.
Kotare (kingfisher)	*Todiramphus sanctus*	Widespread, common.
Miromiro (tomtit)	*Petroica macrocephala*	Widespread, common.
Parera (grey duck)	*Anas superciliosa superciliosa*	Local use of streams.
Pipiwharauroa (shining cuckoo)	*Chrysococcyx lucidus lucidus*	Widespread, common.
Piwakawaka (fantail)	*Rhipidura fuliginosa*	Widespread, common.
Popokatea (whitehead)	*Mohoua albicilla*	Widespread, but patchy records. More common on Mamaku Plateau.
Putangitangi (paradise shelduck)	*Tadorna variegata*	Local on forest margins.
Riroriro (grey warbler)	*Gerygone igata*	Widespread, common.
Ruru (morepork)	*Ninox novaeseelandiae*	Widespread, common.
Tauhou (silvereye)	*Zosterops lateralis*	Widespread, common.
Titipounamu (rifleman)	*Acanthisitta chloris*	Local records only.
Toutouwai (robin)	*Petroica australis*	Widespread in south of project area. Rare in northern Kaimai Range. Densities higher in areas where introduced predators are managed.
Tui	*Prosthemadera novaeseelandiae*	Widespread, common.
Welcome swallow	*Hirundo tahitica neoxena*	Common on forest margins and in open country.
Whio (blue duck)	*Hymenolaimus malacorhynchos*	Visitors only, no longer breed in area.

Table 13: Avifauna species distributions in the Kaimai-Mamaku sub-catchments.

Sub-Catchment	Kahu	Kākā	Kākāriki	Karearea	Kawau	Kereru	Kiwi	Koekoea	Kokako	Korimako	Kotare	Miromiro	Pipiwharauroa	Piwakawaka	Popokatea	Putangitangi	Riroriro	Ruru	Tauhou	Titipounamu	Tui	Welcome swallow	Whio
Waihou Kaimai Sub-Catchments																							
Waihi	✓	✓			✓	✓	✓			✓	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	
Paeroa	✓				✓	✓				✓	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	
Te Aroha	✓	✓			✓	✓				✓	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	
Middle Waihou	✓				✓	✓				✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	
Upper Waihou	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Tauranga Harbour Sub-Catchments																							
Waiau	✓				✓	✓	✓			✓	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	
Tuapiro	✓	✓			✓	✓	✓			✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	
Uretara	✓	✓			✓	✓				✓	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	
Rereatukahia	✓				✓	✓	✓			✓	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	
Aongatete	✓	✓			✓	✓	✓			✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	
Te Puna	✓	✓			✓	✓				✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	
Wairoa	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Omanawa	✓	✓			✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	
Waimapu	✓	✓			✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	
Otawa	✓	✓			✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	

Sources: OSNZ Atlas records; qualitative assessments of habitat type; point records from various reports (refer to Figures 12a-c in this report).

4.11.3 Fish

Waihou Catchments

The Waihou River provides habitat for 14 indigenous and nine exotic freshwater fish species that generally occur at relatively low abundance (Porter *et al.* 2008), with the lack of riparian vegetation and high silt loads in the lower river reaches thought to contribute to the low fish abundance (Speirs 2001). There is a whitebait fishery in the lower Ohinemuri and the Waihou north of the Ohinemuri confluence. Whitebait have been recorded from Tirohia and as far upstream as Te Aroha (Porter *et al.* 2008). The trout fishery is regionally significant and is most important in the upper and mid-reaches of the main river, with suitable spawning habitat in the smaller gravel-dominated tributaries emanating from the Kaimai Range and upper reaches in the vicinity of Putaruru and Tokoroa (Porter *et al.* 2008).

Records from the NIWA freshwater fish database and Porter *et al.* (2008) show 15 indigenous, 10 exotic, and four marine wandering fish in the Waihou River (see Table 14 and Figure 13). Dwarf galaxias (Threatened-Gradual Decline) is present in the upper catchment.

Table 14: Fish records for the middle and upper Waihou catchment.

Scientific Name	Common Name
Indigenous	
Anguilla australis	Shortfin eel
Anguilla dieffenbachii	Longfin eel
Cheimarrichthys fosteri	Torrentfish
Galaxias divergens	dwarf galaxias
Galaxias maculatus	Inanga
Gobiomorphus basalis	Cran's bully
Gobiomorphus breviceps	Upland bully
Gobiomorphus huttonii	Redfin bully
Paranephrops species	koura
Retropinna retropinna	Porohe/smelt
Exotic	
Carassius auratus	Goldfish
Ctenopharyngodon idella	Grass carp
Gambusia affinis	Gambusia
Onchorhynchus mykiss	Rainbow trout
Salmo species	
Salmo trutta	Brown trout

Source: NIWA freshwater fish database.

Dwarf galaxias (*Galaxias divergens,* classified as Chronically Threatened-Gradual Decline) is a non-migratory galaxid, and is known to be present in the upper Waihou catchment. This section is largely summarised from the dwarf galaxias monitoring plan compiled by Kelly (2008b). While generally widespread throughout New Zealand, it has an intermittent distribution in the North Island, including an isolated population in the upper Waihou River, which was discovered in 1990. Monitoring objectives for this population include investigation of population characteristics, such as distribution (e.g. is it present in Other nearby Waihou tributaries) abundance, life history, and breeding. Potential threats to the population will also be investigated.

