Manaaki Whenua
Landcare Research

National ecosystem typology – Northland terrestrial pilot

June 2025

James K. McCarthy, Adrian Monks, Susan K. Wiser

Manaaki Whenua – Landcare Research

Manaaki Whenua Contract Report: LC4630

Prepared for: Ministry for the Environment

Reviewed by:

Olivia Burge
Senior Researcher – Ecology
Manaaki Whenua – Landcare Research

Approved for release by:

Gary Houliston
Portfolio Leader – Plant Biodiversity & Biosecurity
Manaaki Whenua – Landcare Research

Contents

Summary

Project and client

To support its work on creating a nationally standardised typology, the Ministry for the Environment commissioned Manaaki Whenua – Landcare Research to test integrating the expert-based and quantitative plot-based terrestrial typologies ('systems') in Northland. The expert-based system is supported by regional maps that depict 'potential' vegetation patterns. The quantitative, plot-based system is derived from vegetation plot data. Previous work in this area has recommended integrating these two typologies to adopt the best features of each.

Objectives

- Review the standards currently used in New Zealand to name ecosystems and recommend a standard for harmonised naming for ongoing use.
- Assign types from Northland from the expert-based and quantitative plot-based systems to a standardised hierarchy of thematic resolution (the international 'EcoVeg' system).
- Develop methods for, and complete cross-walks between, the expert-based and quantitative plot-based systems.
- Develop example descriptions and fact sheets for four ecosystem types from Northland.
- Evaluate the success of the integration pilot.

Results

- In Northland there are 37 ecosystems ('types') in the expert-based system and 20 types (at the association level of thematic resolution) in the quantitative plot-based system.
- There are two naming systems currently used in New Zealand: the Atkinson system and that provided by the EcoVeg approach. EcoVeg is a classification approach that applies to the existing vegetation of an ecosystem and is based on floristics, structure, and the ecological environment. This approach is used by the International Vegetation Classification (IVC) and is now harmonised with the IUCN Global Ecosystem Typology. Many of the features of the Atkinson naming system are present in EcoVeg through its specification for 'common names' that approximate the way an Atkinson name is constructed. EcoVeg also provides a set of rules for constructing scientific names that are specific enough to assist with descriptions and field identification.
- Types from the expert-based typology are represented across almost all of the hierarchical levels defined by the EcoVeg approach, indicating there is wide variation in the compositional scope of its types. The 'azonal' types (those existing at environmental extremes) tended to be broader in scope, whereas the 'zonal' types (which include most forest types) are more restricted in scope (e.g. more compositionally specific). Types from the quantitative plot-based system were judged to be consistent with the alliance and association levels at which they were originally defined.
- Most types from the quantitative plot-based system had at least some level of compositional/conceptual matching (cross-walk) to the expert-based system. Most types from the expert-based system did not cross-walk to the quantitative plot-based system, especially the azonal types (e.g. wetlands, dune systems). This reflects the fact that the

expert-based system is more environmentally comprehensive, whereas much of the environmental and compositional variation in Northland is not represented in the quantitative plot-based system.

Recommendations

We identified five primary recommendations and six further considerations (see below). More specific details are included in the 'Recommendations' section of this report (section 5).

Primary recommendations

1 Northland: produce a harmonised catalogue of ecosystem types.

2 Northland: continue the pilot to test activities needed for future implementation and operationalisation of a national typology.

3 Proceed with an integration pilot in another region with different environmental gradients and ecosystems.

4 Improve national ecosystem coverage in the quantitative plot-based system by assimilating existing unclassified data (e.g. wetlands).

5 Review ecosystem mapping approaches used internationally.

Further considerations

1 Adopt the EcoVeg approach for ongoing use for future terrestrial ecosystem typologies in New Zealand.

2 Northland: develop a workplan to fill geographical and ecological gaps in the Northland typology in a robust, defensible way.

3 Adopt a method for deriving short codes for ecosystems.

4 Extend the cross-walks between the expert-based and quantitative plot-based systems nationally.

5 Develop tools to allow non-specialists to use data to classify vegetation plots to types in the ecosystems catalogue.

6 Develop a method for proposing new ecosystem types where quantitative plot data are limited or absent.

1 Introduction

1.1 Overview

An ecosystem typology is a system for classifying ecosystems into groups based on shared features. Ecosystem typologies help practitioners understand and compare different ecosystems to support conservation, land-use planning, and ecological monitoring, and they can be used to describe the degree of similarity between ecosystem types (Keith et al. 2022).

Accurate ecosystem maps, classification keys, fact sheets, and ecosystem assessments need to be underpinned by a robust foundational ecosystem typology. The features of a robust typology for New Zealand that spans all environmental domains were assessed by experts and resulted in a set of principles to which a future unified typology must adhere (Collins 2024). These principles included requirements for a typology to be hierarchical, mappable, updateable and adaptable, compatible across domains, robust and transparent, comprehensive, reflective of New Zealand ecology, and familiar to New Zealand ecologists (Sprague & Wiser 2024).

In 2024 the terrestrial typologies (excluding wetlands) currently used in New Zealand were assessed against these principles as part of a project to assess the feasibility of developing a national typology that is harmonised with the International Union for Conservation of Nature Global Ecosystem Typology (IUCN-GET; Keith et al. 2013; Keith et al. 2022), which would thereby facilitate international reporting and ecosystem risk assessment. It was recommended that the two main typologies currently in use be integrated in order to adopt the 'best features' of each (McCarthy & Wiser 2024). These two typologies were referred to as the *expert-based system* and the *quantitative plot-based system*.

1.2 The expert-based system

The expert-based system (Singers & Rogers 2014) was developed with the goal of encompassing the structural and compositional variation in New Zealand's terrestrial ecosystems. It has a two-level hierarchy, comprising environmentally defined levels and biotic ecosystems nested within them. Literature review and expert opinion were used to define the vegetation communities and align them with the predefined environmental units. This typology focuses on and maps 'potential vegetation' as opposed to current vegetation, and therefore has limited or no coverage of successional types or types with non-native components. Ecotones are also not considered.

The expert-based system is widely used, with mapped coverage across all regions except Canterbury and Westland. However, some ecosystem types have been modified over time, so it is not possible to simply combine these regional maps to form a national map. The typology uses terminology and concepts familiar to New Zealand ecologists and conservation practitioners, which has helped facilitate its adoption. To date there has been no attempt to validate this typology using quantitative vegetation plot data, although the original intention for this system was that it would transition to a quantitatively based approach (Singers & Rogers 2014).

1.3 The quantitative plot-based system

This system has been developed progressively over almost 20 years to provide a national-scale quantitative vegetation classification of New Zealand (Wiser et al. 2011; Wiser & De Cáceres 2013; Wiser et al. 2016; Smale et al. 2018; Wiser & De Cáceres 2018; McCarthy et al. 2022; Wiser et al. 2022; Allen et al. 2025). Vegetation plots classified in this system are defined using a statistical approach called 'noise clustering', which for each plot calculates a quantitative measure (membership value) of how well it fits into a type defined by the analysis. Plots with low membership to any defined type can either be assigned to the type to which they have the best fit or left unassigned and classified as 'outliers' (in the analysis termed the 'noise' class). This can indicate either that the type represented by that plot is currently under-sampled or that the plot sampled opportunistic combinations of species that don't recur across the landscape (Wiser et al. 2016). Typically around 10 plots are required to define a vegetation type (Wiser & De Cáceres 2013). At present this classification consists of two hierarchically nested levels: associations, which are imperfectly nested into alliances.

This system incorporates data from almost 20,000 vegetation plots, but the system is largely restricted to areas and types of vegetation that have been sampled adequately, with some ecosystems (e.g. non-grassland alpine habitats, wetlands, coastal areas, urban areas) poorly represented in the typology (Wiser & De Cáceres 2018). The typology does include successional and non-native-dominated ecosystems where sufficient plot data exist to define them, and ecotones can be captured by plots that quantitatively match multiple types known to border each other. Efforts have been made to produce maps using the quantitative plot-based system, but this is restricted to three forests in Northland (McCarthy et al. 2022; Wiser et al. 2022; Allen et al. 2025). The ecosystems described by the typology are familiar to New Zealand ecologists, but the analytical techniques are only familiar to a subset of specialists with quantitative skills.

1.4 A revised typology

McCarthy and Wiser (2024) defined a road map for, and a recommended a series and sequence of actions to develop, a 'revised' terrestrial typology that would contribute to a national unified typology and meet international standards that conform to the IUCN-GET. It was envisaged that this revised typology would include types from both systems, with the long-term goal being that all types are underpinned by plot data.

The first step was to assess the likely success of integration through a pilot study in one region, which we present here for the Northland region, with the following objectives:

- review standards currently used in New Zealand to name ecosystems, and make recommendations for a standard for harmonised naming for ongoing use
- assign types from Northland from the expert-based and quantitative plot-based systems to a standardised hierarchy of thematic resolution (the international 'EcoVeg' system)
- develop methods for, and complete cross-walks between, the expert-based and quantitative plot-based systems
- develop example descriptions and fact sheets for four ecosystem types from Northland
- evaluate the success of the integration pilot.

2 Methods

2.1 Study area data acquisition

Northland has a warm, humid, subtropical climate with typically plentiful year-round rainfall, often provided through heavy rainfall events (Chappell 2013). The region measures approximately 1.25 million hectares and has a diverse range of soils shaped by its long weathering history, varied geology, and vegetation. Contemporary vegetation patterns reflect both natural and anthropogenic influences, with 32% of the land remaining under indigenous vegetation cover. Podocarp/hardwood/kauri forests are the most extensive forest types in Northland. There are also extensive mānuka/kānuka shrublands, present both as successional systems recovering from previous disturbance and in gumlands, which are infertile, seasonally waterlogged systems occurring on podzol soils (Enright 1989; Clarkson et al. 2011).

There have been several efforts to map the ecosystems and vegetation of Northland. The New Zealand Forest Service Forest Class Map (NZFS MS6) mapped most of the remaining forest cover in the region based on the classification of Nicholls (1976). This map, and other data sources (soils, geology, aerial imagery, etc.), were used to provide a spatially complete layer of Northland's potential vegetation cover (Figure 1; Singers & Lawrence 2018) following the expert-based system (Singers & Rogers 2014). Vegetation plots from the region have also been classified through the quantitative plot-based system (Wiser et al. 2011), with maps generated for three forests in the region using models: Warawara (Bellingham et al. 2020; Wiser et al. 2022), Russell (McCarthy et al. 2022), and Mangōnui (Allen et al. 2025).

A copy of the map for the expert-based typology for Northland was provided by Northland Regional Council on 4 November 2024 as a shape file. Plots classified under the quantitative plot-based system occurring within the Northland Regional Council boundary (Figure 1) were identified. The data for these plots are archived in the National Vegetation Survey Databank,[1] and they have been classified into the quantitative plot-based system in a number of work programmes (Wiser et al. 2011; Wiser & De Cáceres 2013; Wiser et al. 2016; McCarthy et al. 2022; Wiser et al. 2022; McCarthy & Bellingham 2024; Allen et al. 2025). Plots have been classified to types at one or two levels of compositional hierarchy (association only, or both alliance and association; see below), and allocations for both were obtained. In this report we use the general term 'types' to signify the 'ecosystem units' of the expert-based systems and the alliances and associations of the quantitative plot-based system.

[1] https://nvs.landcareresearch.co.nz (Wiser et al. 2001).

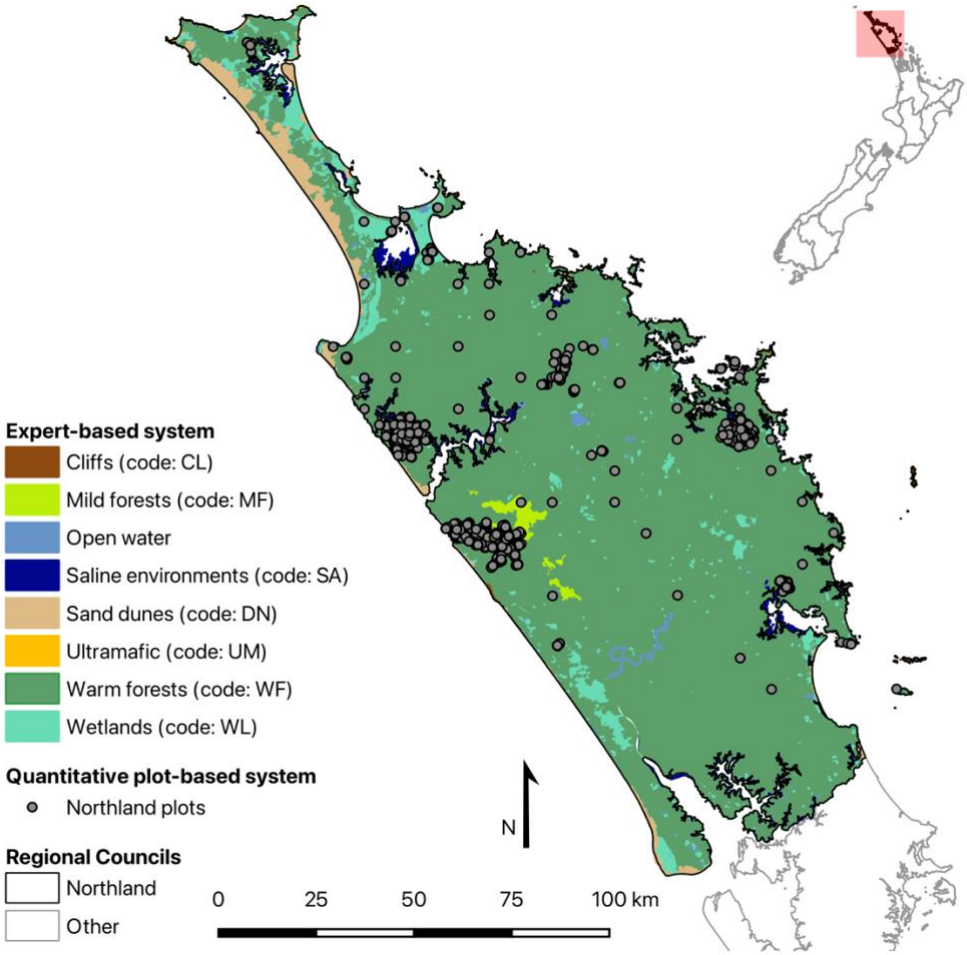


Figure 1. Map of potential vegetation in Northland based on the expert-based system (Singers & Lawrence 2018), and locations of plots in Northland from the quantitative plot-based system.
Notes: For mapping purposes vegetation types have been lumped into categories based on the primary ecosystem drivers of Singers & Rogers 2014; the original, displaying higher thematic resolution, can be viewed on the Northland Regional Council website.[2] Points indicate locations sampled with plots using the quantitative plot-based system. The types from recently measured plots from Mangōnui Forest were considered in this exercise but are not shown on this map to maintain data sovereignty.

2.2 Standard for harmonised naming

In order to recommend a standard for harmonised naming we first reviewed the naming conventions currently used in New Zealand, including those adapted from international systems. Examples include EcoVeg (Ecological Vegetation classification approach; Jennings et al. 2009; Faber-Langendoen et al. 2014; Faber-Langendoen et al. 2025), which is commonly used internationally, and the Atkinson system, which is often used in New Zealand (Atkinson 1962, 1985). We then compared these standards using a range of criteria, including their ability to consider a hierarchy (Collins 2024), their ability to incorporate physiognomic descriptions, and their rules for constructing floristic names. We then recommended a particular system for adoption in New Zealand.

[2] https://data-nrcgis.opendata.arcgis.com/maps/NRCGIS::northland-biodiversity-ranking-potential-ecosystems

2.3 Alignment of typologies to EcoVeg

EcoVeg aims to 'fully describe and classify the diversity of Earth's terrestrial ecosystems based on vegetation and ecological processes' (Faber-Langendoen et al. 2025). It provides a hierarchical classification system that was initially developed out of the Americas to provide a consistent thematic framework to support vegetation description and mapping (Faber-Langendoen et al. 2014; Faber-Langendoen et al. 2018), and it supports the International Vegetation Classification (IVC).

McCarthy and Wiser 2024 recommended adopting the EcoVeg system for the proposed future terrestrial ecosystem typology for New Zealand. The same recommendation has also been made for wetlands (Burge 2025). EcoVeg has recently been adapted to harmonise with the IUCN-GET (Figure 2), and the upper levels have been defined globally (Faber-Langendoen et al. 2025). For more information on EcoVeg and the IVC, see section 3.2.1 'The EcoVeg approach', and section 3.4.2 'Action 2: Adopt a hierarchical structure for a terrestrial ecosystem typology to meet the need to move up and down different levels of specificity for different applications' of McCarthy and Wiser 2024.

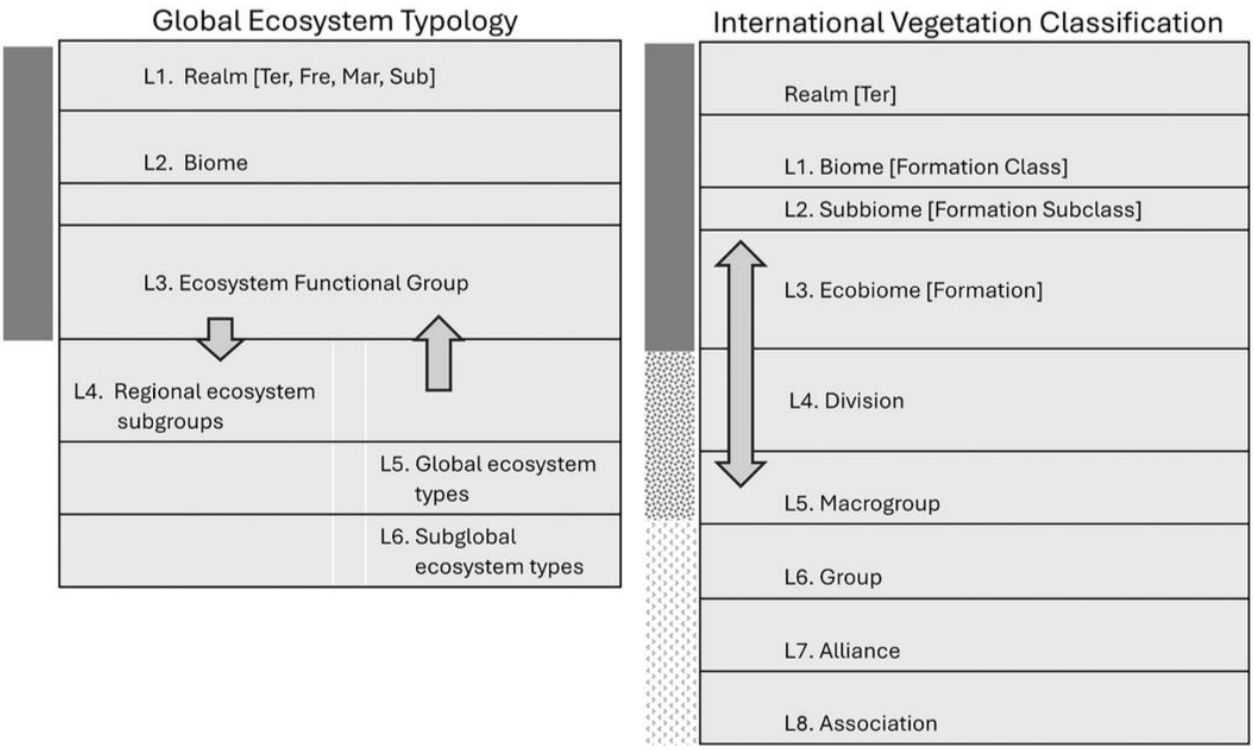


Figure 2. Comparison of the hierarchical structure of the International Union for Conservation of Nature Global Ecosystem Typology (IUCN-GET) (Keith et al. 2022) and the revised International Vegetation Classification (eIVC; Faber-Langendoen et al. 2025).
Notes: Realm codes (Terr, Terrestrial; Fre, Freshwater; Mar, Marine; and Sub, Subterranean) refer to the Realm types. Old IVC formation names are in square brackets (see Table 1). IUCN-GET and eIVC levels are fully populated (solid grey bar), and higher levels from the eIVC are widely (dense stippling) and partially (light stippling) developed.
Source: reproduced from Faber-Langendoen et al. 2025; their Figure 3. See their paper for more detail.