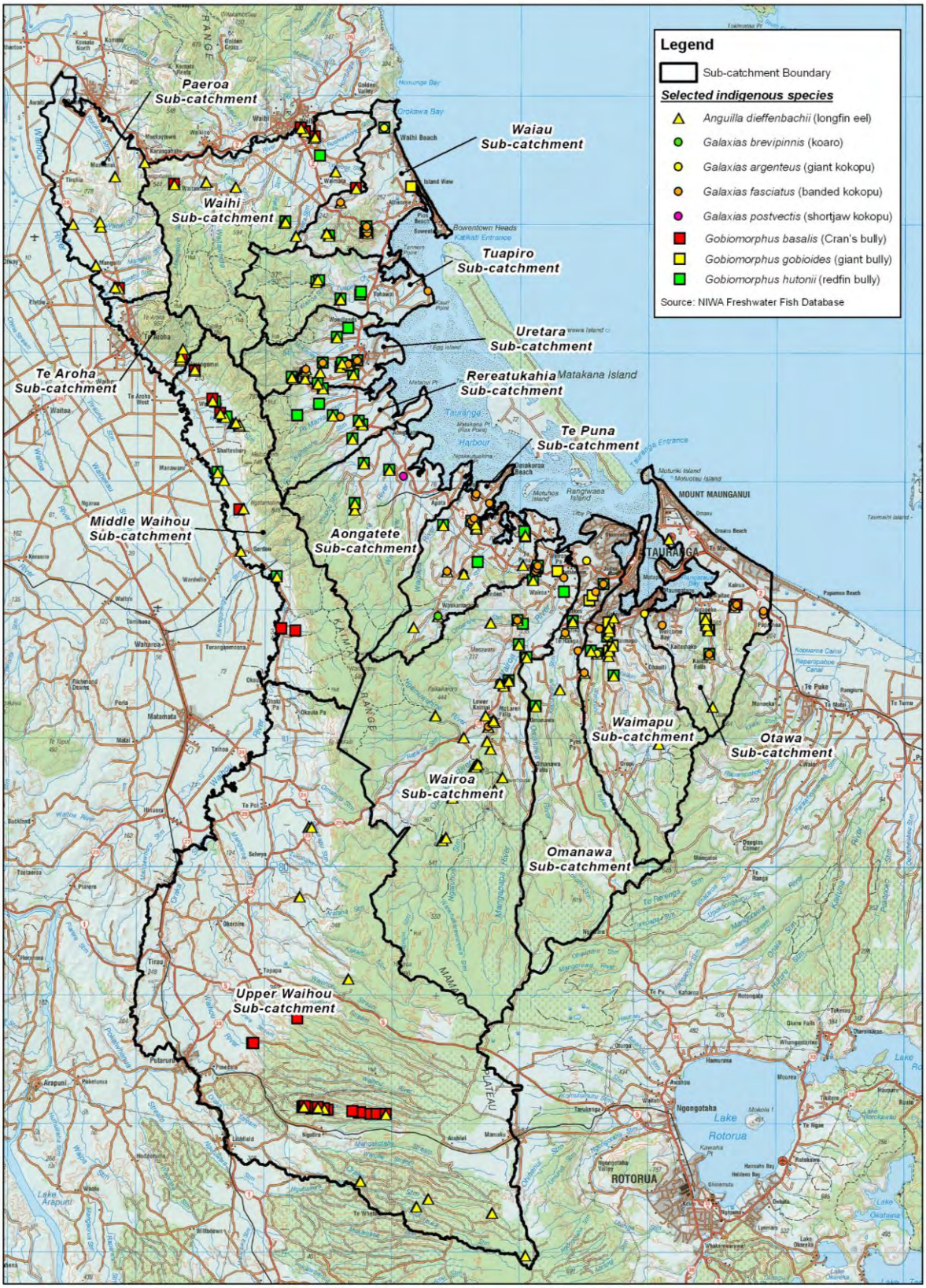

Figure 13: Distribution records for selected indigenous fish species within Kaimai - Mamaku

Tauranga Catchments

A diverse assemblage of indigenous freshwater fish species is present within the Tauranga Ecological District (Table 15 and Figure 13). There are recent (post-1998) records of indigenous fish from highly modified streams, including banded kōkopu (*Galaxias fasciatus*) from the lower reaches of an unnamed tributary of the Waipawa estuary (Shaw and Kusabs 2000), longfin eel (*Anguilla dieffenbachii*, Chronically Threatened-Gradual Decline) from an unnamed stream south of Omokoroa (Shaw and Kusabs 2000), and banded kōkopu and giant kōkopu (*Galaxias argenteus*, Chronically Threatened-Gradual Decline) from an unnamed stream adjacent to Tetley Road, Katikati (Wildland Consultants 2005f). These records suggest that the presence of indigenous fish, including threatened species, can be expected in virtually any river or stream that empties into the sea or harbour and lacks artificial or natural barriers.

Seventeen indigenous and four introduced fish species have been recorded, although their distributions are poorly known. Threatened species present include shortjaw kōkopu (*Galaxias postvectis*, At Risk-Sparse), giant kōkopu, and longfin eel. Common smelt (*Retropinna retropinna*), banded kōkopu, shortfin eel (*Anguilla australis*), red-finned bully (*Gobiomorphus huttoni*), common bully (*Gobiomorphus cotidianus*), torrentfish (*Cheimarrichthys fosteri*), and inanga (*Galaxias maculatus*) are also present. Yellow-eyed mullet (*Agonostomus forsterii*), kahawai (*Arripis trutta*), and black flounder (*Rhombosolea retiaria*) are present in the lower reaches of major waterways (NIWA 2008). Rainbow trout (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*) have been introduced to many streams and rivers in the area.

Table 15: Fish records for the Tauranga Harbour catchments.