Table 1. A summary of the EcoVeg/IVC hierarchy using a worked example from North America.

Natural hierarchy	Definition	Example scientific names	Example colloquial names
Upper levels			
L1: Formation class	A broad combination of dominant general growth forms adapted to basic moisture, temperature, and/or substrate or aquatic conditions.	Mesomorphic Shrub and Herb Vegetation	Shrub and Herb Vegetation
L2: Formation subclass	A combination of general dominant and diagnostic growth forms that reflect global mega- or macroclimatic factors driven primarily by latitude and continental position or that reflect overriding substrate or aquatic conditions.	Temperate and Boreal Shrub and Herb Vegetation	Temperate and Boreal Grassland and Shrubland
L3: Formation	A combination of dominant and diagnostic growth forms that reflect global macroclimatic conditions as modified by altitude, seasonality of precipitation, substrates, and hydrologic conditions.	Temperate Shrub and Herb Vegetation	Temperate Grassland and Shrubland
Middle levels			
L4: Division	A combination of dominant and diagnostic growth forms and a broad set of diagnostic plant species that reflect biogeographic differences in composition and continental differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes.	*Andropogon* – *Stipa* – *Bouteloua* Grassland and Shrubland	Great Plains Grassland and Shrubland
L5: Macrogroup	A moderate set of diagnostic plant species and diagnostic growth forms that reflect biogeographic differences in composition and subcontinental to regional differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes.	*Andropogon gerardii* – *Schizachyrium scoparium* – *Sorghastrum nutans* Grassland and Shrubland	Great Plains Tallgrass Prairie
L6: Group	A relatively narrow set of diagnostic plant species (including dominants and codominants), broadly similar composition, and diagnostic growth forms that reflect regional mesoclimate, geology, substrates, hydrology, and disturbance regimes.	*Andropogon gerardii* – *Heterostipa spartea* – *Muhlenbergia richardsonis* Grassland	Northern Great Plains Tallgrass Prairie
Lower levels			
L7: Alliance	A characteristic range of species composition, habitat conditions, physiognomy, and diagnostic species, typically at least one of which is found in the uppermost or dominant stratum of the vegetation. Alliances reflect regional to subregional climate, substrates, hydrology, moisture/ nutrient factors, and disturbance regimes.	*Andropogon gerardii* – *Sporobolus heterolepis* Grassland	Northern Mesic Tallgrass Prairie
L8: Association	A characteristic range of species composition, diagnostic species occurrence, habitat conditions, and physiognomy. Associations reflect topo-edaphic climate, substrates, hydrology, and disturbance regimes.	*Andropogon gerardii* – *Heterostipa spartea* – *Sporobolus heterolepis* Grassland	Northern Mesic Big Bluestem Prairie

Source: reproduced from Faber-Langendoen et al. 2014; their Table 2.

Here we assigned all types from Northland defined by the quantitative plot-based and expert-based systems to each of the hierarchical EcoVeg levels, as defined in Faber-Langendoen et al. 2014 (Table 1). This was done to assess both the primary resolution and the consistency of ecosystem-level description within the two typologies. Wherever possible, decisions were made based on the EcoVeg diagnostic criteria provided in Tables 3 and 4 of Faber-Langendoen et al. 2014, which concentrate on the level of variation in biogeography and floristics, diagnostic species, growth forms, climate, disturbance and succession, and edaphic and hydrological conditions. In many cases, however, there was insufficient information available in the supporting material from the quantitative plot-based and expert-based systems to assess all the criteria. We therefore created a set of criteria consistent with those from EcoVeg that we were able to use with the information available to us (see below).

2.3.1 Expert-based system

For the expert-based system we made allocations to EcoVeg levels based on the information provided in Singers & Rogers 2014, Singers & Lawrence 2018, and the Northland map. We developed the following criteria for this system.

- For zonal ecosystems we determined that the primary and secondary ecosystem drivers (i.e. code 'WF' for warm forests) were equivalent to EcoVeg Levels 6 (group) or 5 (macrogroup), based on the EcoVeg diagnostic criteria referring to regional and subcontinental climate gradients, respectively. All types nested below that in the hierarchy, indicated by a number following the code (e.g. 'WF6'), were either Levels 7 (alliance) or 8 (association) (see below). Exceptions were when types were described (or mapped) as encompassing ecological variation beyond that of their defined ecosystem driver(s); these were allocated to higher EcoVeg levels based on the level of climactic and compositional variability described, with reference to the EcoVeg diagnostic criteria. Azonal ecosystems were assessed based on their level of compositional and environmental (climate, disturbance, soils, geology, hydrology; where available) variability.
- For some ecosystem types, Singers and Rogers (2014) describe internal compositional and geographical or environmental variants. When allocating such nested types to Levels 7 or 8 (alliance or association), we based our decision on the amount of compositional (and environmental) variability described, so that types with high variability were assigned to Level 7 (alliance) and those with low variability to Level 8 (association). We allocated types described as including compositional variation (especially across environmental or successional gradients, or over geographical space) to Level 7 (alliance). If there was little or no compositional variability described, we allocated the type to Level 8 (association). For ecosystems types where the ecological breadth described nationally (Singers & Rogers 2014) was broader than described for Northland (Singers & Lawrence 2018), we based our allocation on the national description.
- Wetlands were commonly assigned to levels higher in the hierarchy because they encompassed different vegetation structural types (i.e. woody and non-woody components). They were also commonly physiognomically defined (i.e. rushland and wetland scrub, code 'WL10'), with just a list of common species. We have interpreted these types from the name and the predominant text from the description, but excluded any parts of descriptions focusing on ecotonal gradation into other types (e.g. 'grading into wetland scrub on margins'), because these are beyond the concept of the named ecosystem type itself. We

note that in a typology the intent is to identify and describe homogeneous assemblages of species and their associated environment that recur across the landscape. Individual types can be extensive or confined to a small, discrete area. They may grade into other types gradually over long distances or rapidly over short distances with sharp ecotones. Although it is useful to understand the nature of these ecotones, these are not what characterises or defines an ecosystem type.

- At times there was insufficient information from which to make a decision. In this case we presented several options (e.g. 'alliance or association').
- In all cases notes were provided to support our decision.

2.3.2 Quantitative plot-based system

For the quantitative plot-based system we made allocations to EcoVeg levels based on the information provided in articles supporting the typology (Wiser et al. 2011; Wiser & De Cáceres 2013; Wiser et al. 2016; Wiser & De Cáceres 2018). Given the ecosystems were defined at the alliance and association levels based on the IVC (Jennings et al. 2009), we still verified them against the EcoVeg criteria, but in all cases accepted their levels as stated.

2.4 Cross-walking typologies to each other

We consulted published literature that described the composition of and context for each of the ecosystem types (Singers & Rogers 2014). For the quantitative plot-based system we consulted several published articles (Wiser et al. 2011; Wiser & De Cáceres 2013; Wiser et al. 2016; McCarthy et al. 2022; Wiser et al. 2022), the New Zealand woody ecosystem type online fact sheets,[3] and unpublished quantitative summaries of the average species composition of the quantitative plot-based woody ecosystem types (S. Wiser, unpubl.). This information was used to construct a mental picture of the ecosystem types, their location in environmental space, where they fitted into successional pathways (for the quantitative plot-based ecosystem types), and any other defining features. Crosswalks were completed for both the alliances and associations from the quantitative plot-based system.

For each type recorded in Northland from each typology we assessed whether there was one or more types described in the alternative typology that encompassed the same compositional and ecological variation. We did this based on the available information and our knowledge of the ecosystems. Where there was no plausible corresponding type we recorded 'no match'. Where there was a match we estimated the degree of overlap ('fuzzy matching') with the corresponding ecosystem type using the approach of the draft IUCN-GET cross-walk guidelines (D.A. Keith, unpubl.; Table 2).

Using this approach, the membership scores of a given entity across all its potential matches summed to 1, and sometimes included a 'no match' component. If there was only one plausible match and the properties were a strongly aligned, then the score assigned to that match will be close to 1. If there were two plausible matches, with good alignment between the properties and the ecosystems equally likely to be a member of either, then each match was assigned a score of 0.5. If, however, those two plausible matches showed only a limited alignment of their properties,

[3] https://www.landcareresearch.co.nz/publications/woody-ecosystem-types/

and an undescribed ecosystem might be more likely, the matches might only be assigned 0.2 each. If one of the two plausible matches was assessed as twice as likely as the other, then its membership score would be twice that of the other. We also defined the nature of the relationship between related types (e.g. '=' concepts are equivalent; '>' type is broader; '<' type is finer), following Faber-Langendoen et al. (2025; their Appendix S5, Table S1).

Finally, using the locations of the plots from the quantitative plot-based system, we compared their types (alliances and associations) with those mapped by the expert-based system. It should be noted, however, that there could be inaccuracies in this analysis if plots have incorrect coordinates, or if they are located near boundaries of mapped types. Therefore this analysis should be considered preliminary until a more formal analysis incorporating this uncertainty is undertaken.

The cross-walk was peer-reviewed by an expert with deep experience of Northland forests and the cross-walking process. Refinements were made after evaluating the expert feedback to arrive at the final cross-walk.

Table 2. Rules for estimating fuzzy membership values

Strength of evidence that classification unit 'A' is a member of ecosystem functional group 'X'	Membership estimate
Virtually certain (properties are a strong match, no plausible alternative type)	1.0
Very likely (properties are a strong match and all plausible alternative types are very unlikely)	0.90–0.99
Likely (properties are a good match and all plausible alternative types are unlikely)	0.66–0.89
More likely than not (properties are a good match, but other plausible types could be almost as likely)	0.50–0.65
About as likely as not (properties are a reasonable match, but alterative types could be as likely)	0.33–0.66
Unlikely (properties show a limited degree of match, but alternative types could be more likely)	0.10–0.33
Very unlikely (properties show a very limited match, and alternative types should be more likely)	0.01–0.10
Exceptionally unlikely (key diagnostic properties do not match, membership is implausible)	0

Source: adapted from D.A. Keith, unpubl.

2.5 Descriptions and fact sheets

Fact sheets were prepared for four association types from the quantitative plot-based system that had some level of conceptual overlap with types from the expert-based system. Types representing different characteristic vegetation communities of the region were selected in consultation with representatives from Northland Regional Council. The New Zealand woody ecosystem[4] and US

[4] https://www.landcareresearch.co.nz/publications/woody-ecosystem-types/

National Vegetation Classification[5] fact sheets were consulted when designing the fact sheets,[6] with information included under the following headings:

- Overview – names, codes, description, threat status, diagnostic characteristics, similar types within the typology
- Vegetation – physiognomy, structure, dynamics
- Environment and associated fauna – description, including an analysis of temperature and precipitation comparing plots of the type to the range of these variables experienced throughout New Zealand (McCarthy et al. 2021), geology (GNS Science 2012), soils (Newsome et al. 2008) from the plot locations, known associated fauna
- Distribution – geographical range description, known regions, map of surveyed/plot locations
- Confidence level – level of confidence in the type (useful to describe whether types have been quantitatively or provisionally described)
- Synonymy – with other New Zealand typologies, including the expert-based typology (Singers & Rogers 2014) and Wardle (1991)
- Hierarchy – where the type sits in the EcoVeg hierarchy
- Authorship and version – concept author(s), description author(s), version, and version date
- Further reading – relevant references
- Links – links for additional information
- Photos.

The intention is that all fields will be present in every fact sheet, even if the relevant information is blank. This is to make it clear to users when information is not yet known about a type. Information for the fact sheets was kept concise, with the intention that in the future fact sheets would be generated and updated automatically from information stored in a database.

3 Results

3.1 Ecosystems in Northland

There were 37 unique types identified from the expert-based system in Northland (Appendix 1; Table A1.1). This included 'WF7' 'Pūriri forest' and its three subtypes ('WF7.1', 'WF7.2', and 'WF7.3'). There were two broad wetland mosaic types ('WL Bog/Fen mosaic' and 'WL, Bog mosaic') that were not delineated to any finer compositional resolution. Of the zonal ecosystems from the expert-based typology, there were 14 types: 12 from the primary ecosystem driver 'wet forest' ('WF' types), the most common from the region; and two 'mild forest' ('MF') types. The remaining 23 types were azonal ecosystems (from extreme environments), including 11 wetland ('WL') types. The rest of the azonal types were from cliff ('CL', three types), dune ('DN', two types), saline ('SA', three types), and ultramafic ('UM', one type) environments, and the two wetland mosaics. Wet forests were the most widespread geographically, occurring across the whole region (Figure 1). Wetlands and dune types were common in the east and west of the Aupōuri Peninsula, respectively.

[5] https://www1.usgs.gov/csas/nvcs/

[6] Northland Regional Council, and the Regional Council Steering Group also provided input (see Acknowledgements).

There were 20 types from the quantitative plot-based system's association data set (excluding the outlier/noise class), identified from 1,117 plots in Northland (Appendix 1; Table A1.3). There were five types from the alliance data set (Appendix 1; Table A1.2); however recent Northland surveys from Warawara, Russell, Taika, and Mangōnui forests (*n* = 445 plots, 40%), have not yet been subject to the analysis required to classify them into alliances. All plots have been included in association-level classification analyses, which showed that 128 (11%) had no strong compositional affinity to any of the nationally defined associations so are designated as outliers and remain unclassified.

For the 989 plots classified to the associations, 90 were in the more broadly defined 'Broadleaved' structural type ('BL' codes), 251 were 'Broadleaved-podocarp' ('BLP'), 19 were 'Kauri' ('K'), 293 were 'Other forest' ('OF'), 28 were 'Shrubland' ('S'), 67 were gumland types from Wiser et al. 2016 ('AS8'), and 241 have not yet been structurally characterised ('Ru', 'Wh', and 'WW' codes) (Appendix 1; Table A1.3). 'Broadleaved-podocarp forest (including kauri)' was the most common structural type from the alliance data set (code 'BLPF'; 423 plots), followed by the gumland types ('AS8'; 67 plots), 'Other forests' ('OF'; 20 plots), and 'Shrublands' ('S'; two plots) (Appendix 1; Table A1.2). Note that the number of plots of each type cannot be interpreted as the proportion of that vegetation type in Northland because plot sampling has been spatially and ecologically biased, with some areas more intensively sampled than others (Figure 1).

3.2 Standard for harmonised naming

When vegetation communities are classified, names are required for the classes, and typically this naming follows a set of rules to ensure consistency. Below we describe the emerging international standard and the primary system that has been used in New Zealand.

3.2.1 The EcoVeg approach

The EcoVeg approach provides eight hierarchical levels, ranging from broad upper levels (e.g. formation class, formation subclass) to higher-resolution lower levels (e.g. alliance, association). EcoVeg builds on over a century of work on vegetation classification (Jennings et al. 2003; Faber-Langendoen et al. 2014; Faber-Langendoen et al. 2025), particularly that of Braun-Blanquet (1928), which is the most widely applied vegetation classification in the world.

EcoVeg provides the backbone for the IVC. The IVC has its roots in the United States National Vegetation Classification System, which was developed to help conserve and manage ecosystems, initially across the USA and then extended to cover a greater portion of the Americas (Grossman et al. 1998). In subsequent years it underwent various iterations and refinements to increase its applicability (e.g. to overcome a challenge related to a lack of 'mid-scale' units, to include cultural and anthropogenic vegetation types), and to incorporate global perspectives and concepts, before forming the basis of the EcoVeg approach (Faber-Langendoen et al. 2014; Faber-Langendoen et al. 2018).

The finest level of EcoVeg is the association (Table 1), which is the 'primary unit of vegetation, reflecting patterns of plant species occurrence and frequency' (Jennings et al. 2009). The next level up is the alliance, which is composed of one-to-many associations. The upper levels comprise, in descending order, the formation class, formation subclass, and formation, and were pre-populated globally (Faber-Langendoen et al. 2016). Upon the release of the IUCN-GET (Keith et al. 2022),

EcoVeg and the IVC were revised as the ecosystem-based International Vegetation Classification (eIVC). As part of this revision the top-level realm and biome concepts from the IUCN-GET were adopted, and the eIVC Level 3 formation was formalised as being equivalent to the IUCN-GET Level 3 ecosystem functional group (the lowest global and pre-populated IUCN-GET level; Faber-Langendoen et al. 2025). A full cross-walk between the two systems' Level 3 types was included. The eIVC now covers all terrestrial and transitional terrestrial realms, including non-vegetated substrates, although the details for naming non-vegetated substrates are still unclear (Faber-Langendoen et al. 2025).

In New Zealand the IVC approach to naming associations and alliances (later adopted by EcoVeg) was followed by the quantitative plot-based system (Wiser et al. 2011 and subsequent publications). The association is conceptually defined by three inter-related criteria: species composition, structure, and habitat. Associations represent plant assemblages that exhibit similar total species composition and vegetation structure and occur under similar habitat conditions. Scientific names encompass both the dominant species (those with the greatest cover) and diagnostic species (those found consistently in some associations but not others), regardless of whether they are dominant trees or inconspicuous understorey plants. Therefore, the association, and its name, reflect a greater ecological specificity than classification and naming systems that rely solely on the dominant species of the upper tier/stratum.

The rules for assigning scientific names to associations and alliances in the quantitative plot-based system were originally based on Jennings et al. 2009 and are specified in Wiser et al. 2016. A maximum of six species names are included in association names, and a maximum of four species in alliance names, and they include species with the highest constancy (i.e. occurrence frequency in that association or alliance) and abundance. Species names are ordered based on their occurrence in the tallest to shortest strata, with a priority given to species in the tallest strata.

Parentheses or square brackets indicate species less commonly found in the plots of an association or alliance, defined as species with constancy values <0.7 (i.e. species that occur in <70% of plots). An en dash ('–') indicates species occurring in the same tier, and a slash ('/') indicates species that occur in different tiers. The compositional name is followed by the structural class name, following Atkinson 1985. The colloquial name, akin to a common name for a species, follows no specific convention. Alliance names include the dominant structural (or physiognomic) group to which they belong (e.g. 'Forest', 'Woodland', 'Herbaceous'). When confidence in the definition of an association or alliance is low, the name can be followed by the term '[provisional]', although to date this term has not been applied in New Zealand.

Some examples of association and alliance names[7] include:

- association: *Nothofagus menziesii – Weinmannia racemosa – Pseudowintera colorata / Blechnum discolor – Grammitis billardierei – Asplenium flaccidum* forest (common name: Silver beech – kāmahi – horopito forest with crown fern)
- association: *Leptospermum scoparium* successional shrubland (common name: Mānuka successional shrubland)

[7] Note that in some cases these names do not reflect the current accepted taxonomy; e.g. the updates to *Nothofagus* spp. (Heenan & Smissen 2013) and *Weinmannia* spp. (Pillon et al. 2021).

- alliance: *Cyathea dealbata – Melicytus ramiflorus – Freycinetia baueriana – Ripogonum scandens* forest (common name: Silver fern – māhoe forest)
- alliance: *Discaria toumatou – Coprosma propinqua / Anthoxanthum odoratum – Dactylis glomerata* shrubland (common name: Matagouri shrubland).

3.2.2 The Atkinson system

In New Zealand, the Atkinson system for naming and delineating vegetation classes is the most widely used formal system and is applicable to all terrestrial ecosystems (Atkinson 1962, 1985). Each name comprises two components: a floristic name that indicates the identity of the major canopy layers (e.g. red beech-silver beech forest), and a structural name based on the proportion of plant growth forms in the canopy or ground surface in open communities (e.g. scrub, shrub-tussockland, moss-boulderfield).

Species present in the canopy with a mean abundance ≥20% are included in the floristic name using their vernacular name rather than their scientific name, capping the theoretical maximum number of species at five (in reality it is rare that more than three plants appear; Atkinson 1962). Species with ≥50% cover are underlined. If no species reaches 20%, the two most abundant species are used, and if no species has greater than 1% cover, then no floristic name is given and the unit is named solely based on the nature of the open-ground surface (Atkinson 1985). When communities are named from species contributing <5% of the total, precedence is given to species that are the longest lived.

Prominent (or conspicuous) species with low abundance in the canopy but that are critical to describing the appearance of the vegetation – based on the user's judgement – are listed in parentheses; for example, a mountain beech forest with emergent kaikawaka is '(kaikawaka) / mountain beech forest'. These species are arranged first in order of height, then abundance, and common names are used in preference to scientific names. As in the IVC, a slash ('/') distinguishes different canopy tiers and a hyphen ('-') links species in the same tier. Structural names are based on a classification of growth forms and other surfaces provided in Table 9 of Atkinson (1985), such as 'forest', 'treeland', 'scrub', 'shrubland' (see also Table 2 in Atkinson 1962).

Some examples of names, from Atkinson (1981) are:

- Mountain inaka shrubland
- Rata-rimu/kamahi forest
- Bracken fernland.

The structural names from the Atkinson system form the basis for labelling vegetation communities and ground-cover types in the national typology based on an expert-based system (Singers & Rogers 2014). The species or taxonomic group names that precede the structural name are stated as those of 'structural or physiognomic dominance', without additional detail, probably due to the expert-derived nature of the typology (i.e. without using plot or canopy cover data to derive names). Overall, the names in the expert-based system most closely approximate the nature of the names in the Atkinson system. The Atkinson system is also used in the most commonly used treatment of wetlands in New Zealand (Johnson & Gerbeaux 2024).

3.2.3 Comparison between the EcoVeg approach and the Atkinson system

The structural component of names using the Atkinson system approximates the terms describing physiognomy applied at all levels in EcoVeg (Table 1). The floristic name is most equivalent to the dominant and diagnostic taxa used to name the mid and lower levels (Levels 5–8) of EcoVeg, except note that common names are preferred in the Atkinson system. Cover thresholds may result in only a small number of species represented in the floristic name component of the Atkinson system, which may limit the level of specificity (i.e. they will be too coarse) to accurately discriminate between some alliances and associations. A range of comparisons between EcoVeg and Atkinson features are provided in Table 3, and a comparison between names is provided in Table 4. EcoVeg and the associated IVC are undergoing active development internationally to remain current (e.g. Faber-Langendoen et al. 2025).

Table 3. A comparison between the Atkinson and EcoVeg naming systems

Feature	Atkinson system	EcoVeg approach
Hierarchical levels	Names include both structure (physiognomy) and floristics. No hierarchy implied.	Upper-level names reflect physiognomy, climate, and site factors. Lower-level names include physiognomy and floristics.
Physiognomic names	Specifies a dictionary of physiognomic names to be used in Atkinson (1985; their Table 9).	Recommends that within formations physiognomic terms be consistent and as specific as possible, and that a catalogue of terms and their usage be maintained to ensure consistency.
Rule base for floristic names	Only include species in the canopy.	Alliance: typically only species from the dominant tier/stratum. Association: can include species from any tier/stratum.
	Species included based on % cover (dominance).	Includes species that are diagnostic (differential, character) and/or dominant and constant.
	Common names preferred.	Scientific names preferred (for the scientific name).
Construction of floristic names	'-' (a hyphen) links species in the same tier.	'–' (an en dash) links species in the same tier.
	'/' links species in different tiers.	'/' links species in different tiers.
	Species with ≥20% cover are included; if no species reaches 20%, the two most abundant species are used.	Species with highest abundance and constancy are included: a maximum of six in an association and four in an alliance.
	Species with ≥50% cover are underlined. Prominent species are shown in parentheses (based on user's judgement).	Species less consistently found either in all associations of an alliance or in all occurrences/plots of an association are shown in brackets.

Table 4. Comparison between EcoVeg and Atkinson names in New Zealand

EcoVeg scientific name[a]	EcoVeg colloquial name[a]	Atkinson name[b]	Notes
Nothofagus solandri / *Coprosma pseudocuneata* – *Phyllocladus alpinus* (*Podocarpus nivalis*) subalpine forest	Mountain beech subalpine forest	Mountain beech forest	Both EcoVeg names provide more detail than the Atkinson name, with the colloquial name still user friendly. Several EcoVeg associations fit within this single Atkinson name (see next example).
Nothofagus solandri / *Polystichum vestitum* – *Blechnum penna-marina* (*Laginifera strangulata* – *Nemotoceras trilobum*) forest	Black/mountain beech forest with hard fern and little hard fern	Mountain beech forest	Both EcoVeg names provide more detail than the Atkinson name, with the colloquial name still user friendly. Several EcoVeg associations fit within this single Atkinson name (see previous example).
Leptospermum scoparium successional shrubland	Mānuka successional shrubland	Mānuka scrub	The EcoVeg name allows differentiation between successional and primary mānuka types.
Chionochloa flavescens – *Dracophyllum uniflorum* – *Podocarpus nivalis* – *Celmisia coriacea* – *Myrsine nummularia* shrubland	Broad-leaved snow tussock and turpentine scrub shrubland	Broad-leaved snow tussock and turpentine scrub shrubland	The EcoVeg scientific name provides more information, whereas the colloquial names are the same.

[a] Associations of the quantitative plot-based system (Wiser et al. 2011; Wiser et al. 2016).
[b] Ecosystem unit of the expert-based system (Singers & Rogers 2014).

3.3 Alignment of typologies to EcoVeg

Types from the expert-based system were allocated broadly across all EcoVeg levels, except for the broadest formation class (Level 1) (Figure 3). The most common level was alliance, followed by the association. Forested zonal ecosystems were almost aways allocated to these two levels, except for 'WF8' ('Kahikatea, pukatea forest'), 'WF9' ('Taraire, tawa, podocarp forest'), and 'MF4' ('Kahikatea forest'), which were all at the group level (Level 6) because they were stated as occurring outside the scope of their defined ecosystem drivers (see 'Methods') (Appendix 2). Remaining types at coarser/upper levels were all azonal ecosystems that had mainly physiognomic descriptions (i.e. listing growth forms rather than species), broad geographical ranges encompassing wide environmental variation, and wide structural variation (i.e. including both woody and non-woody components). Allocations to the highest upper three formation levels of EcoVeg were mostly defined at levels equivalent to the IUCN-GET Ecosystem Functional Groups (Keith et al. 2022). Six azonal ecosystems were at the alliance or association level, primarily because their type descriptions included limited (or no) internal compositional variation.

All types from the quantitative plot-based system were in either the alliance or association levels (Figure 3). This was not unexpected given they were defined quantitatively at that level (Jennings et al. 2009). There have been no attempts to define types at levels higher than the alliance level, either within Northland or nationally. Types have, however, been allocated to 'structural classes' (Tables A1.2, A1.3; Appendix 1), using rules defined by Wiser et al. (2011) for woody ecosystems and following the diagnostic criteria of Atkinson (1985; their Table 9) for non-woody ecosystems (Wiser et al. 2016).

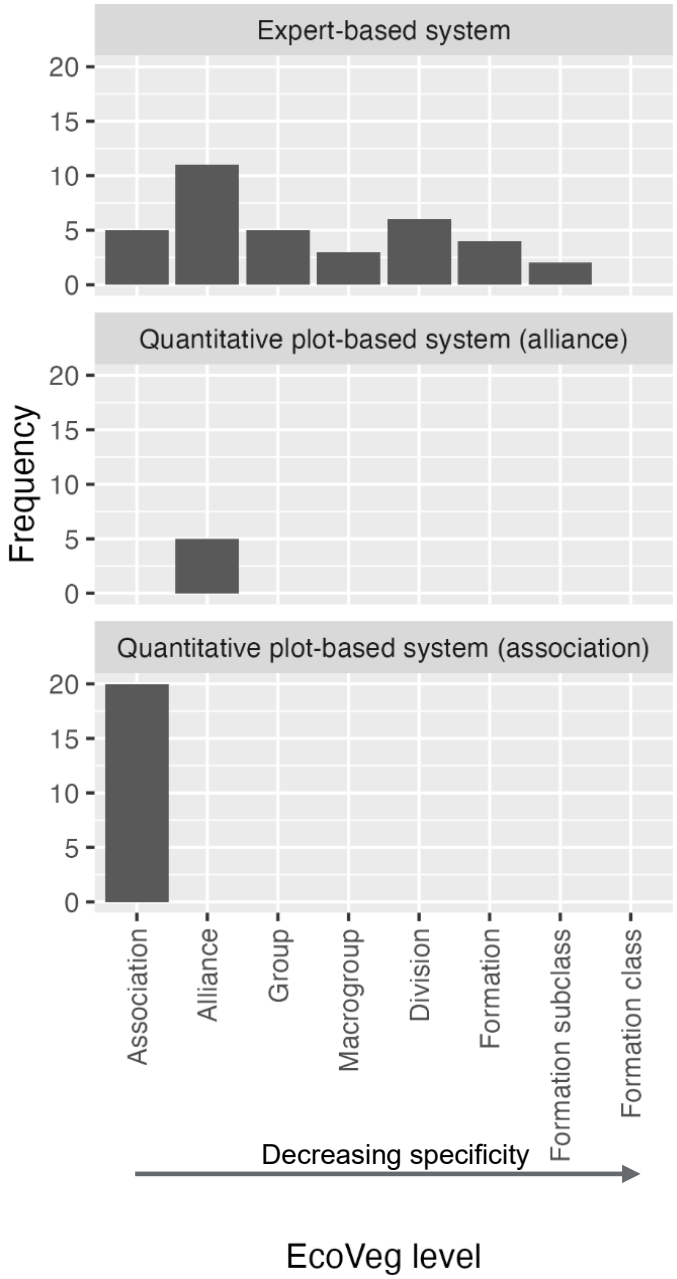


Figure 3. Assignment of types in the expert-based and quantitative plot-based systems to the levels in EcoVeg (Faber-Langendoen et al. 2014), which provides a framework for the hierarchical classifying of vegetation.
Notes: Types from the alliance and association data sets from the quantitative plot-based system were considered separately. When, for the expert-based typology, two levels were considered equally likely (e.g. 'alliance or association'), we displayed the finer of those levels.

3.4 Cross-walking typologies to each other

Overall, few types in the expert-based and quantitative plot-based systems represented equivalent concepts. Most of the types from the expert-based typology (28 out of 34, excluding the wetland mosaic types and 'WF7', which has sub-types) did not have any equivalent in associations or alliances of the quantitative plot-based system. In contrast, all of the alliances and all but two (18

out of 20) of the associations from the quantitative plot-based system had some conceptual overlap with types in the expert-based typology (Tables A3.5, A3.6). Between the two typologies most conceptual overlap was partial, with some of the described compositional variation of the focal type fitting within that of a type from the alternative typology, and the balance beyond scope of the other type. As a result, the 'relationship' for most cross-walk comparisons was designated as 'relationship complex' ('><'; Appendix 3, Tables A3.1–A3.4). The full cross-walks, including their fuzzy membership values, are presented in Appendix 3. This includes pairwise results between types of each system (Tables A3.1–A3.4) and a fully populated matrix displaying the cross-walks between both systems (Tables A3.5, A3.6).

Over half (9 out of 13) of the zonal forest types ('MF' and 'WF' codes) from the expert-based system were not represented in the associations of the quantitative plot-based system (Tables A3.2, A3.6). This was also the case for the quantitative plot-based system alliances (Tables A3.1, A3.5). This is primarily due to the scarce plot sampling of certain subsets of the Northland environment (alluvial and volcanic soils, areas of poor drainage, some high-elevation forests). A similar proportion of the wetland types (9 out of 11; 'WL' codes) also had no equivalent associations, and neither did any of the remaining relatively rare (Figure 1) azonal types (0 out of 10; 'CL', 'DN', 'GT', 'SA', and 'UM' codes). This reflects the fact that the expert-based typology is more ecologically comprehensive, whereas there has been no attempt to quantitatively sample all ecosystems of Northland using plots. There are plot data for many of the wetlands, but these have yet to be incorporated into the quantitative plot-based system (Clarkson et al. 2013; Burge et al. 2021). This was recommended by the ecosystem typology road map for wetlands (Burge 2025) and would probably increase coverage of many of the wetland types from the expert-based system in the quantitative plot-based system.

The only associations from the quantitative plot-based system that had no match to a type from the expert-based system were 'Gorse shrubland with cabbage trees' (code 'a: S6') and 'Tōwai – tawa / kiekie – patē forest' ('a: BL7'). Many of the associations from the quantitative plot-based system are conceptually related to types from the expert-based system (Singers & Rogers 2014) that weren't mapped in Northland (Table A3.6) (Singers & Lawrence 2018). The highest level of conceptual overlap was for associations from the quantitative plot-based system that included kauri. The gumland associations (codes 'AS8:a1' and 'AS8:a2') and alliance ('AS8') also matched well with the expert-based 'WL1' type.

Examining which type from the expert-based system was mapped on the locations where plots were sampled provided additional insights into the relationships between the two typologies. Of the 672 plots that have been classified to alliances of the quantitative plot-based system, over half (n = 425) occurred in areas mapped as 'WF11' following the expert-based system (Appendix 3; Table A3.7). 'WF11' has the greatest geographical extent in Northland of any of the expert-defined types mapped (Appendix 1; Table A1.1). Over half (n = 686) of the 989 plots classified to associations are mapped by the expert-based system as one of the 'WF' ('Warm Forest') types that include kauri (e.g. codes 'WF10', 'WF11'; Table A3.8), and this was partially consistent with the compositional affinities shown in the cross-walk analysis (Tables A3.2, A3.6). However, other mapped locations are not consistent with the results of the cross-walk analyses. This is especially true for the successional ('S' codes, 'Ru_M1' and 'Wh_M1') and 'Other forest' types ('OF' codes), which are typically also successional. This probably reflects the emphasis of the expert-based mapping on potential vegetation rather than current vegetation.

3.5 Descriptions and fact sheets

Fact sheets were prepared for the following four ecosystems:

- 'a: OF1' ('Kānuka – silver fern – hangehange – māhoe forest')
- 'a: OF2' ('Kohekohe – nīkau – māhoe forest')
- 'a: BLP16' ('Tawhero – taraire – tawa forest with kohekohe and kauri')
- 'AS8:a1' ('*Leptospermum scoparium* / *Gleichenia* spp. – *Baumea teretifolia* shrubland').

Information was available for most of the headings. Exceptions included 'diagnostic characteristics' because an indicator species analysis has not yet been performed for the quantitative plot-based system's associations, 'threat status' because national ecosystem threat assessments have not yet been completed, and 'associated fauna' for which an assessment is also yet to be performed. For some types, 'dynamics' were also unknown, and photos were only available for two of the four types. The example fact sheets are provided in Appendix 4.

Future additions to the fact sheets could include information from the Land Environments of New Zealand (Leathwick et al. 2002), compositional data from the National Vegetation Survey Databank (NVS), though this detailed information might be surplus to most user's requirements. Proportion of geographic range remaining in comparison to a reference state, and successional pathways would also be informative but require additional analysis to quantify and describe.

4 Conclusions

We found that the EcoVeg approach (Faber-Langendoen et al. 2014), which supports the IVC and is already in use for the quantitative plot-based system, would suit the requirements for a revised terrestrial typology in New Zealand (Collins 2024; McCarthy & Wiser 2024; Sprague & Wiser 2024). The EcoVeg naming system can be harmonised with the Atkinson naming system (Atkinson et al. 1962; Atkinson 1985), which is widely used in New Zealand. EcoVeg does not specify specific physiognomic or structural terms to components of names (i.e. '*Leptospermum scoparium* successional **shrubland**') but suggests that usage terms should be as consistent and specific as possible within formations, and that a catalogue of terms and their usage should be maintained for classification projects to ensure consistency, allowing Atkinson structural names to be adopted.

EcoVeg allows for a colloquial name that would closely approximate the way the Atkinson name is constructed (Table 4). EcoVeg also allows for more species names to be included in names of types than does the Atkinson system; this should enable a high degree of ecological resolution at the lowest (association) level. Higher ecological specificity in the name will assist with comprehensive ecosystem-level descriptions and field identifications of the type. Furthermore, EcoVeg supports the IVC, is harmonised with the IUCN-GET, and has a specified hierarchy to which any number of levels can be populated. A well-defined and consistently applied naming system will also facilitate the cataloguing of ecosystem types in a dedicated database.

Because standardisation of ecosystem scope was not a criterion during the development of the expert-based system, the component ecosystem types were allocated across almost all EcoVeg levels, as was expected. The forested zonal systems were largely allocated to the higher, more specific association and alliance levels, whereas the azonal types (ecosystems associated with

environmental extremes, i.e. wetlands, salt-adapted systems) were often allocated to the lower, broader levels. However, types from the quantitative plot-based system were allocated consistently to the association and alliance levels (within the association and alliance data sets).

This variability in conceptual scope of ecosystem types was evident in the result from the cross-walk between the two typologies. Types from the quantitative plot-based system were more often wholly embedded within types from the expert-based system, but the reverse was never observed. When types from the quantitative plot-based system matched more than one type from the expert-based system, this was because the quantitative type straddled two or more expert-based types, even though the quantitative plot-based system's type was more compositionally specific. Most of the types from the expert-based system (28 out of 34) did not match any type from the quantitative plot-based system, even when quantitative types not yet sampled from Northland were assessed. This indicates that many of the ecosystems of Northland are not represented by quantitative plot data (that are available).

Given that many types from the expert-based typology were allocated at levels higher than the quantitative plot-based system, it is likely that many tens of ecosystems from the region are currently undescribed to an alliance or association level of specificity. One of the types from the quantitative plot-based system that didn't match any from the expert-based system was a successional system including non-native gorse, reflecting the expert-based system's focus on 'steady' or 'potential' states rather than compositional expressions of disturbance by humans or introduced pests and weeds. Further plot-based surveys of the region, especially targeting currently unsampled ecosystems, would increase the comprehensiveness of a refined, future typology.

The close examination required to allocate types from each system to hierarchical levels of EcoVeg and complete the cross-walks helped to familiarise us with the ecosystems in Northland and how they are represented. Types that were represented in both systems can be readily adopted in a synthetic ecosystem catalogue; however, where relationships between the types of the two systems are highly complex, these will probably need to be resolved by Northland experts. This could be informed by assimilation of plot data sets not yet represented in the quantitative plot-based system, and also by sampling new locations.

Such activities could take place in a subsequent refinement step. The synthetic catalogue will use the allocation to EcoVeg hierarchy levels and the cross-walk relationships. It will list all ecosystems at their allocated hierarchical level, and the position in the hierarchy will be displayed (Figure 4). This will allow existing gaps to be readily visualised, and all types would be assigned a confidence level adopted from Jennings et al. 2009. This catalogue will reflect the level of conceptual overlap identified in our cross-walk process. Following are some examples:

- All ecosystems that have no match in the alternative typology (association crosswalks: 28 from the expert-based system, two from the quantitative plot-based system) will be listed. Any currently defined nestedness (at their allocated hierarchical level, including nestedness that has previously been defined) will be retained (e.g. 'WF7' 'Pūriri forest' and its subunits 'WF7.1'–'WF7.3'; 'A: S3' 'Mānuka shrubland alliance' and its component associations 'a: S4', 'a: S5').
- Where a quantitatively defined type is equivalent to an expert-derived type, the quantitatively defined type will be retained, with synonymy recorded.