Scientific Name	Common Name
Indigenous	
Aldrichetta forsteri[1]	Yellow-eyed mullet
Anguilla australis	Shortfin eel
Anguilla dieffenbachii	Longfin eel
Arripis trutta[1]	Kahawai
Cheimarrichthys fosteri	Torrentfish
Galaxias argenteus	Giant kōkopu
Galaxias brevipinnis	Koaro
Galaxias fasciatus	Banded kōkopu
Galaxias maculates	Inanga
Galaxias postvectis	Short-jawed kōkopu
Geotria australis	Lamprey
Gobiomorphus cotidienus	Common bully
Gobiomorphus gobioides	Giant bully
Gobiomorphus huttoni	Red-finned bully
Oncorhynchus mykiss	Rainbow trout
Retropinna retropinna	Common smelt
Rhombosolea retiaria[1]	Black flounder

[1] Marine wanderer.

Scientific Name	Common Name
Exotic	
Carassius auratus	Goldfish
Cyprinus carpio[1]	Koi carp (Kauri Pt Found at three irrigation ponds at Kauri Point and one Wharawhara ornamental pond)
Gambusia affinis	Mosquito fish
Oncorhynchus mykiss	Rainbow trout
Salmo trutta	Brown trout

Sources: Rasch (1989); Cromarty (1996); Department of Conservation (1997); Wildland Consultants Ltd (2000e); Wildland Consultants Ltd (2001b; Boubée and Baker (2005); NIWA Freshwater Fish Database.

The pest species koi carp (*Cyprinus carpio*) is present in some Tauranga catchments, and known locations are shown in Figure 14. Koi is the least desirable fish in the New Zealand freshwater fish fauna (McDowall 1990), creating aquatic turbidity and degrading the composition and quality of aquatic habitats.

4.11.4 Terrestrial invertebrates

Indigenous

A large number and diverse range of terrestrial invertebrates will be present, although many records will only be in taxonomic collections. The overall amount of survey work and collection is likely to be very limited, although there are species lists for snails for some reserves (e.g. Mayhill 1994). Various introduced invertebrate species are present, with more than 2,000 already present in New Zealand (www.landcare research.co.nz/research/biocons/invertebrates/ id_surveillance.asp). The most obvious pest species are *Vespula* wasps, which are widespread throughout the project area.

There are a number of post-1980 observations of stag beetle (*Geodorcus articulatus*) at and adjacent to the summit of Mt Te Aroha, including the walking track from the summit to Te Aroha Domain in the Tutumangae Stream catchment at 620 m, the upper Mangakino Stream near Lewis and Bartley Creeks at 640 m, the Waiorongomai Stream headwaters and Tui Stream headwaters, and at Dog Kennel Flat.

Tangarona pensus, an endemic monotypic genus of highly specialised Carabidae belonging to the Rhysodini (wrinkled bark beetles) (Bell and Bell 1982) has possibly been collected from Te Aroha. Two other Carabid beetles, *Mecodema atrox* and *M. pluto,* have been collected from the Kaimai Range. The Te Aroha trig is the type locality for *Mecodema pluto,* which is currently known from Little Barrier Island, Coromandel and Kaimai Range (McGuiness 2001). There is a single record of *Mecodema atrox* from Tauranga County (Watt 1979).

[1] Control programme is in place (R. Lander, DOC, pers. comm.).