- Where a quantitatively derived type is a subset of an expert-derived type, the quantitively derived type will be retained and its relationship to the expert-derived type made explicit in the hierarchy.
- Where a quantitatively derived type overlaps with multiple expert-derived types, the quantitative type will be retained and the circumscription of the expert-derived type tagged for re-evaluation. Examination of plot data not yet incorporated into the quantitative plot-based system or collection of new data may be required to resolve this.
- There will be other complex scenarios of overlap between the two typologies for which solutions will need to be developed on a case-by-case basis.

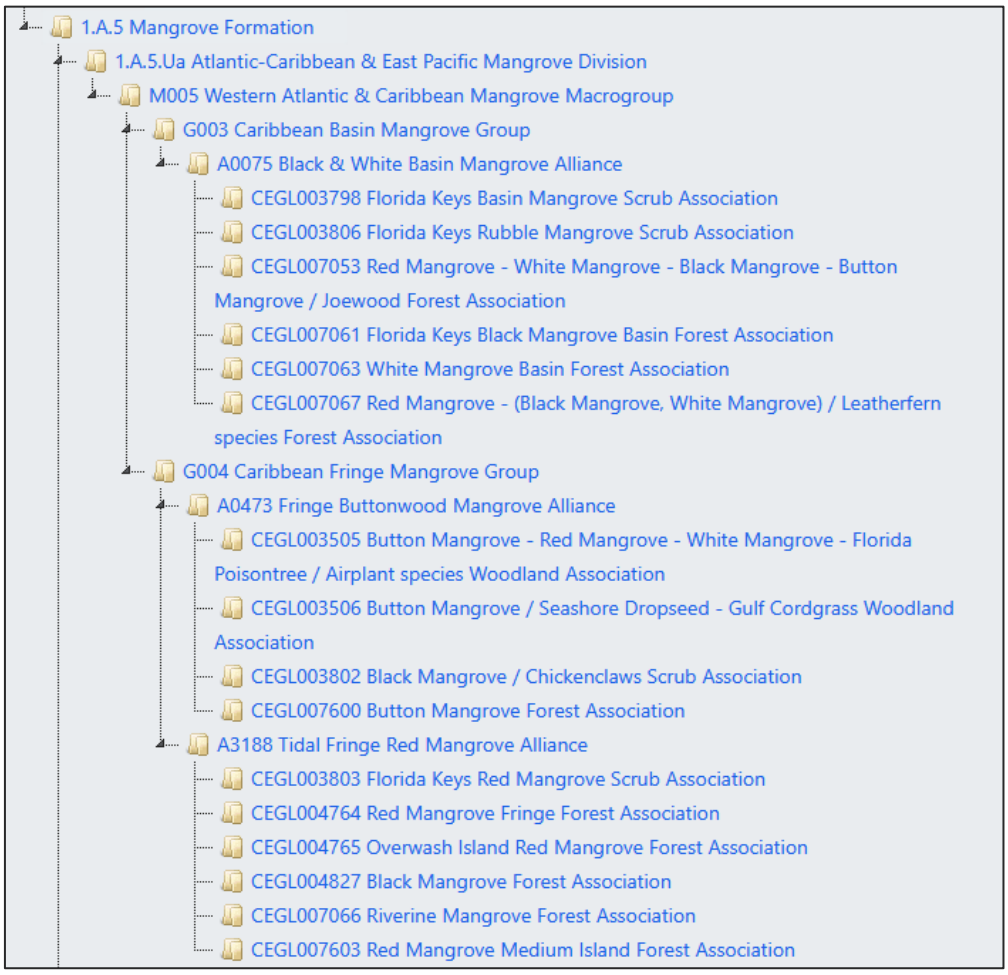


Figure 4. Example of a populated hierarchy using the IVC, taken from the US National Vegetation Classification (https://usnvc.org/explore-classification/) on 12 June 2025.

An integrated catalogue would need further work to be operationalised for use (see Primary Recommendation 1). Preparation of a catalogue of ecosystem types from Northland would provide the basis for a national ecosystem catalogue.

This report partially or wholly completes several of the Actions and Key Tasks defined in the terrestrial typology road map (McCarthy & Wiser 2024):

Action 2:

- The governance group confirms selection of the EcoVeg hierarchical framework for the terrestrial ecosystem typology for New Zealand. *Further Consideration 1 from this report needs to be implemented for completion.*
- Assign types from both New Zealand typologies to their appropriate levels in EcoVeg. *Completed for Northland*.
- Define new, higher (less granular) levels for the revised typology. *This task is no longer needed if EcoVeg and IVC are adopted.*

Action 3:

- Develop a template for standard, comprehensive descriptions of ecosystem types. *Example fact sheets have been completed.*
- Adopt a standard for naming ecosystem types. *Further Consideration 3 from this report needs to be implemented for completion.*

Action 7

- Decide on a candidate region to carry out a pilot study of integration. *Northland was the first candidate region.*
- Complete cross-walks between expert-based and quantitative plot-based systems, starting in the pilot study region. *This has been completed for Northland*.
- Develop criteria to finalise types. *Progress has been made – see Primary Recommendation 1.*

5 Recommendations

We have five primary recommendations and six further considerations, as follows.

5.1 Primary recommendations

1 *Northland: produce a harmonised catalogue of ecosystem types.* Using the EcoVeg framework and naming system, produce a harmonised, hierarchically explicit catalogue of ecosystem types in Northland that integrates the expert-based and the quantitative plot-based systems. This catalogue would reflect the level of conceptual overlap identified in our cross-walk process and would form the basis for a subsequent national ecosystem catalogue.

2 *Northland: continue the pilot to test activities needed for future implementation and operationalisation of a national typology*. With reference to the Actions and Tasks recommended by McCarthy & Wiser (2024), consider:

   - developing quantitative diagnostic criteria to allow the identification of types by third parties
   - developing complementary criteria to allow the identification of types without full plot data
   - generating ecological interpretations (i.e. climatic and environmental characteristics, successional status) for associations in the quantitative plot-based system

- incorporating vegetation plots collected more recently or collected with customised methods into the quantitative plot-based system.

This would probably advance the characterisation of ecosystem types in the expert-based system that may not yet be associated with vegetation plots. Finally:

- link plots previously designated as outliers in the quantitative plot-based system to appropriate types of the expert-based system to initiate the process of providing them a quantitative basis.

3 *Proceed with an integration pilot in another region with different environmental gradients and ecosystems*. This would allow the process of allocation to EcoVeg levels and cross-walking to be completed in another region before expanding to a wider geographical scope (i.e. nationally), in order to hone techniques and identify barriers to wider implementation. Ideally this would be completed in a region with different environmental conditions to those in Northland.

4 *Improve national ecosystem coverage in the quantitative plot-based system through identification and assimilation of existing unclassified data (e.g. wetlands).* There are existing plot data not yet included in the quantitative plot-based system, such as selected naturally uncommon ecosystems (e.g. gravel beaches), unclassified forest plot data sets, and wetlands. Of the Northland wetland types from the expert-based system, for example, 9 out of 11 had no equivalents in the quantitative plot-based system. There are, however, over 1,300 wetland plots collected nationally, including c. 73 in Northland, that have not yet been quantitatively allocated to types (O. Burge, pers. comm.). Their representation in the quantitative plot-based system will greatly improve the coverage of New Zealand's wetlands in the typology.

5 *Review ecosystem mapping approaches used internationally*. While mapping is usually attempted after the generation of a typology, the methods used to produce ecosystem maps can be researched and assessed before the terrestrial typology is complete. Pilot studies in region(s) would likely follow.

5.2 Further considerations

1 *Adopt the EcoVeg approach for ongoing use for future terrestrial ecosystem typologies in New Zealand.* The EcoVeg approach, which supports the IVC and is harmonised with the IUCN-GET, provides a robust and well-defined hierarchy to depict different levels of resolution for ecosystem delineation and enforces full nesting of lower levels into higher levels (Jennings et al. 2009; Faber-Langendoen et al. 2014; Faber-Langendoen et al. 2025). At the more specific levels where floristic information is included in the name, we recommend both a scientific name and a common/vernacular name to facilitate use. We suggest adopting the Atkinson terminology for physiognomy of 'forest', 'shrubland', 'fernland' etc., as these are in wide use in New Zealand (Atkinson 1985; their Table 9).

2 *Northland: develop a workplan to fill geographical and ecological gaps in the Northland typology in a robust, defensible way.* This could include integrating existing plots with quantitative data into the quantitative plot-based system, and collecting new plot data, especially in undersampled environments.

3 *Adopt a method for deriving short codes for ecosystems*. This code may reflect the level in the hierarchy, physiognomy, or some other feature. This would require a brief review of coding

systems used internationally and could complement the national cross-walk (see next consideration).

4 *Extend the cross-walks between the expert-based and quantitative plot-based systems nationally.* To assess the coverage of the quantitative plot-based system, a national cross-walk should be completed. This would ideally follow a further case study from another region (see Primary Recommendation 3 above).

5 *Develop tools to allow non-specialists to use data to classify vegetation plots to types in the ecosystems catalogue.* At present the allocation of plot data to types in the quantitative plot-based system is only able to be completed by a small number of specialists. Informatic tools should be developed to allow plots to be assigned to existing types, and a workflow developed for the description of new types. Ideally this would be linked with an national ecosystems catalogue (see Primary Recommendation 1, above)

6 *Develop a method for proposing new types where quantitative plot data are limited or absent.* This would be akin to the types of 'low' classification confidence from Jennings et al. 2009, and could be derived from qualitative assessments or community descriptions, often lacking complete plot data or providing only partial summaries, such as listing dominant species. Existing plot data currently classified as 'outliers' could also be examined for potential matches to undefined types.

6 Acknowledgements

We thank the following, who were members of a regional council steering group that advised the project: Annabel Beattie (Hawke's Bay Regional Council), Lorraine Cook (Horizons Regional Council), Alistair Jamieson (Auckland Regional Council), Matt Moss (Tasman District Council), and Stephanie Tong (Northland Regional Council).

We were also advised by a steering group comprising Anne-Gaelle Ausseil (Ministry for the Environment), Michael Berardozzi (Ministry for Primary Industries), Ellen Cieraad (Department of Conservation), Amy Hawcroft (Department of Conservation), Mark Hollis (Ministry for Primary Industries), Scott Jarvie (Otago Regional Council), Karen Tunley (Ministry for Primary Industries), and Roger Uys (Greater Wellington Regional Council).

We also thank Fiona Hodge, Rachel Corran, and Carolyn Mander from the Ministry for the Environment, and Lisa Forester, James Griffin, Katrina Hansen, Marley Ford, and Stephanie Tong from Northland Regional Council, for their direction and guidance.

Peter Bellingham helped review the ecosystem cross-walks. We thank Olivia Burge for helpful discussions and for reviewing this report, Ray Prebble for editing, and Kate Boardman for formatting.

7 References

Allen WJ, Godfrey P, Jolly BH, McCarthy JK, Wiser SK, Bellingham PJ 2025. Baseline information about vegetation and birds to guide kaitiakitanga in Mangōnui Forest. Manaaki Whenua – Landcare Research contract report LC4617.

Atkinson IAE 1962. Semi-quantitative measurements of canopy composition as a basis for mapping vegetation. Proceedings of the New Zealand Ecological Society 9: 1–8.

Atkinson IAE 1981. Vegetation map of Tongariro National Park, North Island, New Zealand. 1:50,000. Wellington, NZ, Botany Division, Department of Scientific and Industrial Research.

Atkinson IAE 1985. Derivation of vegetation mapping units for an ecological survey of Tongariro National North Island, New Zealand. New Zealand Journal of Botany 23: 361–378.

Atkinson IAE, Bieleski RL, Newhook FJ 1962. *Metrosideros parkinsonii* Buchan. on Little Barrier Island. Transactions of the Royal Society of New Zealand: Botany 1: 279–284.

Bellingham PJ, Wiser SK, McCarthy JK, Arnst EA, Innes JG, Fitzgerald NB, et al. 2020. Baseline information about vegetation and birds to guide kaitiakitanga in Warawara ngahere. Manaaki Whenua – Landcare Research contract report LC3671.

Braun-Blanquet J 1928. Pflanzensoziologie. Berlin, Springer-Verlag.

Burge OR 2025. Road map to an updated ecosystem typology for wetlands. Manaaki Whenua – Landcare Research contract report LC4596.

Burge OR, Clarkson BR, Eger A, Fitzgerald N 2021. Wetland plant foliage nutrients as indicators of soil nutrients. Manaaki Whenua – Landcare Research contract report LC3955.

Chappell PR 2013. The climate and weather of Northland. NIWA Science and Technology Series, No. 59, https://webstatic.niwa.co.nz/static/Northland%20ClimateWEB.pdf.

Clarkson BR, Ausseil AGE, Gerbeaux P 2013. Wetland ecosystem services In: Dymond JR ed. Ecosystem Services in New Zealand. Lincoln, NZ, Manaaki Whenua Press. Pp. 192–202.

Clarkson BR, Smale MC, Williams PA, Wiser SK, Buxton RP 2011. Drainage, soil fertility and fire frequency determine composition and structure of gumland heaths in northern New Zealand. New Zealand Journal of Ecology 31: 96–113.

Collins D 2024. Standardised ecosystem typologies: recommendations for New Zealand. Christchurch, NZ, Collins Consulting Ltd. https://environment.govt.nz/publications/standardised/.

Enright NJ 1989. Heathland vegetation of the Spirits Bay area, far northern New Zealand. New Zealand Journal of Ecology 12: 63–75.

Faber-Langendoen D, Baldwin K, Peet RK, Meidinger D, Muldavin E, Keeler-Wolf T, et al. 2018. The EcoVeg approach in the Americas: U.S., Canadian and International Vegetation Classifications. Phytocoenologia 48: 215–237.

Faber-Langendoen D, Keeler T, Meidinger D, Josse C, Weakley A, Tart D, et al. 2016. Classification and description of world formation types. General Technical Report RMRS-GTR-346, Fort Collins, CO, U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Faber-Langendoen D, Keeler-Wolf T, Meidinger D, Tart D, Hoagland B, Josse C, et al. 2014. EcoVeg: a new approach to vegetation description and classification. Ecological Monographs 84: 533–561.

Faber-Langendoen D, Keith DA, Loidi J, Helmer EH, Willner W, Navarro G, et al. 2025. Advancing the EcoVeg approach as a terrestrial ecosystem typology: from global biomes to local plant communities. Ecosphere 16: e70237.

GNS Science 2012. Geological map of New Zealand. GNS Science. https://doi.org/10.21420/QF82-7D42.

Grossman DH, Faber-Langendoen D, Weakley AS, Anderson M, Bourgeron P, Crawford R, et al. 1998. International classification of ecological communities: terrestrial vegetation of the United States. Volume I, The National Vegetation Classification System: development, status, and applications. Arlington, VA, US, The Nature Conservancy.

Heenan PB, Smissen RD 2013. Revised circumscription of *Nothofagus* and recognition of the segregate genera *Fuscospora*, *Lophozonia*, and *Trisyngyne* (Nothofagaceae). Phytotaxa 146: 1–31.

Jennings M, Loucks O, Glenn-Lewin D, Peet R, Faber-Langendoen D, Grossman D, et al. 2003. Guidelines for describing associations and alliances of the U.S. National Vegetation Classification. The Ecological Society of America, Vegetation Classification Panel, Version 3.0.

Jennings MD, Faber-Langendoen D, Loucks OL, Peet RK, Roberts D 2009. Standards for associations and alliances of the U.S. National Vegetation Classification. Ecological Monographs 79: 173–199.

Johnson P, Gerbeaux P 2024. Wetland types in New Zealand. Wellington, NZ, Department of Conservation.

Keith DA, Ferrer-Paris JR, Nicholson E, Bishop MJ, Polidoro BA, Ramirez-Llodra E, et al. 2022. A function-based typology for Earth's ecosystems. Nature 610: 513–518.

Keith DA, Rodríguez JP, Rodríguez-Clark KM, Nicholson E, Aapala K, Alonso A, et al. 2013. Scientific foundations for an IUCN Red List of ecosystems. PLoS ONE 8: e62111.

Leathwick J, Morgan F, Wilson G, Rutledge D, McLeod M, Johnson K 2002. Land Environments of New Zealand: A Technical Guide. Wellington, NZ, Ministry for the Environment.

McCarthy JK, Bellingham PJ 2024. Vegetation associations at Tāika Forest, Northland. Manaaki Whenua – Landcare Research contract report LC4512.

McCarthy JK, Bellingham PJ, Wiser SK, Buxton RP, Fergus A, Jolly BH, et al. 2022. Baseline information about vegetation and birds to guide kaitiakitanga in Russell ngahere. Manaaki Whenua – Landcare Research contract report LC4142.

McCarthy JK, Leathwick JR, Roudier P, Barringer JRF, Etherington TR, Morgan FJ, et al. 2021. New Zealand Environmental Data Stack (NZEnvDS): a standardised collection of spatial layers for environmental modelling and site characterisation. New Zealand Journal of Ecology 45: 3440.

McCarthy JK, Wiser SK 2024. Road map to update the existing typology for terrestrial ecosystems. Manaaki Whenua – Landcare Research contract report LC4528.

Newsome PFJ, Wilde RH, Willoughby EJ 2008. Land Resource Information System spatial data layers: data dictionary. Palmerston North, NZ, Landcare Research.

Nicholls JL 1976. A revised classification of the North Island indigenous forests. New Zealand Journal of Forestry 21: 105–132.

Pillon Y, Hopkins HCF, Maurin O, Epitawalage N, Bradford J, Rogers ZS, et al. 2021. Phylogenomics and biogeography of Cunoniaceae (Oxalidales) with complete generic sampling and taxonomic realignments. American Journal of Botany 108: 1181–1200.

Singers N, Lawrence C 2018. A potential ecosystem map for the Northland Region – explanatory information to accompany the map. Nicholas Singers Ecological Solutions Ltd.

Singers NJD, Rogers GM 2014. A classification of New Zealand's terrestrial ecosystems. Science for Conservation 325. Wellington, NZ, Department of Conservation. https://www.doc.govt.nz/Documents/science-and-technical/sfc325entire.pdf.

Smale MC, Wiser SK, Bergin MJ, Fitzgerald NB 2018. A classification of the geothermal vegetation of the Taupō Volcanic Zone, New Zealand. Journal of the Royal Society of New Zealand 48: 21–38.

Sprague RI, Wiser SK 2024. Investigating a unifying ecosystem typology for all of New Zealand. Manaaki Whenua – Landcare Research contract report LC4514.

Wiser SK, Bellingham PJ, Burrows LE 2001. Managing biodiversity information: development of New Zealand's National Vegetation Survey databank. New Zealand Journal of Ecology 25: 1–17.

Wiser SK, De Cáceres M 2013. Updating vegetation classifications: an example with New Zealand's woody vegetation. Journal of Vegetation Science 24: 80–93.

Wiser SK, De Cáceres M 2018. New Zealand's plot-based classification of vegetation. Phytocoenologia 48: 153–161.

Wiser SK, Hurst JM 2008. Classification of New Zealand forest and shrubland communities based on national plot sampling on an 8-km grid. Landcare Research contract report LC0809/007.

Wiser SK, Hurst JM 2010. Composition and structure of 24 New Zealand forest and shrubland vegetation communities. Landcare Research contract report LC0910/073.

Wiser SK, Hurst JM, Wright EF, Allen RB 2011. New Zealand's forest and shrubland communities: a quantitative classification based on a nationally representative plot network. Applied Vegetation Science 14: 506–523.

Wiser SK, McCarthy JK, Bellingham PJ, Jolly B, Meiforth JJ, Warawara Komiti Kaitiaki 2022. Integrating plot-based and remotely sensed data to map vegetation types in a New Zealand warm temperate rainforest. Applied Vegetation Science 25: e12695.

Wiser SK, Thomson FJ, De Cáceres M 2016. Expanding an existing classification of New Zealand vegetation to include non-forested vegetation. New Zealand Journal of Ecology 40: 160–178.