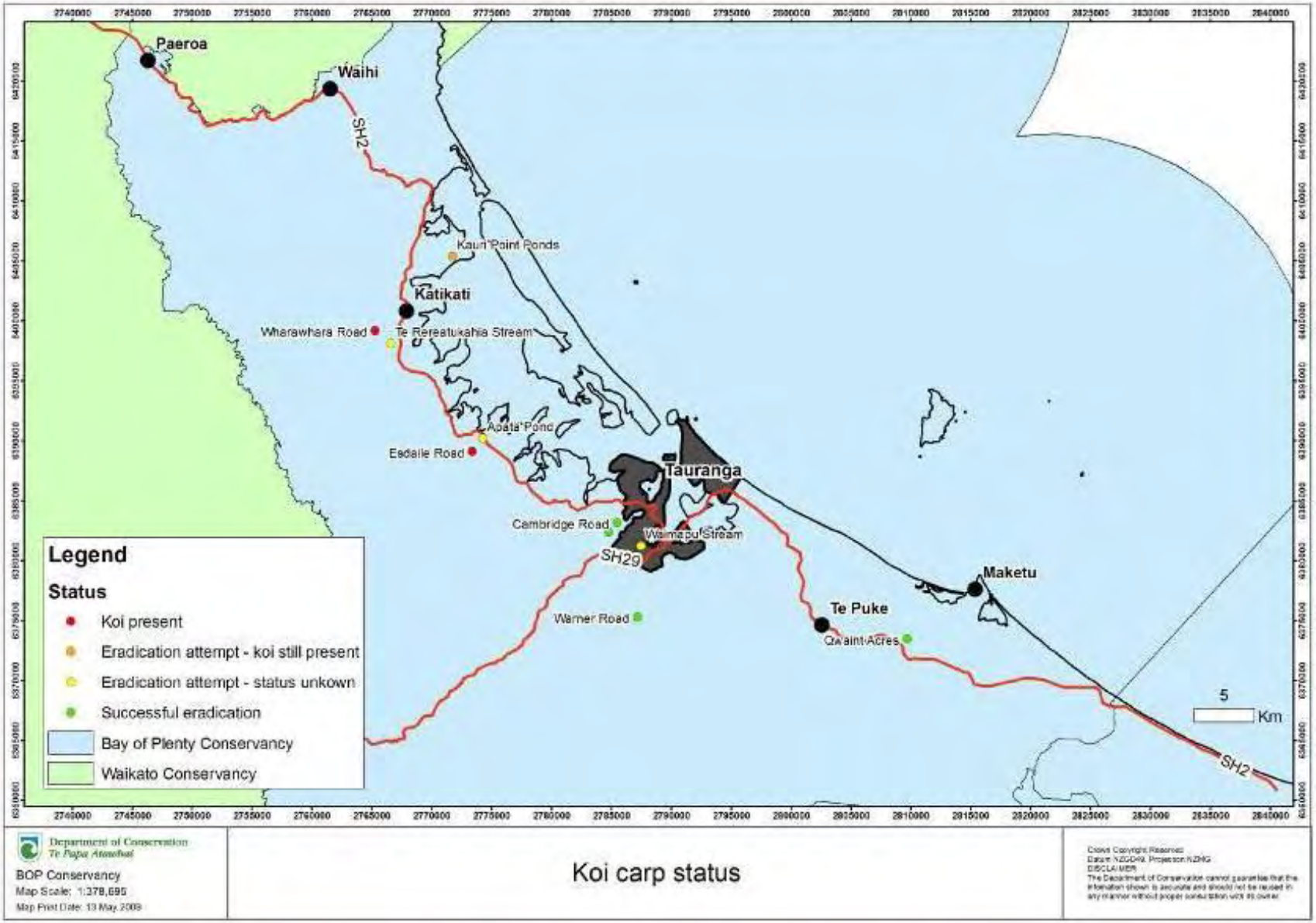

Figure 14 - Koi carp sites in Tauranga catchment.

Invertebrate monitoring is undertaken within the Aongatete pest control project area and the invertebrate fauna of this forest is characteristic of forests undergoing senescence and collapse (Peter Maddison pers. comm.). Invertebrate monitoring is also being undertaken in the Puketoki Reserve, at Whakamarama, where intensive ground-based pest control is also being undertaken.

Exotic

Common wasps established in New Zealand in the late 1970s. Anecdotal evidence suggests wasps predate a wide range of invertebrates (for instance araneid spiders and stick insects), and deplete honeydew resources. However, the impacts of *Vespula* foraging and predation are unknown.

Argentine ants (*Linepithema humile*) were first found in Auckland in 1990, at Mt Smart after the Commonwealth Games, and have spread widely. They were found in the Bay of Plenty in 1998 at the Port of Tauranga, in industrial areas in Mount Maunganui and in several adjacent residential areas. Argentine ants were classified as eradication pest animals in the Bay of Plenty Regional Pest Management Strategy (2003-2008). However, Environment Bay of Plenty has ceased attempts to eradicate ants after failing to dispatch local populations. Argentine ants occupy about 14 ha of suburban lands within Tauranga City, and are very close to significant natural areas such as Mauao, where there is a breeding colony of grey-faced petrel. Argentine ants could have potentially serious effects on survivorship of grey-faced petrel chicks, were they to attain the upper slopes of Mauao (Peter Maddison pers. comm.).

4.11.5 Aquatic invertebrates

General information has been collected on species numbers and faunal composition within tributaries of the Waihou River by Porter *et al*. (2008) In general terms, the streams are of moderate to high quality habitat for aquatic macroinvertebrates in their upper reaches, but of moderate to poor habitat quality in their lower reaches (Porter *et al.* 2008). The upper reaches generally flow through indigenous and/or exotic plantation forest, and have good cover and shading of boulder/cobble streambeds. Invertebrate faunas of high quality waterways are dominated by mayflies (Ephemeroptera), caddisflies (Trichoptera), and stoneflies (Plecoptera), which together may account for between 10-15 species and 45-60% of the individuals in a stream. Mayfly genera present include *Austroclima*, *Coloburiscus* and *Deleatidum*. High quality streams are also inhabited by riffle beetles (Elmidae). The streams then flow down through pasture in the lower floodplains, which provides little cover or shade to predominantly soft sediment streambeds, before discharging into the Waihou River and the Firth of Thames (Porter *et al.* 2008). Poor quality waterways are inhabited by few species of mayfly, caddisfly, and stonefly, with 3-4 species recorded by Porter *et al.* (2008), at low abundance. The invertebrate faunas of low quality streams are dominated by orthoclad flies (Chironomidae subf. Orthocladiinae), and sandflies (*Austrosimulum*). Other invertebrates present include amphipods of the genus *Paracalliope*, and the New Zealand mudsnail, *Potamopyrgus*.

4.11.6 Herpetofauna

Overview

Mainland herpetofauna populations have been severely depleted by introduced predators (Whitaker 2000). Some species now occur in mainland forests at densities so low that they are virtually undetectable, for example forest gecko (*Hoplodactylus granulatus*), Pacific gecko (*Hoplodactylus pacificus*), green gecko (*Naultinus elegans elegans*) (Whitaker *et al*. 1999). Whitaker (2000) considered these three gecko species, and four skink species - copper skink (*Cyclodina aenea*), ornate skink (*Cyclodina ornata*), speckled skink (*Oligosoma infrapunctatum*), striped skink (*Hoplodactylus stephensi*) - were possibly present in the Opuiaki Ecological Area. This species assemblage is probably typical of forests throughout the Range. The current low numbers are illustrated by only 13 forest geckos being found within the Opuiaki Ecological Area despite 51.25 person hours of night searching (Whitaker 2000). Herpetofauna records from within the project area are shown in Figure 15.

Geckos

Green gecko were observed just to the west of Waihi in 1965. Pacific gecko were recorded from Paeroa in 1984 and the Karangahake Gorge in 2009. Recent mainland records of forest gecko have been from above 400 m. Green gecko were observed by Tony Whitaker at Katikati in 1964 and at Waihi in 1965. Two green geckos were recorded near Rereioturu Falls in the early 1980s, but were not observed during the 2000 survey of Opuiaki (Whitaker 2000). Duvaucel's gecko (*Hoplodactylus duvacelli*) was recorded at Paeroa in 1941.