Appendix 1 – Ecosystem types in Northland

Table A1.1. Ecosystem types present in Northland from the expert-based system (Singers & Rogers 2014; Singers & Lawrence 2018). Areas presented are calculated from the associated map. Area values from polygons with mixed membership were split evenly across their component ecosystem types, so numbers may differ from other publications.

Ecosystem code	Ecosystem name	Ecosystem description (from Singers & Rogers 2014)	Area in Northland (ha)
CL1	Pōhutukawa treeland/flaxland/ rockland	Coastal rockland and colluvial slopes, with mosaics of treeland of abundant pōhutukawa, and occasional houpara, taupata, karo, kawakawa, wharangi, species of *Carmichaelia* and *Hebe*, harakeke, rengarenga, *Astelia banksii*, coastal tussock and halophytic herbs (e.g. ice plant and pigweed). Flax can be locally abundant in exposed and windswept locations.	2,118.8
CL6	*Hebe*, whararikiflaxland/rockland	Rockland and colluvial slopes with several local variants over a wide latitudinal/altitudinal gradient, with mosaics of short-statured herbs, grasses, short forest and scrub. Dominants include whararikiki, *Poa anceps*, species of *Hebe*, *Gaultheria*, *Pimelea*, *Olearia*, *Sophora*, *Carmichaelia*, *Leucopogon*, *Cyathodes* and *Dracophyllum*, and tutu, and locally ngaio, kānuka, *Chionochloa flavicans*, *Astelia solandri*, *Dianella nigra* and *Collospermum hastatum*. Locally, subalpine species include *Hebe colensoi* and *Pimelea* spp. on inland sites, and local endemics on weakly weathered calcareous parent materials. Locally includes *Machaerina sinclarii*, kiokio, and rheophytic herbs, sedges, grasses and bryophytes associated with seepages, streams and rivers.	41.2
CL10[a]	Kiokio fernland/rockland	Rockland and colluvial slopes, with mosaics of scrub, shrub, fern, herbs and grass species, and locally lianes. Dominants may include species of *Blechnum* and *Hymenophyllum*, *Schoenus pauciflorus*, whararikiki, species of *Coprosma*, *Hebe*, *Olearia* and *Pseudopanax*, tutu, kāmahi and kōtukutuku, and locally southern rātā. Altitudinal variants occur, with subalpine/alpine species such as species of *Ourisia*, *Ranunculus* and *Chionochloa* present, which may be locally dominant. Includes rheophytic herbs, sedges, grasses and bryophytes associated with seepages, streams and rivers, including species of *Parahebe*, *Gunnera* and *Nertera*, and *Anaphalioides trinervis*.	0.0
DN2	Spinifex, pīngao grassland/ sedgeland	Sedgeland, grassland of abundant spinifex and pīngao, with occasional shore bindweed, sand coprosma, tauhinu and sand daphne, grading into rear semi-stable dunes with open, scattered dune scrub of bracken, *Muehlenbeckia complexa*, toetoe, harakeke and cabbage trees. Locally includes matagouri, mānuka, kānuka, tutu and *Olearia solandri*.	32,060.6
DN5	Oioi, knobby clubrush sedgeland	Sedgeland, herbfield of several local variants with both dry and ephemerally wet communities of a range of successional stages. Dominant species include *Carex pumila*, species of *Gunnera*, *Selliera*, *Isolepis*, *Epilobium*, *Ranunculus*, *Leptinella*, *Lobelia*, *Colobanthus*, *Geranium* and *Hydrocotyle*, and locally *Lilaeopsis novae-zelandiae*, *Myriophyllum votschii*, *Triglochin striata*, *Limosella lineata* and other turf-forming species. Older stages develop into oioi, knobby clubrush, toetoe and harakeke, and locally *Cyperus ustulatus*, *Lepidosperma australe*, silver tussock	601.0

Ecosystem code	Ecosystem name	Ecosystem description (from Singers & Rogers 2014)	Area in Northland (ha)
		and *Raoulia* spp. Locally includes *Coprosma propinqua* and mānuka in older successions.	
GT2[a]	Geothermally heated water and steam	Geysers, pools, springs/streams, fumaroles and sinter terraces (including their margins), and geothermal wetlands of a range of temperature, chemical and pH conditions, with associated microbes, cyanobacteria mats and bryophytes, and locally ferns and sedges.	0.0
MF4[a]	Kahikatea forest	Podocarp forest of abundant kahikatea locally with mataī and a sparse subcanopy of ribbonwood and houhere species, and locally kōwhai, pōkākā, māhoe and tarata on alluvial flood plains. Ribbonwood and hohere are locally absent, while pōkākā can often be more abundant. Divaricating shrubs are a common lower understorey element.	0.0
MF24	Rimu, tōwai forest	Podocarp, broadleaved forest with occasional emergent rimu, miro and northern rātā, abundant tōwai, locally tawa and swamp maire, and occasional hīnau, rewarewa, tāwari, pukatea, mangeao, raukawa, narrow-leaved maire, makamaka and hutu.	9,541.8
SA1	Mangrove forest and scrub	Forest and scrub of abundant mangrove, often with areas of rushland, herbfield including sea rush and oioi, and locally species of *Machaerinajuncea* and *Bolboschoenus*, and salt marsh ribbonwood, grading to seagrass herbfield on tidal flats. May locally include shell barrier beaches with a scattered herbfield of glasswort, buggar grass, knobby clubrush, sea rush, sea primrose and sea blite.	18,182.6
SA4[b]	Shore bindweed, knobby clubrush gravelfield/ stonefield	Stonefield, gravelfield with at least four variants. Contains halophytic herbs, sedges and vines, including glasswort, half-star, shore celery, arrow grass, shore spurge, knobby clubrush and shore bindweed grading into a coastal scrub-vineland of *Coprosma* and *Muehlenbeckia*, and locally species of *Melicytus*, *Pimelea* and *Ozothamnus*, and harakeke. Treeland also locally includes ngaio, taupata, akeake, kōwhai and tānekaha further inland on older beach ridges at Miranda. Dominated by local endemics, including *Myosotidium hortensium* and *Embergeria grandifolia*, on the Chatham Islands.	6.1
SA7	Iceplant, glasswort herbfield/loamfield	Mosaic of herbfield of glasswort, ice plant, pigweed, shore groundsel, sea primrose, shore celery, and *Lepidium* spp., and locally oioi, knobby clubrush, toetoe and *Poa* spp., with a scattered scrub/vineland of locally taupata, houpara, flax, ngaio, shrubby *Melicytus*, *Hebe* spp. and small-leaved pōhuehue interspersed with bare ground, bird burrows and guano deposits.	132.3
UM1	Pōhutukawa tānekaha forest/scrub/ rockland	Mosaics of short forest, scrub and rockland of pōhutukawa, tānekaha, kānuka, karo, *Astelia banksii*, toetoe and harakeke, with a large number of associated local endemics.	174.6
WF4	Pōhutukawa, pūriri, karaka, broadleaved forest	Broadleaved forest of several variants, with pōhutukawa and pūriri, and locally with karaka, kohekohe, tītoki, mangeao, rewarewa, tawa, puka, tawāpou, ngaio, nīkau, taraire, and occasional tānekaha and kauri in the northern part of range, and locally hard beech along the Bay of Plenty coast and East Cape (also with black beech). Kānuka and kōwhai locally occur on dry, steep ridges. Includes local endemic species and varieties where present on	28,200.6

Ecosystem code	Ecosystem name	Ecosystem description (from Singers & Rogers 2014)	Area in Northland (ha)
		some northern offshore islands, especially Manawatāwhi/Three Kings Islands.	
WF5	Tōtara, kānuka, broadleaved forest [Dune forest]	Mosaics of kānuka forest on younger (Holocene) dunes, grading into podocarp, broadleaved forest of tītoki, tōtara, māhoe, karaka, kohekohe, tawa, pūriri and hīnau, and locally pōhutukawa, narrow-leaved maire and taraire on older dunes.	47,406.2
WF7	Pūriri forest	Broadleaved forest of abundant pūriri of three variants determined by landform and soil type (see below).	106,278.9[c]
WF7.1	Pūriri tōtara forest	In addition to WF7: occasional tōtara, mataī, kahikatea and titoki locally, with kōwhai and taraire on alluvial, free-draining soils.	35,776.2
WF7.2	Pūriri, taraire forest	In addition to WF7: locally abundant taraire and kohekohe, and occasional tōtara, mataī, pukatea, rewarewa, karaka, tawa, tītoki and northern rātā, and abundant nīkau on fertile basaltic volcanic loam soils.	44,380.5
WF7.3	Pūriri, kahikatea forest	In addition to WF7: occasional emergent kahikatea and kohekohe, and locally taraire, tītoki, pukatea and nīkau on moderately well-drained fluvial and allophanic soils derived from basaltic ash.	26,122.0
WF8	Kahikatea, pukatea forest	Podocarp, broadleaved forest of abundant kahikatea, with occasional to abundant pukatea, kiekie and supplejack, and locally rimu, tawa and swamp maire, particularly on organic and gley soils with a high water table.	68,347.7
WF9	Taraire, tawa, podocarp forest	Podocarp, broadleaved forest of abundant taraire, with occasional rimu, miro, northern rātā, tawa, kohekohe, hīnau and rewarewa, and with pukatea and kahikatea commonly in gullies. Locally includes tōtara, pūriri and tōwai.	108,527.8
WF10	Kauri forest	Kauri forest with occasional podocarps (miro, rimu, toatoa, Hall's tōtara, tānekaha) and broadleaved trees (northern rātā, tawa, taraire, hīnau, rewarewa, kohekohe and tōwai).	13,345.7
WF11	Kauri, podocarp, broadleaved forest	Kauri, podocarp, broadleaved forest with occasional rimu, miro, kahikatea, kauri, taraire, tawa, tōwai, kohekohe, pūriri and rewarewa. Altitude variants occur, with taraire and kohekohe more abundant at lower altitudes, and tawa and tōwai more common at higher altitudes.	743,466.9
WF12	Kauri, podocarp, broadleaved, beech forest	Kauri, podocarp, broadleaved and hard beech forest with occasional tānekaha, Hall's tōtara or lowland tōtara, rimu, miro, tawa, hīnau and rewarewa, and locally narrow-leaved maire, tāwari and hard beech. Generally confined to ridges.	346.2
WF13	Tawa, kohekohe, rewarewa, hīnau, podocarp forest	Podocarp, broadleaved forest of occasional emergent rimu, miro, northern rātā and locally kahikatea, with abundant tawa, kohekohe, hīnau, rewarewa and pukatea. Locally includes tāwari, kāmahi, tōwai, pūriri and mangeao, although tōwai and mangeao are locally absent or rare (e.g. Auckland and East Cape).	10,254.4
WL1	Mānuka, gumland grass tree, *Machaerina* scrub/sedgeland [Gumland]	Low scrub, sedgeland of two broad types (poor-draining and seasonally dry), dominated by mānuka with gumland grass tree and tall mingimingi, and with species of *Machaerina*, *Schoenus*, *Gahnia*, *Tetraria*, *Lepidosperma* sedges and, locally, tangle fern.	40,539.5

Ecosystem code	Ecosystem name	Ecosystem description (from Singers & Rogers 2014)	Area in Northland (ha)
WL2	Mānuka, greater wire rush restiad rushland	Scrub, restiad rushland, fernland, sedgeland of abundant mānuka, with greater wire rush, tangle fern, *Machaerina teretifolia* (e.g. *M. rubignosa*) and *Schoenus brevifolius*.	1,214.3
WL3	Bamboo rush, greater wire rush restiad rushland	Restiad rushland of abundant bamboo rush and locally abundant greater wire rush, with occasional scrub of mānuka, *Dracophyllum lessonianum* and *Epacris sinclairii*, and locally *Lycopodiella lateralis*, *Machaerina teretifolia*, *Schoenus brevifolius* and tangle fern. May include small, embedded pools with sphagnum, and species of *Utricularia* and *Drosera*.	1,214.3
WL10	Oioi restiad-rushland/reedland	Restiad rushland with abundant oioi, locally with large *Machaerina*, *Bolboschoenus* spp., kuta and lake clubrush, and often with occasional raupō and scattered harakeke grading into wetland scrub on margins.	59.7
WL11[d]	*Machaerina* sedgeland	Sedgeland, rushland with a high water table dominated by species of *Machaerina*, square sedge, *Eleocharis* and *Juncus*, often with scattered harakeke and *Carex* spp. Locally includes oioi, tangle fern and *Gahnia* spp., which can be locally dominant. Lagg margins often grade into mānuka scrub fens.	–
WL12[d]	Mānuka, tanglefern scrub/fernland	Scrub with abundant mānuka and occasional species of *Olearia*, *Coprosma* and *Dracophyllum*, and species of *Machaerina*, square sedge, *Carex* and *Juncus*. Locally abundant tangle fern, *Schoenus pauciflorus*, sphagnum, stunted harakeke, and species of *Astelia* and *Gahnia*. Locally also includes bog pine, silver pine and pink pine.	–
WL14	Herbfield [Ephemeral wetland]	Herbfield and/or low sedgeland dominated by a wide range of predominantly montane, short-statured herbs, grasses and sedges. Dominants may include species of *Leptinella*, *Lobelia*, *Hydrocotyle*, *Euchiton*, *Epilobium*, *Plantago*, *Ranunculus*, *Myriophyllum*, *Elatine*, *Glossostigma*, *Isolepis*, *Eleocharis*, *Carex* and *Deschampsia*.	14.1
WL15	Herbfield [Lakeshore turf]	Herbfield and/or low sedgeland of two broad variants (coastal and inland), which often have species in common. Coastal variant is often brackish, and commonly includes *Selliera radicans*, and species of *Isolepis*, *Limosella* and *Lilaeopsis*, and grades into salt marsh with increasing salinity. Inland variant commonly includes *Glossistigma elatinoides*, species of *Lilaeopsis*, *Carex*, *Eleocharis*, *Lobelia*, *Centrolepis*, *Hydrocotyle*, *Myriophyllum*, *Plantago*, *Ranunculus* and *Crassula*, and other herb species.	25.9
WL18[d]	Flaxland	Flaxland of abundant harakeke, often with toetoe, species of *Carex* (e.g. pūkio) and *Machaerina*, and kiokio, occasional wetland scrub, treeland of cabbage tree, *Coprosma* spp. and mānuka, and locally weeping matipo and twiggy tree daisy. Areas with high water tables may be dominated by pūkio. May grade or succeed into wetland carr, with abundant emergent cabbage trees.	–
WL19	Raupō reedland	Reedland of abundant raupō, locally with species of *Bolboschoenus*, *Schoenoplectus* and *Machaerinaarticulata*, pūkio, harakeke, and swamp millet. A margin of scrub of *Coprosma* species and cabbage tree, and locally twiggy tree daisy and mānuka, with scattered kahikatea in unmodified areas. Often occurs on lake margins, or includes small ponds with shallow water/pools with floating/rafted aquatics such as water milfoils,	7.5

Ecosystem code	Ecosystem name	Ecosystem description (from Singers & Rogers 2014)	Area in Northland (ha)
		buttercups, willowherbs, species of *Potamogeton*, *Isolepis*, *Azolla* and *Lemna*, and spiked sedges (e.g. kuta).	
WL20[d]	*Coprosma Olearia* scrub	Scrub of species of *Coprosma* and locally twiggy tree daisy (which can be locally dominant), with a mosaic of a wide variety of *Carex* spp. and locally kiokio. May also locally include scattered harakeke, raupō, toetoe and cabbage trees.	–
–	WL Bog/Fen mosaic[e]	Does not feature in Singers & Rogers 2014. Description from Singers & Lawrence 2018: 'Copied from Northland wetland layer. This ecosystem was mapped in areas with the organic soil type OMA. The common ecosystem types present likely include WL2: Mānuka, greater wire rush restiad rushland, WL11: *Machaerina* sedgeland and WL12: Mānuka, tanglefern scrub/fernland.'	22,082.4
–	WL, Bog mosaic[e]	Does not feature in Singers & Rogers 2014. Description from Singers & Lawrence 2018: 'Copied from Northland wetland layer.'	7,462.8

[a] Features in Singers & Lawrence 2018 but not mapped.

[b] Does not feature in Singers & Lawrence 2018 but appears in the map.

[c] Sum of WF7.1, WF7.2, and WF7.3.

[d] Features in Singers & Lawrence 2018 but only mapped as part of wetland mosaics.

[e] Other combinations of this name that were mapped but not specified in Singers & Lawrence 2018 were split evenly across these two types.

Table A1.2. Ecosystem types present in Northland from the quantitative plot-based system alliances (Wiser et al. 2011; Wiser & De Cáceres 2013; Wiser et al. 2016; McCarthy et al. 2022; Wiser et al. 2022; Allen et al. 2025). Values indicating the number of plots in Northland do not come from an unbiased sample set so are not a reliable estimate of ecosystem extent. Types with the same letter portion of their code are members of the same 'structural class'.

Alliance code	Alliance name (common)	Alliance name (scientific)	Alliance description[a]	Number of plots in Northland
A: BLPF4	Silver fern – māhoe forest	*Cyathea dealbata* – *Melicytus ramiflorus* – *Freycinetia baueriana* – *Ripogonum scandens* forest	The forest is dominated by *Cyathea dealbata*, *Melicytus ramiflorus*, and the climbers *Freycinetia baueriana* and *Ripogonum scandens*. Diagnostic species include *Rhopostylis sapida*, *Dysoxylum spectabile*, *Blechnum filiforme*, *Freycinetia baueriana*, *Beilschmiedia tarairi*, and the climbing fern *Lygodium articulatum*. Important subcanopy species are *Pseudopanax crassifolius*, *Schefflera digitata*, *Coprosma grandifolia*, *Clematis paniculata*, *Myrsine australis*, *Olearia rani*, and the tree fern *Dicksonia squarrosa*. On the ground layer important species are *Microsorum pustulatum*, *Uncinia uncinata*, *Astelia solandri*, *Blechnum filiforme*, and *Asplenium oblongifolium*. Climbing rātā are common, especially *Metrosideros perforata* and *M. diffusa*. Species richness is high with on average 56 species per plot, with half of these (28) being measurable trees. Ferns are important in this forest class, comprising on average 34% of the species (mean = 19 per plot, range 6–32), the most frequent being *Microsorum pustulatum*, *Asplenium flaccidum* and *A. polyodon*. Exotic species richness is low to moderate (mean = 2 per plot, range 0–25), but no individual species is particularly frequent.	202
A: BLPF7	Tōwai – tawa forest	*Weinmannia silvicola* – *Beilschmiedia tawa* / *Freycinetia banksii* forest	Stands are consistently dominated by *Weinmannia silvicola* and *Beilschmiedia tawa* in the canopy and *Freycinetia banksii* in the subcanopy. *Dysoxylum spectabile*, *Podocarpus hallii*, *Prumnopitys ferruginea*, *Agathis australis*, *Beilschmiedia taraire*, and *Dacrydium cupressinum* frequently occur in the canopy, and *Cyathea dealbata* frequently occurs in the subcanopy. Indicator species include *Weinmannia silvicola*, *Blechnum fraseri*, *Metrosideros albiflora*, *Astelia trinervia*, *Lygodium articulatum* and *Brachyglottis kirkii*. Species richness is high, with on average 50 species per plot. No exotics have been recorded.	221
A: OF1	Kānuka forest and tall shrubland	*Kunzea ericoides* – *Cyathea dealbata* – (*Leptospermum scoparium*) / *Leucopogon fasciculatus* (*Coprosma rhamnoides*) forest and tall shrubland	The forest is dominated by *Kunzea ericoides*, typically with an understorey of *Coprosma rhamnoides*, *Leucopogon fasciculatus*, *Geniostoma rupestre*, and *Cyathea dealbata*. On some sites *Leptospermum scoparium* co-dominates. Diagnostic species include *Doodia australis*, *Oplismenus imbecillis*, the exotic weed *Ageratina riparia*, and *Kunzea ericoides*.	20

Alliance code	Alliance name (common)	Alliance name (scientific)	Alliance description[a]	Number of plots in Northland
			Important species on the ground layer are bracken, *Uncinia uncinata*, *Oplismenus imbecillis*, *Blechnum novae-zealandiae*, *Dianella nigra*, *Microlaena stipoides*, *Lotus pedunculatus*, and occasional *Doodia australis*. Species richness is moderate, with on average 41 species per plot, with 17 of these being measurable trees. Exotic species are prominent (averaging 19 ± 2.4% of total species richness), the most frequent being *Lotus pedunculatus*, *Cirsium vulgare*, and *Prunella vulgaris*.	
A: S1	Kānuka shrubland with *Coprosma* and prickly mingimingi	*Kunzea ericoides* / (*Coprosma rhamnoides* – *Leptecophylla juniperina*) shrubland	The shrubland is dominated by *Kunzea ericoides* in the canopy. The smaller shrubs *Coprosma rhamnoides*, *Leptecophylla juniperina*, and *Leucopogon fasciculatus* are frequent. *Kunzea ericoides* is the only indicator species. Species richness of this alliance is moderately low, with, on average, 27 species per plot. On average, 14% (5 species) of these are exotic.	2
AS8	Kānuka – mānuka heath	*Leptospermum scoparium* / *Schoenus brevifolius* – [*Gleichenia* spp.] shrubland	No description available. Defined in Wiser et al. 2016, but also see Clarkson et al. 2011.	67
Noise[b]	Noise class	–	–	160
Unclassified[c]	–	–	–	445

[a] From https://www.landcareresearch.co.nz/publications/woody-ecosystem-types/.

[b] These are plots that did not have sufficient compositional similarity to another defined type.

[c] These plots have not yet been classified at the alliance level, but do have associations assigned.

Table A1.3. Ecosystem types present in Northland from the quantitative plot-based system associations (Wiser et al. 2011; Wiser & De Cáceres 2013; Wiser et al. 2016; McCarthy et al. 2022; Wiser et al. 2022; Allen et al. 2025). Values indicating the number of plots in Northland do not come from an unbiased sample set so are not a reliable estimate of ecosystem extent. Types with the same letter portion of their code are members of the same 'structural class'.

Association code	Association name (common)	Association name (scientific)[a]	Association description[b]	Number of plots in Northland
a: BL4	Māhoe – pigeonwood – tawa forest	*Melicytus ramiflorus – Hedycarya arborea – Beilschmiedia tawa / Schefflera digitata / Ripogonum scandens – Asplenium bulbiferum* forest	This forest association is, on average, 17 m tall but can range widely from 4 to 65 m. It tends to be species-rich with an average of 46 species on a plot, but can range from 32 to 67. On average there are few (less than 2%) exotic species present.	2
a: BL7	Tōwai – tawa / kiekie – patē forest (Bellingham et al. 2020) High-elevation hardwood forest (Wiser et al. 2022)	*Pterophylla sylvicola – Beilschmiedia tawa – Beilschmiedia tarairi / Freycinetia banksii – Coprosma autumnalis – Olearia rani – Geniostoma ligustrifolium – Melicytus macrophyllus* forest	No description available. Defined in Bellingham et al. 2020 and Wiser et al. 2022.	88
a: BLP3	Tawa – kāmahi forest – pigeonwood forest with hard and soft tree ferns	*Beilschmiedia tawa – Weinmannia racemosa – Hedycarya arborea / Cyathea smithii – Dicksonia squarrosa / Blechnum discolor* forest	This forest association is, on average, 19 m tall but can range from 6 to 35 m. It tends to contain a moderately rich amount of species with an average of 34 species on a plot, but can reach 72. On average, there are very few (less than 1%) exotic species present.	1
a: BLP9	Mataī – māhoe – red māpou forest	*Prumnopitys taxifolia / Melicytus ramiflorus – Myrsine australis / Macropiper excelsum* forest	On average stands are 13 m tall, but may be up to 25 m tall. These forests are quite rich in species, with on average 40 species, and as many as 90 species, recorded on a plot. Seven percent of these, on average, are exotic.	1
a: BLP15	Kāmahi – pigeonwood forest with hard fern and kiekie	*Weinmannia racemosa – Hedycarya arborea* (*Melicytus ramiflorus*) / *Dicksonia squarrosa – Freycinetia banksii – Ripogonum scandens* forest	On average stands are 14 m tall, but may be as tall as 35 m. These forests are relatively species-rich, with on average 42 species, and as many as 70, recorded on a plot. These forests have a low level of invasion by exotics, with on average less than 1% of the species present being exotic.	2

Association code	Association name (common)	Association name (scientific)[a]	Association description[b]	Number of plots in Northland
a: BLP16	Tawhero – taraire – tawa forest with kohekohe and kauri	*Weinmannia silvicola – Beilschmiedia tarairi – Beilschmiedia tawa –* (*Dysoxylum spectabile – Agathis australis*) / *Freycinetia banksii – Dicksonia squarrosa* forest	This forest association is, on average, 21 m tall but can range from 2 to 37 m. It tends to be species-rich with an average of 65 species on a plot, but can range from 56 to 81. On average there are very few (less than 1%) exotic species present.	247
a: K1	Tawhero – kauri forest with mānuka and rewarewa	*Weinmannia silvicola –* (*Agathis australis*) / *Leptospermum scoparium – Knightia excelsa* / *Leucopogon fasciculatus – Blechnum novae-zealandiae* forest	This forest association is rather short statured at, on average, 10 m tall but can range from 5 to 15 m. It tends to contain a moderate amount of species, with an average of 24 species on a plot, but can reach 42. On average there are few (less than 2%) exotic species present.	19
a: OF1	Kānuka – silver fern – hangehange – māhoe forest	*Kunzea ericoides – Cyathea dealbata – Geniostoma rupestre – Melicytus ramiflorus* / *Coprosma rhamnoides – Leucopogon fasciculatus* forest	This short-statured forest association has an average height of 10 m (range 6 to 15 m) and tends to be species-rich with, on average, 37 species on a plot, but can reach as many as 59. On average, 7% of species in this association are exotic.	56
a: OF2	Kohekohe – nīkau – māhoe forest	*Dysoxylum spectabile – Rhopalostylis sapida – Melicytus ramiflorus* (*Beilschmiedia tarairi*) / *Freycinetia banksii – Cyathea dealbata – Ripogonum scandens* forest	On average this forest association is 19 m tall, but can reach 38 m. It tends to be species rich with, on average, 51 species on a plot and very few (less than 1%) exotic.	237
a: S1	Kānuka shrubland with native shrubs	*Kunzea ericoides* / (*Coprosma rhamnoides – Leucopogon fasciculatus – Leptocophylla juniperina*) shrubland	This shrubland association is, on average, 7 m tall but can range from 2 to 16 m. It tends to have moderate plant diversity with an average of 21 species on a plot, but can reach 50. On average, 11% of species in this association are exotic.	7
a: S2	Grey scrub with kānuka and exotic grasses	(*Kunzea ericoides*) / *Coprosma rhamnoides* / *Dactylis glomerata – Anthoxanthum odoratum – Plantago lanceolata –* (*Agrostis capillaris*) successional shrubland	This shrubland association is, on average, 4 m tall but can range from 0.2 to 6.5 m. It tends to be species-rich, with an average of 43 species on a plot, but can range from 23 to 69. On average, however, over half of these species are exotic.	8
a: S3	Kānuka shrubland with exotic grasses	*Kunzea ericoides* / *Agrostis capillaris – Anthoxanthum odoratum* shrubland	No description available.	1

Association code	Association name (common)	Association name (scientific)[a]	Association description[b]	Number of plots in Northland
a: S4	Mānuka shrubland with wire rush and tangle fern	*Leptospermum scoparium* / *Empodisma minus* – *Gleichenia* sp. – *Lycopodiella diffusa* – *Leptecophylla juniperina* shrubland	This shrubland association is, on average, 3 m tall but can range from 1 to 7 m. It tends to be species-poor, with an average of 16 species on a plot, but can range from 8 to 25. On average, there are few (less than 2%) exotic species present.	1
a: S5	Mānuka successional shrubland	*Leptospermum scoparium* successional shrubland	On average stands are 3 m tall, but may be up to 6 m tall. These shrublands have moderate numbers of species, with on average 18 species, but as few as 6 and as many as 57, recorded on a plot. Of these 9% are exotic, on average.	9
a: S6	Gorse shrubland with cabbage trees	(*Cordyline australis*) *Ulex europaeus* shrubland	These shrublands range from 2 to 3 m tall. They tend to be species-poor with an average of only 4 species on a plot, but can, reach 26. On average over a third of species present are exotic.	2
AS8.a1	–	*Leptospermum scoparium* / *Gleichenia* spp. – *Baumea teretifolia* shrubland	No description available. Defined in Wiser et al. 2016, but also see Clarkson et al. 2011.	38
AS8.a2	–	*Leptospermum scoparium* – *Hakea sericea* / *Schoenus brevifolius* shrubland	No description available. Defined in Wiser et al. 2016, but also see Clarkson et al. 2011.	29
Ru_M1	Tānekaha – kānuka – kauri secondary forest	*Phyllocladus trichomanoides* – *Kunzea ericoides* – *Agathis australis* / *Beilschmiedia tarairi* / *Cyathea dealbata* / *Freycinetia banksii* forest	No description available. Defined in McCarthy et al. 2022.	100
Wh_M1	Kānuka – tōwai – ponga – māpere secondary forest	*Kunzea ericoides* – *Pterophylla sylvicola* / *Cyathea dealbata* – (*Leptospermum scoparium*) / *Gahnia setifolia* forest	No description available. Defined in Allen et al. 2025.	61
WW_M2	Tōwai / tāwari – kiekie forest (emergent kauri – tōtara) (Bellingham et al. 2020) High-elevation kauri – podocarp – hardwood forest (Wiser et al. 2022)	*Pterophylla sylvicola* – *Podocarpus laetus* – (*Agathis australis*) / *Freycinetia banksii* – *Quintinia serrata* – *Ixerba brexioides* / *Gahnia xanthocarpa* – *Dicksonia lanata* forest	No description available. Defined in Bellingham et al. 2020 and Wiser et al. 2022.	80

Association code	Association name (common)	Association name (scientific)[a]	Association description[b]	Number of plots in Northland
Noise[c]	Noise class	–	–	128

[a] Note that in some cases these names do not reflect the current accepted taxonomy; e.g. the updates to *Nothofagus* spp. (Heenan & Smissen 2013) and *Weinmannia* spp. (Pillon et al. 2021).

[b] From https://www.landcareresearch.co.nz/publications/woody-ecosystem-types/ (unless otherwise cited).

[c] These are plots that did not have sufficient compositional similarity to another defined type.

Appendix 2 – Assignment of ecosystems to EcoVeg

Table A2.1. Assignment of ecosystems from the expert-based and quantitative plot-based systems to EcoVeg

Typology	Ecosystem code	Ecosystem name[a]	EcoVeg level	Notes
Expert-based	Not provided	WL, Bog Mosaic	Formation	No information on this type is available, but bogs are at the Formation level in the IUCN-GET. This type is from Singers & Lawrence 2018 but does not feature in Singers & Rogers 2014.
Expert-based	Not provided	WL Bog/Fen mosaic	Formation subclass	Contains bogs and fens, which are both at the Formation level in the IUCN-GET, so we selected one level above. This type is from Singers & Lawrence 2018 but does not feature in Singers & Rogers 2014.
Expert-based	CL1	Pōhutukawa treeland/flaxland/ rockland	Alliance	This type encompasses wide environmental variation and describes a mosaic of vegetation types. Also defines offshore islands as being distinct (but included) and having endemics.
Expert-based	CL6	*Hebe*, whararikiflaxland/rockland	Group	Includes a wide compositional and physiognomic gradient; also occurs on a range of substrates and across a range of climates.
Expert-based	CL10	Kiokio fernland/rockland	Group	Includes a wide compositional and physiognomic gradient; also occurs on a range of substrates and across a range of climates.
Expert-based	DN2	Spinifex, pīngao grassland/sedgeland	Alliance	It is stated that this type has local variation, and it is also mapped as a mosaic with DN5 in Northland.
Expert-based	DN5	Oioi, knobby clubrush sedgeland	Alliance	It is stated that this type has local variation, and it is also mapped as a mosaic with DN2 in Northland.
Expert-based	GT2	Geothermally heated water and steam	Formation	Equivalent to an IUCN-GET Ecosystem Functional Group (includes non-terrestrial systems/realms; terrestrial component sits at Formation level).
Expert-based	MF4	Kahikatea forest	Group	This unit is described as occurring in mild semi-arid areas, but is also described as occurring elsewhere. Substantial local variation is also described for this type.
Expert-based	MF24	Rimu, tōwai forest	Alliance or Association	Difficult to assign – some local variation noted ('locally').

Typology	Ecosystem code	Ecosystem name[a]	EcoVeg level	Notes
Expert-based	SA1	Mangrove forest and scrub	Formation	Equivalent to IUCN-GET Ecosystem Functional Group 'MFT1.2 Intertidal forests and shrublands'. Our assessment has ignored the phrase about rushlands and herbfields, etc. (from Singers & Rogers 2014), which encompasses both woody and non-woody ecosystems.
Expert-based	SA4	Shore bindweed, knobby clubrush gravelfield/stonefield	Division	Primarily described based on growth form, and reflects biogeographic differences in composition and environment. This type occurs nationally.
Expert-based	SA7	Iceplant, glasswort herbfield/loamfield	Macrogroup	Has several diagnostic species, and specific disturbance regime (seabirds). This is one of several expert-based types that result from seabird nesting sites. Spans 'continental' climatic gradients from central North Island to Otago.
Expert-based	UM1	Pōhutukawa, tānekaha forest/scrub/rockland	Macrogroup	Described as a mosaic of physiognomies, and with local variation described ('a large number of associated local endemics'). Reflects regional geology and substrate. This is a site-based description that encompasses broad variability in physiognomy, so difficult to assign.
Expert-based	WF4	Pōhutukawa, pūriri, karaka, broadleaved forest	Alliance	There is substantial compositional variation in the definition of this type, particularly in comparison to areas outside Northland.
Expert-based	WF5	Tōtara, kānuka, broadleaved forest [Dune forest]	Alliance	There is substantial compositional variation in the definition of this type, in part related to dune age.
Expert-based	WF7	Pūriri forest	Alliance	There is substantial compositional variation in the definition of this type, based on topo-edaphic influences. There are recognised subtypes in this type (see units WF7.1, WF7.2, and WF7.3).
Expert-based	WF7.1	Pūriri tōtara forest	Association	A subtype of WF7, differentiated based on composition, geology, and soils
Expert-based	WF7.2	Pūriri, taraire forest	Association	A subtype of WF7, differentiated based on composition, geology, and soils
Expert-based	WF7.3	Pūriri, kahikatea forest	Association	A subtype of WF7, differentiated based on composition, geology, and soils
Expert-based	WF8	Kahikatea, pukatea forest	Group	Occurs outside the sub-humid range of the designated secondary ecosystem driver. Possibly higher than Group, given the list of diagnostic species isn't comprehensive.

Typology	Ecosystem code	Ecosystem name[a]	EcoVeg level	Notes
Expert-based	WF9	Taraire, tawa, podocarp forest	Group	This unit is predominantly in the warm climatic zone, but is also described as occurring south to the Waikato district. Singers and Lawrence (2018) also include substantial variation through both logged and unlogged forests.
Expert-based	WF10	Kauri forest	Alliance	There is little compositional variation described in this type. However, based on the cross-walks, several quantitative plot-based associations are included in this type. Relationship to WF11 needs to be better understood.
Expert-based	WF11	Kauri, podocarp, broadleaved forest	Alliance	Described as having altitudinal variation that influences composition. Singers and Lawrence (2018) state that it occurs on a wide range of soil types.
Expert-based	WF12	Kauri, podocarp, broadleaved, beech forest	Alliance or Association	Difficult to assign – described as confined to ridges (specific landform), but also described local variation.
Expert-based	WF13	Tawa, kohekohe, rewarewa, hīnau, podocarp forest	Alliance	Describes local variation (in Singers & Rogers 2014).
Expert-based	WL1	Mānuka, gumland grass tree, *Machaerina* scrub/sedgeland [Gumland]	Alliance	Described as including local variation.
Expert-based	WL2	Mānuka, greater wire rush restiad rushland	Alliance	Mapped in Northland as a mosaic with WL3. No internal variation described, but broader compositionally than WL3 (O. Burge, pers. comm.).
Expert-based	WL3	Bamboo rush, greater wire rush restiad rushland	Alliance	Mapped in Northland as a mosaic with WL2. Local variation described.
Expert-based	WL10	Oioi restiad-rushland/reedland	Division	Largely growth forms and genera used in the name and description. Our assessment has ignored the phrase 'grading into wetland scrub on margins' (from Singers & Rogers 2014) as this expands the definition to encompass woody wetlands.
Expert-based	WL11	*Machaerina* sedgeland	Division	Largely growth forms and genera used in the name and description. Our assessment has ignored the phrase 'margins often grade into mānuka scrub fens' (from Singers & Rogers 2014) as this expands the definition to encompass woody wetlands.
Expert-based	WL12	Mānuka, tanglefern scrub/fernland	Macrogroup	Described as including local variation. Spans a wide range of climatic gradients from Northland to Stewart Island.
Expert-based	WL14	Herbfield [Ephemeral wetland]	Formation	This type is physiognomic with a list of commonly included dominant genera.

Typology	Ecosystem code	Ecosystem name[a]	EcoVeg level	Notes
Expert-based	WL15	Herbfield [Lakeshore turf]	Formation subclass	Has large environmental and compositional variation, ranging from coastal brackish to inland wetlands. This type includes multiple IUCN-GET Ecosystem Functional Groups across multiple transitional realms.
Expert-based	WL18	Flaxland	Division	This type is distinguished primarily by growth forms, and ranges from being dominated by harakeke to pūkio. It has a very broad geographical range. These species can occur in many wetland types and can be at different successional stages.
Expert-based	WL19	Raupō reedland	Division	Spans 'continental' climatic gradients, from Northland to south Otago. Our assessment has ignored the phrase 'margin of scrub' (from Singers & Rogers 2014) as this expands the definition to encompass woody wetlands.
Expert-based	WL20	*Coprosma Olearia* scrub (Singers & Lawrence 2018); *Coprosma*, twiggy tree daisy scrub (Singers & Rogers 2014)	Division	Note that WL20 has different names in the expert-based Northland and main reports. Spans 'continental' climatic gradients from the central North Island to Southland.
Quantitative (alliances)	A: BLPF4	Silver fern – māhoe forest	Alliance	Quantitatively defined at the alliance level.
Quantitative (alliances)	A: BLPF7	Tōwai – tawa forest	Alliance	Quantitatively defined at the alliance level.
Quantitative (alliances)	A: OF1	Kānuka forest and tall shrubland	Alliance	Quantitatively defined at the alliance level.
Quantitative (alliances)	A: S1	Kānuka shrubland with *Coprosma* and prickly mingimingi	Alliance	Quantitatively defined at the alliance level.
Quantitative (alliances)	AS8	*Kānuka – mānuka* heath	Alliance	Quantitatively defined at the alliance level (non-woody classification, Wiser et al. 2016).
Quantitative (associations)	a: BL4	Māhoe – pigeonwood – tawa forest	Association	Quantitatively defined at the association level.
Quantitative (associations)	a: BL7	Tōwai – tawa / kiekie – patē forest	Association	Quantitatively defined at the association level.
Quantitative (associations)	a: BLP3	Tawa – kāmahi forest – pigeonwood forest with hard and soft tree ferns	Association	Quantitatively defined at the association level.
Quantitative (associations)	a: BLP9	Mataī – māhoe – red māpou forest	Association	Quantitatively defined at the association level.
Quantitative (associations)	a: BLP15	Kāmahi – pigeonwood forest with hard fern and kiekie	Association	Quantitatively defined at the association level.