Skinks

Many species of skink have undergone massive range contractions and declines since the arrival of people in New Zealand (Towns 1999). Striped skink (*Oligosoma striatum*) were recorded from Ngawaro in 1979, and there have also been several recent records (2002 and 2005) from near the Mount Te Aroha summit road. Moko skink (*Oligosoma moco*) was previously widespread but recent records are only near the coast, and moko skink approaches its southern limit here. Copper skink is widespread through the Tauranga Basin. Moko skink are known to extend long distances inland; on Great Barrier Island they occur on main ridges at 400-600 meters above sea level and several kilometres from the coast (Whitaker 2000). Shore skink is also widespread, but is restricted to coastal margins and does not extend inland. Refer to Table 16.

Rainbow skinks (*Lampropholis delicata*) are well established within urban areas in the Tauranga area. Rainbow skinks occupy a range of habitat types, including urban and suburban gardens, farmland, scrub, and forest (Peace 2004). Although rainbow skinks co-inhabit with copper skinks, neither display avoidance behaviour nor exhibit any reduction in fitness as compared to individuals occupying sites alone, possibly as a function of microhabitat segregation in foraging behaviour (Peace 2004). It is not yet clear whether they pose a serious competition risk to indigenous skink species.

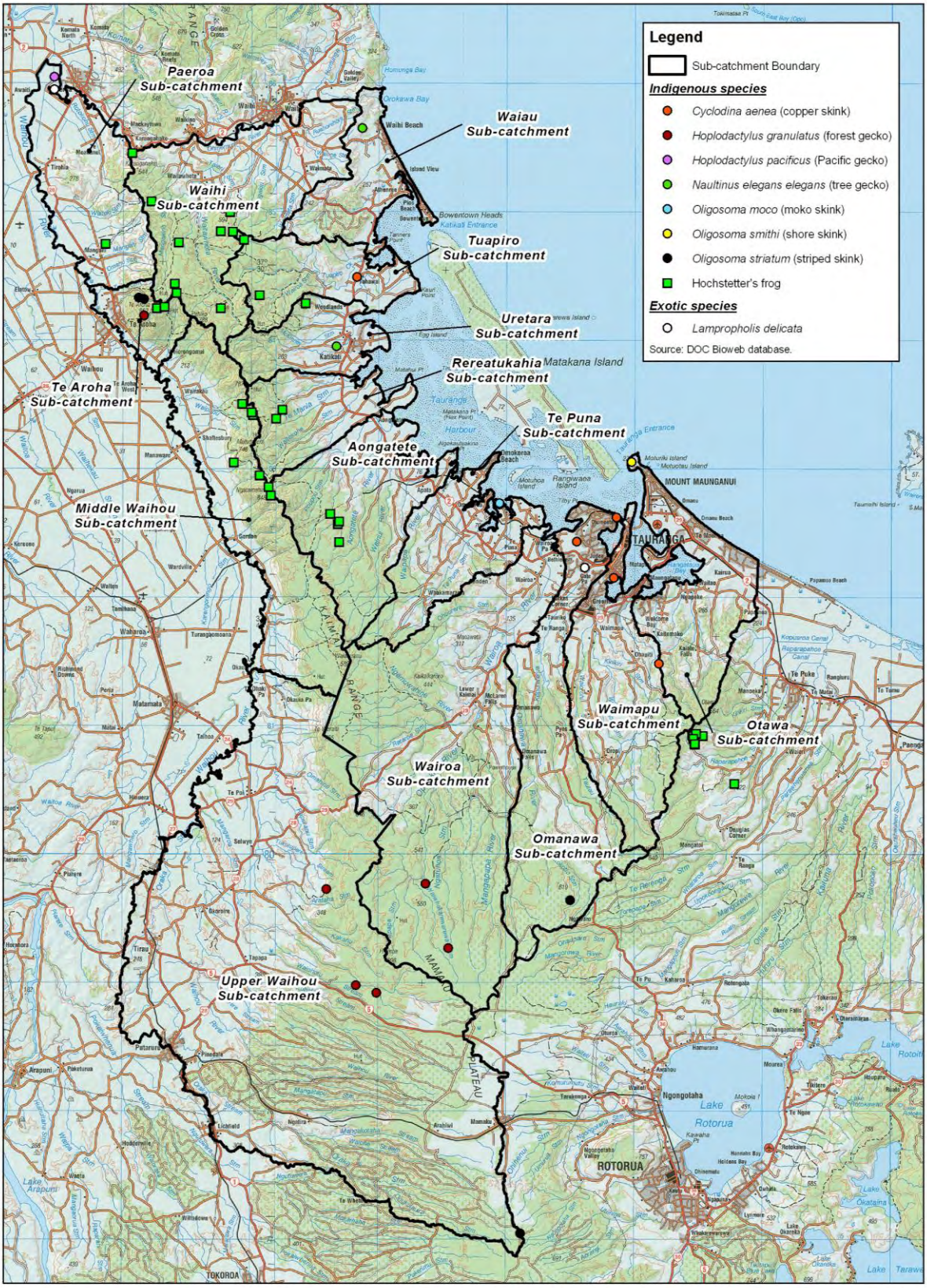

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Figure 15: Hochstetter's Frog and Lizard Records within Kaimai - Mamaku

0 7.5 15 km

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Wildlands

Scale: 1:273,842
Date: 09/12/09
Cartographer: FM

Frogs

New Zealand has four species of endemic frogs (*Leiopelma* spp.), all of which are regarded as threatened.

Hochstetter's frog (*Leiopelma hochstetteri*) is widespread in forested streams throughout the northern two thirds of the Kaimai Range, as far south as Wairere Falls on the west and the Aongatete River on the east (Smuts-Kennedy 2003). Refer to Table 16 and Figure 15. They are apparently absent from the ignimbrite country of the Mamaku Plateau, but also occur on rhyolite in the Otawa forest in the south-eastern section of the project area. Studies suggest that the Otawa Forest population may be different from those of the Kaimai Range.