Typology	Ecosystem code	Ecosystem name[a]	EcoVeg level	Notes
Quantitative (associations)	a: BLP16	Tawhero – taraire – tawa forest with kohekohe and kauri	Association	Quantitatively defined at the association level.
Quantitative (associations)	a: K1	Tawhero – kauri forest with mānuka and rewarewa	Association	Quantitatively defined at the association level.
Quantitative (associations)	a: OF1	Kānuka – silver fern – hangehange – māhoe forest	Association	Quantitatively defined at the association level.
Quantitative (associations)	a: OF2	Kohekohe – nīkau – māhoe forest	Association	Quantitatively defined at the association level.
Quantitative (associations)	a: S1	Kānuka shrubland with native shrubs	Association	Quantitatively defined at the association level.
Quantitative (associations)	a: S2	Grey scrub with kānuka and exotic grasses	Association	Quantitatively defined at the association level.
Quantitative (associations)	a: S3	Kānuka shrubland with exotic grasses	Association	Quantitatively defined at the association level.
Quantitative (associations)	a: S4	Mānuka shrubland with wire rush and tangle fern	Association	Quantitatively defined at the association level.
Quantitative (associations)	a: S5	Mānuka successional shrubland	Association	Quantitatively defined at the association level.
Quantitative (associations)	a: S6	Gorse shrubland with cabbage trees	Association	Quantitatively defined at the association level.
Quantitative (associations)	AS8:a1	*Leptospermum scoparium* / *Gleichenia* spp. – *Baumea teretifolia* shrubland	Association	Quantitatively defined at the association level (non-woody classification, Wiser et al. 2016). There is no common name for this type.
Quantitative (associations)	AS8:a2	*Leptospermum scoparium* – *Hakea sericea* / *Schoenus brevifolius* shrubland	Association	Quantitatively defined at the association level (non-woody classification, Wiser et al. 2016). There is no common name for this type.
Quantitative (associations)	Noise	Noise class	NA	Unable to assess – these are plots that did not have sufficient compositional similarity to another defined type.
Quantitative (associations)	Ru_M1	Tānekaha – kānuka – kauri secondary forest	Association	Quantitatively defined at the association level. This type has not yet been allocated an ecosystem code from the typology.
Quantitative (associations)	Wh_M1	Kānuka – tōwai – ponga – māpere secondary forest	Association	Quantitatively defined at the association level. This type has not yet been allocated an ecosystem code from the typology.
Quantitative (associations)	WW_M2	Tōwai / tāwari – kiekie forest (emergent kauri – tōtara)	Association	Quantitatively defined at the association level. This type has not yet been allocated an ecosystem code from the typology.

[a] Common name presented for the quantitative plot-based system (where available).

Appendix 3 – Cross-walks between the expert-based and quantitative plot-based systems

Table A3.1. Cross-walk table from the expert-based system to the quantitative plot-based system (alliances). Following Appendix S5 of Faber-Langendoen et al. 2025, the 'Relationship' column summarises the cross-walk where: '=' means the concepts are equivalent; '~=' means the concepts are largely equivalent; '>' means the expert-based system concept is broader than the quantitative system concept; '<' means the quantitative system is finer than the expert-based system concept; '= ><' means the relationship is complex; and '?=' means the relationship is uncertain.

Ecosystem code (expert-based system)	Ecosystem name (expert-based system)	Fuzzy membership	Relationship	Ecosystem code (quantitative plot-based system, alliances)	Ecosystem name (quantitative plot-based system, alliances)	Notes
Not provided	WL Bog/Fen mosaic	–	–	Not evaluated	–	There is limited detail provided on this mosaic, so not evaluated.
Not provided	WL, Bog mosaic	–	–	Not evaluated	–	There is limited detail provided on this mosaic, so not evaluated.
CL1	Pōhutukawa treeland/flaxland/rockland	1.0	–	No overlap	–	Includes rare ecosystems: coastal rock stacks; coastal cliffs on acidic rock; basic coastal cliffs; seabird guano deposits; and seabird burrowed soil
CL6	Hebe, whararikiflaxland/rockland	1.0	–	No overlap	–	Includes rare ecosystems: cliffs, scarps and tors on acidic rocks; calcareous cliffs, tors and scarps; and cliffs, scarps and tors on basic rocks
CL10	Kiokio fernland/rockland	1.0	–	No overlap	–	Includes rare ecosystems: cliffs, scarps and tors on acidic rocks; and seepages and flushes
DN2	Spinifex, pīngao grassland/sedgeland	1.0	–	No overlap	–	Includes rare ecosystem active sand dunes
DN5	Oioi, knobby clubrush sedgeland	1.0	–	No overlap	–	Includes rare ecosystems: deflation hollow; damp sand plains; and dune slacks
GT2	Geothermally heated water and steam	1.0	–	No overlap	–	Includes rare ecosystems: geothermal streamsides; and fumaroles

Ecosystem code (expert-based system)	Ecosystem name (expert-based system)	Fuzzy membership	Relationship	Ecosystem code (quantitative plot-based system, alliances)	Ecosystem name (quantitative plot-based system, alliances)	Notes
MF4	Kahikatea forest	1.0	–	No overlap	–	Primarily east coast of both islands to Oamaru in the south. Possible overlap with a: BLP9 (Mataī – māhoe – red māpou forest), which has an easterly distribution, but descriptions are quite different. Alluvium is scarcely sampled in Northland, so not surprising this doesn't appear as a type in the quantitative plot-based system.
MF24	Rimu, tōwai forest	1.0	–	No overlap	–	Includes rare ecosystem cloud forest. No suitable combination described in the quantitative plot-based system. The high-elevation forests of Northland are scarcely sampled, so not surprising this doesn't appear as a type in the quantitative plot-based system.
SA1	Mangrove forest and scrub	1.0	–	No overlap	–	Includes rare ecosystem: shell barrier beaches (Chenier Plains).
SA4	Shore bindweed, knobby clubrush gravelfield/ stonefield	1.0	–	No overlap	–	Includes rare ecosystems: shingle beaches, and stony beach ridges.
SA7	Iceplant, glasswort herbfield/loamfield	1.0	–	No overlap	–	Includes rare ecosystems: seabird guano deposits; and seabird burrowed soil.
UM1	Pōhutukawa tānekaha forest/scrub/rockland	1.0	–	No overlap	–	Includes rare ecosystems: ultrabasic sea cliffs; and ultrabasic hills. Unique to North Cape ultramafic belt.
WF4	Pōhutukawa, pūriri, karaka, broadleaved forest	1.0	–	No overlap	–	Includes rare ecosystem recent larva flows.

Ecosystem code (expert-based system)	Ecosystem name (expert-based system)	Fuzzy membership	Relationship	Ecosystem code (quantitative plot-based system, alliances)	Ecosystem name (quantitative plot-based system, alliances)	Notes
WF5	Tōtara, kānuka, broadleaved forest [Dune forest]	1.0	–	No overlap	–	Includes rare ecosystem stable sand dunes. This is a coastal forest type without a clear counterpart in the quantitative plot-based system (the *Kunzea*-dominated associations described there are not coastal). Plots inadequately sample dunes in Northland, so not surprising this doesn't appear as a type in the quantitative plot-based system.
WF7	Pūriri forest	1.0	–	No overlap	–	These associations are described as extremely rare, and therefore unlikely to have been classified directly in the quantitative plot-based system, where the alluvia and volcanic soils are scarcely sampled.
WF7.1	Pūriri tōtara forest	1.0	–	No overlap	–	See above (WF7).
WF7.2	Pūriri, taraire forest	1.0	–	No overlap	–	See above (WF7).
WF7.3	Pūriri, kahikatea forest	1.0	–	No overlap	–	See above (WF7).
WF8	Kahikatea, pukatea forest	1.0	–	No overlap	–	Of the many podocarp–broadleaved associations described in the quantitative plot-based system, there is nothing that seems to capture the warm forest with poor drainage typified by this type. It is likely there are some types in Northland that sample this type of forest, but not many.
WF9	Taraire, tawa, podocarp forest	1.0.	–	No overlap	–	No equivalent in the quantitative plot-based system.
WF10	Kauri forest	0.1	><	A: BLPF7 (partial overlap)	Tōwai – tawa forest	There is a weak element of kauri in A: BLPF7 that probably overlaps.
WF10	Kauri forest	0.9	–	No overlap	–	No alliance is described for the associations that include kauri (a: K1, WW_M2 or Ru_M1).
WF11	Kauri, podocarp, broadleaved forest	0.66	–	No overlap	–	No equivalent in the quantitative plot-based system.

Ecosystem code (expert-based system)	Ecosystem name (expert-based system)	Fuzzy membership	Relationship	Ecosystem code (quantitative plot-based system, alliances)	Ecosystem name (quantitative plot-based system, alliances)	Notes
WF11	Kauri, podocarp, broadleaved forest	0.33	> <	A: BLPF7 (partial overlap)	Tōwai – tawa forest	
WF12	Kauri, podocarp, broadleaved, beech forest	1.0	–	No overlap	–	Types from the quantitative plot-based system don't include kauri and beech together. Singers and Rogers (2014) note that this type is generally confined to ridges, so it is perhaps unlikely it was sampled in sufficient quantity to be identified in a quantitative plot-based system.
WF13	Tawa, kohekohe, rewarewa, hīnau, podocarp forest	0.6	> <	A: BLPF3 (partial overlap)	Tawa forest	
WF13	Tawa, kohekohe, rewarewa, hīnau, podocarp forest	0.2	> <	A: BLPF4 (partial overlap)	Silver fern – māhoe forest	
WF13	Tawa, kohekohe, rewarewa, hīnau, podocarp forest	0.2	–	No overlap	–	No equivalent in the quantitative plot-based system.
WL1	Mānuka, gumland grass tree, *Machaerina* scrub/sedgeland [Gumland]	1.0	=	A:S8 (overlaps with)	Kānuka – mānuka heath	Includes rare ecosystem gumland. The distinction between poor draining and seasonally dry match the two component associations of A:S8 from Wiser et al. (2016).
WL2	Mānuka, greater wire rush restiad rushland	0.2	> <	A: S3 (overlap)	Mānuka shrubland	Has affinities to A: S3 but doesn't have lessor wire rush as a key feature. A: S3 likely more southern in distribution therefore confidence is low.
WL2	Mānuka, greater wire rush restiad rushland	0.8	–	No overlap	–	No equivalent in the quantitative plot-based system.
WL3	Bamboo rush, greater wire rush restiad rushland	1.0	–	No overlap	–	Includes rare ecosystem domed bog. Vegetation closely aligned with WL2 but on older bogs (>7000 yrs). No equivalent in the quantitative plot-based system.

Ecosystem code (expert-based system)	Ecosystem name (expert-based system)	Fuzzy membership	Relationship	Ecosystem code (quantitative plot-based system, alliances)	Ecosystem name (quantitative plot-based system, alliances)	Notes
WL10	Oioi restiad-rushland/reedland	1.0	–	No overlap	–	No equivalent in the quantitative plot-based system.
WL11	*Machaerina* sedgeland	1.0	–	No overlap	–	Includes rare ecosystems lagoon and lake margins. No equivalent in the quantitative plot-based system.
WL12	Mānuka, tanglefern scrub/fernland	0.6	><	A: S3 (partial overlap)	Mānuka shrubland	The alliance A: S3 overlaps according to quantitative plot-based system factsheet.
WL12	Mānuka, tanglefern scrub/fernland	0.4	–	No overlap	–	No equivalent in the quantitative plot-based system.
WL14	Herbfield [Ephemeral wetland]	1.0	–	No overlap	–	Includes rare ecosystem ephemeral wetlands and lagoon margins.
WL15	Herbfield [Lakeshore turf]	1.0	–	No overlap	–	Includes rare ecosystem lagoon and lake margins.
WL18	Flaxland	1.0	–	No overlap	–	No equivalent in the quantitative plot-based system.
WL19	Raupō reedland	1.0	–	No overlap	–	Includes rare ecosystem lake margins.
WL20	*Coprosma Olearia* scrub	1.0	–	No overlap	–	No equivalent in the quantitative plot-based system.

Table A3.2. Cross-walk table from the expert-based system to the quantitative plot-based system (associations). Following Appendix S5 of Faber-Langendoen et al. 2025, the 'Relationship' column summarises the cross-walk where: '=' means the concepts are equivalent; '~=' means the concepts are largely equivalent; '>' means the expert-based system concept is broader than the quantitative system concept; '<' means the quantitative system is finer than the expert-based system concept; '= ><' means the relationship is complex; and '?=' means the relationship is uncertain.

Ecosystem code (expert-based system)	Ecosystem name (expert-based system)	Fuzzy membership	Relationship	Ecosystem code (quantitative plot-based system, associations)	Ecosystem name (quantitative plot-based system, associations)	Notes
Not provided	WL Bog/Fen mosaic	–	–	Not evaluated	–	There is limited detail provided on this mosaic, so not evaluated.
Not provided	WL, Bog mosaic	–	–	Not evaluated	–	There is limited detail provided on this mosaic, so not evaluated.
CL1	Pōhutukawa treeland/flaxland/rockland	1.0	–	No overlap	–	Includes rare ecosystems: coastal rock stacks; coastal cliffs on acidic rock; basic coastal cliffs; seabird guano deposits; and seabird burrowed soil.
CL6	Hebe, whararikiflaxland/rockland	1.0	–	No overlap	–	Includes rare ecosystems: cliffs, scarps and tors on acidic rocks; and seepages and flushes.
CL10	Kiokio fernland/rockland	1.0	–	No overlap	–	Includes rare ecosystems: cliffs, scarps and tors on acidic rocks; and seepages and flushes.
DN2	Spinifex, pīngao grassland/sedgeland	1.0	–	No overlap	–	Includes rare ecosystem active sand dunes.
DN5	Oioi, knobby clubrush sedgeland	1.0	–	No overlap	–	Includes rare ecosystems: deflation hollows; damp sand plains; and dune slacks.
GT2	Geothermally heated water and steam	1.0	–	No overlap	–	Includes rare ecosystems: geothermal streamsides; and fumaroles.
MF4	Kahikatea forest	1.0	–	No overlap	–	Primarily east coast of both islands to Oamaru in the south. Possible overlap with a: BLP9 (Mataī – māhoe – red māpou forest), which has an easterly distribution, but descriptions are quite different. Alluvium is scarcely sampled in Northland, so not surprising this doesn't appear as a type in the quantitative plot-based system.

Ecosystem code (expert-based system)	Ecosystem name (expert-based system)	Fuzzy membership	Relationship	Ecosystem code (quantitative plot-based system, associations)	Ecosystem name (quantitative plot-based system, associations)	Notes
MF24	Rimu, tōwai forest	1.0	–	No overlap	–	Includes rare ecosystem cloud forest. No suitable combination described in the quantitative plot-based system. The high-elevation forests of Northland are scarcely sampled, so not surprising this doesn't appear as a type in the quantitative plot-based system.
SA1	Mangrove forest and scrub	1.0	–	No overlap	–	Includes rare ecosystem: shell barrier beaches (Chenier Plains).
SA4	Shore bindweed, knobby clubrush gravelfield/ stonefield	1.0	–	No overlap	–	Includes rare ecosystems: shingle beaches; and stony beach ridges.
SA7	Iceplant, glasswort herbfield/loamfield	1.0	–	No overlap	–	Includes rare ecosystems: seabird guano deposits; and seabird burrowed soil.
UM1	Pōhutukawa tānekaha forest/scrub/rockland	1.0	–	No overlap	–	Includes rare ecosystems: ultrabasic sea cliffs; and ultrabasic hills. Unique to North Cape ultramafic belt.
WF4	Pōhutukawa, pūriri, karaka, broadleaved forest	0.75	–	No overlap	–	Plots inadequately sample the coastal vegetation in Northland, so not surprising this doesn't appear as a type in the quantitative plot-based system.
WF4	Pōhutukawa, pūriri, karaka, broadleaved forest	0.25	><	a: OF2 (partial overlap)	Kohekohe – nīkau – māhoe forest	Includes rare ecosystem recent larva flows. Singers and Lawrence (2018) state that this is known as 'coastal broadleaved forest'. Very northern distribution with southern limit at cut-off for pūriri. Partial overlap with a: OF2, which is also a coastal forest but seems to lack the very coastal elements such as pōhutukawa, and it is also stated as occurring to 485 m.

Ecosystem code (expert-based system)	Ecosystem name (expert-based system)	Fuzzy membership	Relationship	Ecosystem code (quantitative plot-based system, associations)	Ecosystem name (quantitative plot-based system, associations)	Notes
WF5	Tōtara, kānuka, broadleaved forest [Dune forest]	1.0	–	No overlap	–	Includes rare ecosystem stable sand dunes. This is a coastal forest type without a clear counterpart in the quantitative plot-based system (the *Kunzea*-dominated associations described there are not coastal). Plots inadequately sample dunes in Northland, so not surprising this doesn't appear as a type in the quantitative plot-based system.
WF7	Pūriri forest	1.0	–	No overlap	–	These associations are described as extremely rare, and therefore unlikely to have been classified directly in the quantitative plot-based system, where the alluvia and volcanic soils are scarcely sampled. The closest warm coastal forest is a: OF2 but isn't a good match.
WF7.1	Pūriri tōtara forest	1.0	–	No overlap	–	See above (WF7).
WF7.2	Pūriri, taraire forest	1.0	–	No overlap	–	See above (WF7).
WF7.3	Pūriri, kahikatea forest	1.0	–	No overlap	–	See above (WF7).
WF8	Kahikatea, pukatea forest	1.0	–	No overlap	–	Of the many podocarp–broadleaved associations described in the quantitative plot-based system, there is nothing that seems to capture the warm forest with poor drainage typified by this type. It is likely there are some types in Northland that sample this type of forest, but not many.
WF9	Taraire, tawa, podocarp forest	1.0	–	No overlap	–	Superficially quite strong overlap with a: BLP16, but there is no kauri element in WF9 (specifically excluded by Singers & Rogers 2014) and a: BLP16 extends to 760 m elevation, but WF9 is below 450 m. Likely there is no match.
WF10	Kauri forest	0.4	><	a: K1 (partial overlap)	Tawhero – kauri forest with mānuka and rewarewa	Kauri forest is broader than the individual kauri types from the quantitative plot-based system. a: K1 probably has good overlap.

Ecosystem code (expert-based system)	Ecosystem name (expert-based system)	Fuzzy membership	Relationship	Ecosystem code (quantitative plot-based system, associations)	Ecosystem name (quantitative plot-based system, associations)	Notes
WF10	Kauri forest	0.2	> <	Ru_M1 (partial overlap)	Tānekaha – kānuka – kauri secondary forest	Kauri forest is broader than the individual kauri types from the quantitative plot-based system. Ru_M1 is likely subsumed within this group as an early successional version.
WF10	Kauri forest	0.4	> <	WW_M2 (partial overlap)	Tōwai / tāwari – kiekie forest (emergent kauri – tōtara)	Kauri forest is broader than the individual kauri types from the quantitative plot-based system. WW_M2 probably has good overlap.
WF11	Kauri, podocarp, broadleaved forest	0.33	> <	a: BLP16 (partial overlap)	Tawhero – taraire – tawa forest with kohekohe and kauri	Similarly to WF10 (Kauri forest) there is overlap with several types from the quantitative plot-based system. a: BLP16 is largely subsumed within it but is probably a fairly narrow part of the type.
WF11	Kauri, podocarp, broadleaved forest	0.33	> <	a: K1 (partial overlap)	Tawhero – kauri forest with mānuka and rewarewa	Similarly to WF10 (Kauri forest) there is overlap with several types from the quantitative plot-based system.
WF11	Kauri, podocarp, broadleaved forest	0.33	> <	WW_M2 (partial overlap)	Tōwai / tāwari – kiekie forest (emergent kauri – tōtara)	Similarly to WF10 (Kauri forest) there is overlap with several types from the quantitative plot-based system.
WF12	Kauri, podocarp, broadleaved, beech forest	1.0	–	No overlap	–	Types from the quantitative plot-based system don't include kauri and beech together. Singers and Rogers (2014) note that this type is generally confined to ridges, so it is perhaps unlikely it was sampled in sufficient quantity to be identified in a quantitative plot-based system.
WF13	Tawa, kohekohe, rewarewa, hīnau, podocarp forest	0.4	> <	a: BLP4 (partial overlap)	Tawa – kāmahi forest – pigeonwood forest with silver fern	This type occurs in the inland hill country and higher ground in Northland, and includes occasional emergent rimu, miro, and northern rātā. a: BLP4 is possible, having abundant tawa, rewarewa and hīnau, but has limited kohekohe, which is described as abundant in Singers & Rogers 2014. Contains miro, rimu, and northern rātā.