Table 16: Herpetofauna records for the Kaimai-Mamaku project area (Source: DOC Bioweb Database 2009).

Scientific Name	Common Name	Historical	Present Status (Project Area)
Hoplodactylus granulatus	Forest gecko	Widespread in North Island.	Sparse
Hoplodactylus pacificus	Pacific gecko	Widespread in North Island.	Sparse
Hoplodactylus duvacelli	Duvaucel's gecko	Widespread in North Island.	**Presumed Extinct**
Hoplodactylus maculates	Common gecko	Widespread in North Island.	Sparse
Naultinus elegans elegans	Auckland green gecko	Widespread in North Island.	
Oligosoma homalonotum	Chevron skink	Widespread in North Island. Widespread in lowland forests throughout North Island.	**Presumed Extinct**
Oligosoma infrapunctatum	Speckled skink	Widespread in the North Island, up to at least 800 m.	**Presumed Extinct**
Oligosoma microlepis	Small-scaled skink	May have been widely distributed along axial ranges of North Island.	**Presumed Extinct**
Oligosoma moco	Moko skink	Widespread in coast and lowlands of north eastern North Island.	Sparse
Oligosoma smithii	Shore skink	Common along coast	Common along coast
Oligosoma striatum	Striped skink	Widely distributed from Taranaki to at least Kaipara.	Sparse
Cyclodina aenea	Copper skink	Widespread.	Widespread
Cyclodina alani	Robust skink	Lowland forest throughout North Island.	**Presumed Extinct**
Cyclodina macgregori	McGregor's skink	Widespread throughout North Island.	**Presumed Extinct**
Cyclodina oliveri	Marbled skink	Widespread from Northland to Northern Bay of Plenty.	**Presumed Extinct**
Cyclodina ornata	Ornate skink	Widespread at lower elevations throughout the North Island.	Sparse
Cyclodina whitakeri	Whitaker's skink	Lowland forest throughout North Island.	**Presumed Extinct**

Scientific Name	Common Name	Historical	Present Status (Project Area)
Sphenodon punctatus	Northern tuatara	Widespread at least at lower elevations, throughout the North Island.	**Presumed Extinct**
Leiopelma hochstetteri	Hochstetter's frog	Widespread but patchy distribution in forested mountain streams of the upper North Island.	Northern Kaimai and Otawa.

4.11.7 Bats

The following notes summarise recent bat survey work in the Kaimai-Mamaku project area. Unless cited otherwise, information has been summarized from Owen (2005).

Short-tailed bat

A survey within Mokaihaha Ecological Area in 1998 recorded no bat passes. Two short-tailed bat passes were recorded in the Opuiaki Ecological Area in 1999, using automatic bat monitors. In a survey conducted in November 2008, short-tailed bats were detected at one of 10 automatic bat detectors, and were also detected by hand-held bat detectors at three points around the edges of Mokaihaha (Kelly 2008a).

Moore (2001) undertook limited surveys using driving transect methods within southern parts of the Kaimai-Mamaku project area, but failed to detect short-tailed bats.

Long-tailed bat

Mamaku Plateau - Capricorn/Aquarius/Tunnel/Leslie Roads

Moore (2001) detected long-tailed bat activity at several sites on the northern Mamaku plateau, including along a stretch of Capricorn Road, which runs between the Kuhatahi and Waipare streams. Walk-through transects by the Department of Conservation in 2003 detected long-tailed bats along all transects (Owen 2005).

Mokaihaha

A survey using ABMs in January 1999 recorded long-tailed bats at two sites. In 2002, bats passes were detected using an ABM set on 28kHz, but it was concluded that the passes were attributable to long-tailed bats. In a survey conducted in November 2008, long-tailed bats were detected at nine of 10 automatic bat detectors.

Otanewainuku

A dead bat (identification unclear) was collected from a track in Otanewainuku Forest December 2003, and handed into the Department of Conservation, Tauranga.

Southern Kaimai

Long-tailed bats were recorded from Omanawa Forest, an exotic plantation forest between Galaxy Road and Opuiaki Ecological Area, in 2005 (Wildland Consultants 2005)

Northern Kaimai

Small numbers of long-tailed bats have been observed at the Waitawheta Hut clearing, northern Kaimai, over the last 15 years, most recently in September 2003.

4.12 Introduced mammals

The project area contains a suite of introduced animals that is now ubiquitous across much of the New Zealand mainland. This complement includes red deer (*Cervus elaphus scoticus*), fallow deer (*Dama dama dama*), feral goats (*Capra hircus*), and feral pigs (*Sus scrofa*).

Cattle

Feral cattle were previously widespread throughout the tract, especially on the Mamaku Plateau, and now occur only locally in the northern Mamaku Plateau. Dale and James (1977) recorded the following:

"Domestic cattle have access to the forest margins on both the eastern and western sides of the ranges, occasionally roaming almost to the main crest of the ranges. The forest is used for winter grazing of cattle and, in addition to severe depletion of the forest ground cover in these peripheral forests, ground compaction is common on the main access routes.

There are few wild cattle on the Whakamarama Plateau. The National Forest Survey records indicates that wild cattle were very numerous in the southern Kaimais around 1950."

Wandering domestic cattle (*Bos taurus*) (and sheep (*Ovis aries*) and goats) have been significant problems in the past, but this issue has largely been resolved by many years of work by the Department of Conservation working with adjacent private landowners to fence property boundaries.

Red Deer

Red deer occur throughout, and have been present for nearly 100 years, but have never attained high numbers in the northern Kaimai or on the Mamaku Plateau or its northern fringes. Dale and James (1977) record the following observations:

"There is only one "official" recorded liberation of red deer in the Kaimais, that at Te Aroha in 1912 by the Auckland Acclimatisation Society, but the Tauranga Acclimatisation Society liberated deer at intervals in the Te Aroha and Katikati districts from 1912 to 1917 (Logan and Harris 1967). It is probable that the red deer which have been present in the Woodlands Road and Athenree areas for over 30 years

derive from these liberations. The red deer elsewhere in the ranges probably resulted from a northward colonisation from the Mamaku Plateau."

"Red deer are scattered throughout the ranges but their numbers are low. The present distribution pattern reflects the southward colonisation. Deer numbers are greatest in the south-east of the ranges on the Whakamarama Plateau where the frequency of occurrence varies between 10 and 15%. Elsewhere numbers are very low (0-5%), except for small areas in the Wharawhara and south of Thompsons Track where the frequency of occurrence is between 5-10%. Mid- and lower-altitude forests are favoured by deer, and animals appear occasionally on pasture adjacent to the bush edge."

Current red deer distribution is low-moderate from SH29 north to roughly Wahine Rock/Wharawhara catchment with low deer numbers throughout northern Kaimai. Numbers between SH29 and Wahine Rock are high enough to attract ongoing interest by recreational hunters (B. Angus, Department of Conservation, pers. comm.). Numbers appear to have increased, over the last 30 years or so, in the 7 km-wide band between Thompsons Track and Wahine Rock. There are very few red deer within the Forest Park south of SH29 and north of SH5 (northern Mamaku), confined largely to pasture/forest margins, with no deer in the Opuiaki area. Deer are present south of SH5 (southern Mamaku).

Fallow

Fallow deer are present in the Otawa-Otanewainuku area, where there has been a population for nearly 130 years (Davidson and Nugent 1995).

Feral Goats

Feral goats have been present for more than 140 years, as noted by Dale and James (1977):

"Goats were first introduced during the gold-mining era, with improved strains being introduced in the 1870s to improve the hide quality. Further liberations were made in the early 1990s for control of blackberry on adjacent farmlands.

Feral goats were not regarded as being at pest numbers until 1948, when the Department of Internal Affairs undertook a control operation between the Karangahake Gorge, the Wharawhara, and the Wairakau catchments. The New Zealand Forest Service took over control operations in 1965 and up to 31 March 1974 almost 7,000 goats had been destroyed, not including those shot by private hunters."

"Goats are often found in large mobs around the large slips in the northern and central region of the ranges. However, they move down ridges into the lower zones of the forest and are seen frequently on farmland adjacent to the forest."

A summary of goat control is provided in Hickson and Angus (2007). Goat control in the KMFP began in the late 1940s at varying intensities. Intensive control commenced in the mid to late 1970s which continued into the 1980s and 1990s. The goat population was reduced to very low levels over the entire park by the mid-1990s.

However, over the last ten years, the population had recovered in the northern Kaimai. Increased funding in 2008 and 2009 has resulted in a significant hunting effort over 10,000 hectares of the northern Kaimai, which has significantly reduced the goat population.

Apart from the northern Kaimai, goat numbers are still very low or completely absent over most of the park, including the southern and central Kaimai range and the northern Mamaku. Goats are present on the Mamaku Plateau, on plantation-pasture-bush margins on the eastern and western edge of the Plateau, but not in the interior.

Feral Pigs

Feral pigs are in moderate numbers and are subject to recreational hunting. Pig numbers fluctuate naturally in a cyclical manner.

Possums

There appear to have been two possum (*Trichosurus vulpecula*) releases within the Kaimai Range. In 1911 the Ohinemuri Acclimatisation Club secured 12 black possums from the Wellington area and liberated them at Dickey Flat on the southern side of the Waitawheta River (Leach 1929). Reports received eight years later indicated possum numbers were increasing. The first permit for trapping possums was granted in 1929 and trappers in that first season found that 100% of trapped female possums carried young, some having two, one in pouch and the other on back (Leach 1929). In 1915, 14 black possums were released at Karangahake (Dale and James 1977). Possums were also liberated near Mamaku (formerly Kaponga) about 10 km northeast of the Mokaihaha in the early 1900s (Nicholls 1966). Possums are now ubiquitous throughout the area. .

A summary of pest animals affecting indigenous vegetation is set out below in Table 17.

The relative scarcity of ungulates on the northern Mamaku Plateau is thought to be due to cobalt deficiency in the soils causing 'bush sickness', which is a feature of other landscapes dominated by ignimbrites and tephras derived from the Taupo Volcanic Zone.

Stray dogs (*Canis familiaris*) and cattle (*Bos taurus*) are recorded occasionally in the Tauranga Basin, but these have not established feral populations (Wildland Consultants 2008). Dama wallabies (*Macropus eugenii*), occur on the eastern side of the Kaituna River and on Mt Ngongotaha, and could extend their range east and north onto the Mamaku Plateau.

Stoats (*Mustela erminea*), feral cats (*Felis catus*), ship rat (*Rattus rattus*), and mice (*Mus musculus*) are present throughout. Ferrets (*Mustela furo*), Norway rats (*Rattus norvegicus*), and hedgehogs (*Erinaceus europaeus*) are also present, but are likely to be more localised or confined to edge habitats, along with rabbits (*Oryctolagus cuniculus*) and hares (*Lepus europaeus*).

Table 17: Introduced pest animals affecting indigenous vegetation within the Kaimai-Mamaku project area.

Pests Posing Threats To Vegetation	Possum	Goat	Red Deer	Fallow	Ship Rat
Waihou Kaimai Catchments					
Waihi	✓	✓	✓		✓
Paeroa	✓	✓	✓		✓
Te Aroha	✓	✓	✓		✓
Middle Waihou	✓	✓	✓		✓
Upper Waihou	✓	✓	✓		✓
Tauranga Harbour Catchments					
Waiau	✓		✓		✓
Tuapiro	✓		✓		✓
Uretara	✓		✓		✓
Rereatukahia	✓		✓		✓
Aongatete	✓		✓		✓
Te Puna	✓		✓		✓
Wairoa	✓	✓	✓		✓
Omanawa	✓		✓	✓	✓
Waimapu	✓	✓	✓	✓	✓
Otawa	✓	✓	✓	✓	✓

A diverse suite of introduced birds is present, some of which will be present throughout forest habitats, including dunnock (*Prunella modularis*), blackbird (*Turdus merula*), song thrush (*Turdus philomelos*), eastern rosella (*Platycercus eximius*), chaffinch (*Fringilla coelebs*), and magpie (*Gymnorhina tibicen*), with many others in edge habitats.

4.13 Recreation

This section summarises patterns of major recreational uses across the sub-catchments of the Kaimai-Mamaku project area, and provides brief summaries of each recreational use. A tabulated summary of activities in the various catchments is set out below in Table 18.

Access Points

All sub-catchments except Paeroa have access points into Kaimai-Mamaku Forest Park and its network of more remote tramping tracks and huts, or associated outlying areas of Department of Conservation-administered land and public reserves. The density of access points is highest in the northern Kaimai Range.

Short Walks

There are numerous short walks distributed through most sub-catchments. Many are concentrated in the northern Kaimai Range and the Karangahake Gorge, and are relicts of historic mining or logging activity. A network of walkways has been developed around the Waihi area by Waihi Walkways, an incorporated society. Short walks, especially situated along riparian and estuarine areas, are present adjacent to Tauranga Harbour. Mauao is the most heavily used short walk site in the project area, with more than 25,000 users/month.

Table 18: Recreational uses and facilities within the Kaimai-Mamaku project area.

	Recreational Uses								
	Access Points	Short Walks	Walking Tracks	Huts	Hunting	Mountain biking[1]	4WD	Whitewater kayaking	Fishing
Waihou Kaimai Sub-Catchments									
Waihi	✓	✓	✓	2	✓			✓	✓
Paeroa		✓							
Te Aroha	✓	✓	✓		✓	✓			
Middle Waihou	✓		✓	1	✓	✓	✓		✓
Upper Waihou	✓		✓		✓				✓
Tauranga Harbour Sub-Catchments									
Waiau	✓	✓	✓						
Tuapiro	✓	✓	✓	1	✓				
Uretara	✓	✓	✓						
Rereatukahia	✓	✓	✓	1	✓	✓	✓		
Aongatete	✓	✓	✓	1	✓				
Te Puna	✓		✓						
Wairoa	✓	✓	✓	1	✓			✓	✓
Omanawa	✓	✓			✓				
Waimapu	✓	✓			✓				
Otawa	✓	✓			✓				

Walking Tracks

Longer walking and tramping tracks follow the main spine of the Kaimai Range between the Karangahake Gorge and SH 29. Along central and southern parts of the Range, tracks are unmarked or maintained to a lower standard than in the northern Kaimai Range. Many short walks connect road ends to this track network at various points on both eastern and western sides of the Range. Walking track facilities are planned for the newly-developed TECT All Terrain Park (http://www.westernbay.govt.nz/Major-Projects/TECT-All-Terrain-Park/), part of which lies in the Omanawa sub-catchment.

Huts

Seven huts are situated on the tramping track network following the main spine of the Kaimai Range between the Karangahake Gorge and SH 29. The three huts in the northern Kaimai Range are maintained to the Department of Conservation's 'standard' or 'serviced' categories, while those in the southern Kaimai Range are small, and maintained to the Department of Conservation's 'basic' standard. Several are situated off marked tracks, and one is maintained by the Thames Valley Deerstalkers Association.

Hunting

The main recreational hunting areas are in the southern Kaimai Range (red deer), the Mamaku Plateau (red deer), and Otawa Forest (fallow deer).

Mountain-biking

Purpose-built mountain-bike tracks are located at Te Aroha Domain, Oropi Grove, and are planned for the TECT All Terrain Park. Thompson's Track is a recognised mountain-bike ride in various trail guides.

4WD

Thompson's Track is a regular destination for 4WD clubs and recreational 4WD users. 4WD and motocross facilities are planned for the TECT All Terrain Park.

Whitewater Kayaking and Rafting

Whitewater kayaking opportunities (Classes 3 and 4) are available in the Karangahake Gorge section of the Ohinemuri River and sections of the Waitawheta River. The limited amount of whitewater at these locations is off-set by proximity to Auckland. The Wairoa River offers highly-rated Class 3 to 5 whitewater between the McLaren Falls bridge and the Ruahihi powerstation under controlled-release flow conditions, and in high flows on the Mangakarengorengo, Opuiaki and Ngamuwahine tributaries (source: http://rivers.org.nz/), and this is a highly-valued resource, being used for extreme kayaking events on the Wairoa River.

Fishing

The upper and middle reaches of the Waihou River, and the Ohinemuri and Waitawheta Rivers provide an excellent variety of brown and rainbow trout fishing. Lake McLaren (part of the McLaren Falls power scheme) and the Wairoa River provide trout fishing opportunities close to Tauranga.
(sources: http://www.nzfishing.com, http://www.fishandgame.org.nz)

Other Recreational Uses/Stakeholders

Other recreational user groups, including horse-riders and target shooters, will be accommodated at the TECT All Terrain Park
(source: http://www.westernbay.govt.nz/Major-Projects/TECT-All-Terrain-Park/).