Ecosystem code (expert-based system)	Ecosystem name (expert-based system)	Fuzzy membership	Relationship	Ecosystem code (quantitative plot-based system, associations)	Ecosystem name (quantitative plot-based system, associations)	Notes
WF13	Tawa, kohekohe, rewarewa, hīnau, podocarp forest	0.3	> <	a: BLP3 (partial overlap)	Tawa – kāmahi forest – pigeonwood forest with hard and soft tree ferns	a: BLP3 is also possible on some of the higher elevation sites.
WF13	Tawa, kohekohe, rewarewa, hīnau, podocarp forest	0.3	–	No overlap	–	No equivalent in the quantitative plot-based system.
WL1	Mānuka, gumland grass tree, *Machaerina* scrub/sedgeland [Gumland]	0.5	> <	AS8.a1 (partial overlap)	*Leptospermum scoparium* / *Gleichenia* spp. – *Baumea teretifolia* shrubland	Includes rare ecosystem gumland. The distinction between poor-draining and seasonally dry matches the two associations gumland (AS8.a1 and AS8.a2) described in Wiser et al. 2016.
WL1	Mānuka, gumland grass tree, *Machaerina* scrub/sedgeland [Gumland]	0.5	> <	AS8.a2 (partial overlap)	*Leptospermum scoparium* – *Hakea sericea* / *Schoenus brevifolius* shrubland	While *Hakea* is not specifically mentioned, this reflects the expert-based system, which doesn't consider weeds. The distinction between poor draining and seasonally dry matches the two associations gumland (AS8.a1 and AS8.a2) described in Wiser et al. 2016.
WL2	Mānuka, greater wire rush restiad rushland	1.0	–	No overlap	–	No definitive match; a: S4 is similar but this association is largely in south Westland and is more akin to pakihi vegetation, with only one plot in Northland (which may be a misclassification). This ecosystem type is much more likely to be an undescribed association.
WL3	Bamboo rush, greater wire rush restiad rushland	1.0	–	No overlap	–	Includes rare ecosystem domed bog. Vegetation closely aligned with WL2 but on older bogs (>7,000 years). Possible there is some overlap with a: S4, but this has only been sampled in south Westland and is more akin to pakihi vegetation.
WL10	Oioi restiad-rushland/reedland	1.0	–	No overlap	–	No equivalent in the quantitative plot-based system.

Ecosystem code (expert-based system)	Ecosystem name (expert-based system)	Fuzzy membership	Relationship	Ecosystem code (quantitative plot-based system, associations)	Ecosystem name (quantitative plot-based system, associations)	Notes
WL11	*Machaerina* sedgeland	1.0	–	No overlap	–	Includes rare ecosystems lagoon and lake margins. No equivalent in the quantitative plot-based system.
WL12	Mānuka, tanglefern scrub/fernland	1.0	–	No overlap	–	The alliance A:S3 overlaps, according to the fact sheet. The closest association is a: S4, but this is a very good match for WL4 and is only observed in south Westland. The one plot recorded here for Northland is probably a misclassification. The match is most likely an undescribed association.
WL14	Herbfield [Ephemeral wetland]	1.0	–	No overlap	–	Includes rare ecosystem ephemeral wetlands and lagoon margins.
WL15	Herbfield [Lakeshore turf]	1.0	–	No overlap	–	Includes rare ecosystem lagoon and lake margins.
WL18	Flaxland	0.9	–	No overlap	–	No equivalent in the quantitative plot-based system.
WL18	Flaxland	0.1	><	S.a5 (partial overlap)	*Leptospermum scoparium* / *Phormium tenax* – *Coprosma ciliata parviflora* complex – *Coprosma propinqua* – *Blechnum novae-zelandiae* shrubland association	S.a5 is a more narrow definition than in the expert-based typology. s.a5 has fairly low flax cover (occurs in 31% of plots with 4% cover), which doesn't match well with the WL18 description of 'abundant harakeke'. The plots used to define this type in the quantitative plot-based system were only from south Westland (Wiser et al. 2016).
WL19	Raupō reedland	1.0	–	No overlap	–	Includes rare ecosystem lake margins.
WL20	*Coprosma Olearia* scrub	1.0	–	No overlap	–	WL20 includes palustrine/riverine/lacustrine wetlands in the North Island. There is no clear equivalent in the quantitative plot-based system.

Table A3.3. Cross-walk table from the quantitative plot-based system (alliances) to the expert-based system. Following Appendix S5 of Faber-Langendoen et al. 2025, the 'Relationship' column summarises the cross-walk where: '=' means the concepts are equivalent; '~=' means the concepts are largely equivalent; '>' means the expert-based system concept is broader than the quantitative system concept; '<' means the quantitative system is finer than the expert-based system concept; '= ><' means the relationship is complex; and '?=' means the relationship is uncertain.

Ecosystem code (quantitative plot-based system, alliances)	Ecosystem name (quantitative plot-based system, alliances)	Fuzzy membership	Relationship	Ecosystem code (expert-based system)	Ecosystem name (expert-based system)	Notes
A: BLPF4	Silver fern – māhoe forest	0.33	><	VS5 (partial overlap)	Broadleaved species scrub/forest	Quantitative plot-based typology fact sheets note overlap with VS5. Also noted in Singers & Rogers (2014) that VS5 overlaps with this alliance. VS5 seems like a closer match (than WF13, see below) compositionally, with the alliance lacking the strong emergent podocarp elements of WF13. However VS5 is noted as a scrub/short forest which does not fit well with the 18 m (range 6 – 38 m) mean canopy height for this alliance.
A: BLPF4	Silver fern – māhoe forest	0.33	><	WF13 (partial overlap)	Tawa, kohekohe, rewarewa, hīnau, podocarp forest	Quantitative plot-based typology fact sheets note overlap with WF13. Also noted in Singers & Rogers (2014) that WF13 overlaps with this alliance. See notes above.
A: BLPF4	Silver fern – māhoe forest	0.33	–	No overlap	–	No equivalent in the expert-based system.
A: BLPF7	Tōwai – tawa forest	0.6	><	WF11 (partial overlap)	Kauri, podocarp, broadleaved forest	A reasonable match given the kauri component, especially since WF11 also includes tōwai.
A: BLPF7	Tōwai – tawa forest	0.4	><	WF10 (partial overlap)	Kauri forest	A reasonable match given the kauri component, though probably not as strong in A: BLPF7 as is described for WF10.
A: OF1	Kānuka forest and tall shrubland	0.6	><	VS2 (partial overlap)	Kānuka scrub/forest	Singers & Rogers (2014) notes overlaps with this alliance.

Ecosystem code (quantitative plot-based system, alliances)	Ecosystem name (quantitative plot-based system, alliances)	Fuzzy membership	Relationship	Ecosystem code (expert-based system)	Ecosystem name (expert-based system)	Notes
A: OF1	Kānuka forest and tall shrubland	0.4	> <	VS3 (partial overlap)	Mānuka, kānuka scrub	Singers & Rogers (2014) notes overlaps with this alliance.
A: S1	Kānuka shrubland with *Coprosma* and prickly mingimingi	0.75	> <	VS2 (partial overlap)	Kānuka scrub/forest	Stronger overlap with VS2 on account of the kānuka, but alliance fits a successional shrubland.
A: S1	Kānuka shrubland with *Coprosma* and prickly mingimingi	0.25	> <	VS3 (partial overlap)	Mānuka, kānuka scrub	See above.
A:S8	Kānuka – mānuka heath	1.0	=	WL1 (overlaps with)	Mānuka, gumland grass tree, *Machaerina* scrub/sedgeland [Gumland]	WL1 and A:S8 both encompass gumland vegetation.

Table A3.4. Cross-walk table from the quantitative plot-based system (associations) to the expert-based system. Following Appendix S5 of Faber-Langendoen et al. 2025, the 'Relationship' column summarises the cross-walk where: '=' means the concepts are equivalent; '~=' means the concepts are largely equivalent; '>' means the expert-based system concept is broader than the quantitative system concept; '<' means the quantitative system is finer than the expert-based system concept; '= ><' means the relationship is complex; and '?=' means the relationship is uncertain.

Ecosystem code (quantitative plot-based system, associations)	Ecosystem name (quantitative plot-based system, associations)	Fuzzy membership	Relationship	Ecosystem code (expert-based system)	Ecosystem name (expert-based system)	Notes
a: BL4	Māhoe – pigeonwood – tawa forest	0.35	><	MF7 (partial overlap)	Tawa, kāmahi, podocarp forest	Fits with MF7 based on the tawa component. MF8 was another option, but MF8 is a cooler forest type than MF7.
a: BL4	Māhoe – pigeonwood – tawa forest	0.65	–	No overlap	–	No equivalent in the expert-based system.
a: BL7	Tōwai – tawa / kiekie – patē forest	1.0	–	No overlap	–	While this has some similarities with WF9, tōwai is deemed to be local rather than a dominant species. Furthermore, WF9 is described as throughout Northland below 450 m, especially in the east, where kauri is absent. a: BL7 is a higher-elevation forest.
a: BLP3	Tawa – kāmahi forest – pigeonwood forest with hard and soft tree ferns	0.5	><	WF13 (partial overlap)	Tawa, kohekohe, rewarewa, hīnau, podocarp forest	The most likely match.
a: BLP3	Tawa – kāmahi forest – pigeonwood forest with hard and soft tree ferns	0.25	><	MF7 (partial overlap)	Tawa kāmahi podocarp forest	Singers and Rogers (2014) note a more southerly distribution for MF7, so it is possible that while it overlaps with a: BLP3 it doesn't overlap well in Northland.
a: BLP3	Tawa – kāmahi forest – pigeonwood forest with hard and soft tree ferns	0.25	–	No overlap	–	

Ecosystem code (quantitative plot-based system, associations)	Ecosystem name (quantitative plot-based system, associations)	Fuzzy membership	Relationship	Ecosystem code (expert-based system)	Ecosystem name (expert-based system)	Notes
a: BLP9	Mataī – māhoe – red māpou forest	0.25	><	MF3 (partial overlap)	Mataī, tōtara kahikatea broadleaved forest	This type was not expected to be found in Northland and is only represented by one plot. It otherwise occurs in the eastern South Island only. The best match from the expert-based system is MF3, which is probably very similar and described from a similar area in the South Island. If this association does occur in Northland, it is likely that the Northland forests of this type are not the same as MF3 described in the expert-based system.
a: BLP9	Mataī – māhoe – red māpou forest	0.75	–	No overlap	–	
a: BLP15	Kāmahi – pigeonwood forest with hard fern and kiekie	0.25	><	MF7 (partial overlap)	Tawa kāmahi podocarp forest	Singers and Rogers (2014) note a more southerly distribution, so overlap is likely to be small (and possibly not at all for the Northland composition).
a: BLP15	Kāmahi – pigeonwood forest with hard fern and kiekie	0.75	–	No overlap	–	
a: BLP16	Tawhero – taraire – tawa forest with kohekohe and kauri	1.0	<	WF11 (is included within)	Kauri, podocarp, broadleaved forest	Because a: BLP16 contains a kauri element, this excludes WF9, which is similar.
a: K1	Tawhero – kauri forest with mānuka and rewarewa	0.65	><	WF10 (partial overlap)	Kauri forest	Probably a successional variant of WF10.

Ecosystem code (quantitative plot-based system, associations)	Ecosystem name (quantitative plot-based system, associations)	Fuzzy membership	Relationship	Ecosystem code (expert-based system)	Ecosystem name (expert-based system)	Notes
a: K1	Tawhero – kauri forest with mānuka and rewarewa	0.35	><	WF11 (partial overlap)	Kauri, podocarp, broadleaved forest	More closely aligned with WF10, but cannot rule out overlap with WF11. Singers and Rogers (2014) note that WF11 is 'commonly a secondary derivative of kauri forest'. a:K1 is a successional variant and alternative pathways could lead to WF10 or WF11, given how closely aligned they are according to the expert-based system.
a: OF1	Kānuka – silver fern – hangehange – māhoe forest	0.6	><	VS2 (partial overlap)	Kānuka scrub/forest	Singers and Rogers (2014) note overlaps with the alliance that contains this type.
a: OF1	Kānuka – silver fern – hangehange – māhoe forest	0.4	><	VS3 (partial overlap)	Mānuka/kānuka scrub	
a: OF2	Kohekohe – nīkau – māhoe forest	0.2	><	WF4 (partial overlap)	Pōhutukawa, pūriri, karaka, broadleaved forest	Shares similarities with coastal forest WF4, which is a very broad grouping, but a: OF2 lacks the pōhutukawa element (pōhutukawa has not been sampled at all in the quantitative plot-based system). Hence the confidence is low, based on the available information. Missing pūriri is a dominant element for it to be coastal forest types WF7.2 and WF7.3, which are also described as occurring on fertile soils.
a: OF2	Kohekohe – nīkau – māhoe forest	0.8	–	No overlap	–	
a: S1	Kānuka shrubland with native shrubs	0.75	><	VS2 (partial overlap)	Kānuka scrub/forest	Stronger overlap with VS2 on account of the kānuka, but a: S1 fits a successional shrubland, which is not considered in the expert-based system.
a: S1	Kānuka shrubland with native shrubs	0.25	><	VS3 (partial overlap)	Mānuka/kānuka scrub	

Ecosystem code (quantitative plot-based system, associations)	Ecosystem name (quantitative plot-based system, associations)	Fuzzy membership	Relationship	Ecosystem code (expert-based system)	Ecosystem name (expert-based system)	Notes
a: S2	Grey scrub with kānuka and exotic grasses	0.5	> <	VS2 (partial overlap)	Kānuka scrub/forest	Has overlap with VS2 on account of the kānuka, but this is a successional shrubland with an exotic grass understorey, which is not considered in the expert-based system.
a: S2	Grey scrub with kānuka and exotic grasses	0.5	> <	VS3 (partial overlap)	Mānuka/kānuka scrub	
a: S3	Kānuka shrubland with exotic grasses	1.0	<	VS2 (is included within)	Kānuka scrub/forest	While VS2 was not included in Singers & Lawrence 2018, Singers and Rogers (2014) note that this very broad vegetation association extends into Northland.
a: S4	Mānuka shrubland with wire rush and tangle fern	1.0	=	WL4 (overlaps with)	Mānuka, lesser wire rush, tangle fern scrub/fernland/restiad rushland	These two seem very congruent. However, both are pakihi vegetation, typical of south Westland, and the occurrence of a: S4 in Northland may be a misclassification or an outlier within the type. This plot may be something more akin to WL12 and requires further investigation.
a: S5	Mānuka successional shrubland	1.0	<	VS4 (is included within)	Mānuka scrub	While VS4 was not included in Singers & Lawrence 2018, Singers and Rogers (2014) note that this very broad vegetation association extends into Northland.
a: S6	Gorse shrubland with cabbage trees	1.0	–	No overlap	–	No equivalent in the expert-based system.
AS8:a1	*Leptospermum scoparium* / *Gleichenia* spp. – *Baumea teretifolia* shrubland	1.0	<	WL1 (is included within)	Mānuka, gumland grass tree, *Machaerina* scrub/sedgeland [Gumland]	WL1 encompasses both gumland associations from the quantitative plot-based system (S8.a1 and S8.a2).

Ecosystem code (quantitative plot-based system, associations)	Ecosystem name (quantitative plot-based system, associations)	Fuzzy membership	Relationship	Ecosystem code (expert-based system)	Ecosystem name (expert-based system)	Notes
AS8:a2	*Leptospermum scoparium – Hakea sericea / Schoenus brevifolius* shrubland	1.0	<	WL1 (is included within)	Mānuka, gumland grass tree, *Machaerina* scrub/sedgeland [Gumland]	WL1 encompasses both gumland associations from the quantitative plot-based system (S8.a1 and S8.a2).
Ru_M1	Tānekaha – kānuka – kauri secondary forest	1.0	<	WF10 (is included within)	Kauri forest	Probably a successional variant of WF10, which is not explicitly considered in the expert-based system.
Wh_M1	Kānuka – tōwai – ponga – māpere secondary forest	0.75	> <	VS2 (partial overlap)	Kānuka scrub/forest	Allen et al. (2025) note it is an early successional forest with a broad elevational range, except for the lowest and highest elevations. Thought to be a younger type of Ru_M1 by the authors. Has affinities with VS2 and VS3, which are really broadly defined successional communities that include kānuka grading into a mix with mānuka.
Wh_M1	Kānuka – tōwai – ponga – māpere secondary forest	0.25	> <	VS3 (partial overlap)	Mānuka, kānuka scrub	Allen et al. (2025) note it is an early successional forest with a broad elevational range, except for the lowest and highest elevations. Thought to be a younger type of Ru_M1 by the authors. Has affinities with VS2 and VS3, which are really broadly defined successional communities that include kānuka grading into a mix with mānuka.
WW_M2	Tōwai / tāwari – kiekie forest (emergent kauri – tōtara)	0.65	> <	WF10 (partial overlap)	Kauri forest	Compositionally has stronger affiliation with WF10 'Kauri forest' than WF11.
WW_M2	Tōwai / tāwari – kiekie forest (emergent kauri – tōtara)	0.35	> <	WF11 (partial overlap)	Kauri, podocarp, broadleaved forest	Compositionally has stronger affiliation with WF10 'Kauri forest' than WF11.

Table A3.5. Matrix of cross-walk between types in the quantitative plot-based (alliances) and expert-based systems. Numbers indicate the level of fuzzy matching between types (see Table 2), with the colour indicating the direction (blue, upper text = cross-walk from expert-based to quantitative plot-based; red, lower text = quantitative plot-based to expert-based).

Quantitative plot-based system (alliances)		Expert-based system: No overlap	Pōhutukawa treeland/flaxland/rockland	Hebe, whārariki flaxland/rockland	Kiokio fernland/rockland	Spinifex, pīngao grassland/sedgeland	Oioi, knobby clubrush sedgeland	Geothermally heated water and steam	Kahikatea forest	Rimu, tōwai forest	Mangrove forest and scrub	Shore bindweed, knobby clubrush gravelfield/stonefield	Iceplant, glasswort herbfield/loamfield	Pōhutukawa tānekaha forest/scrub/rockland	Pōhutukawa, pūriri, karaka, broadleaved forest	Tōtara, kānuka, broadleaved forest [Dune forest]	Pūriri forest	Pūriri tōtara forest	Pūriri, taraire forest	Pūriri, kahikatea forest	Kahikatea, pukatea forest	Taraire, tawa, podocarp forest	Kauri forest	Kauri, podocarp, broadleaved forest	Kauri, podocarp, broadleaved, beech forest	Tawa, kohekohe, rewarewa, hīnau, podocarp forest	Mānuka, gumland grass tree, *Machaerina* scrub/sedgeland [Gumland]	Mānuka, greater wire rush restiad rushland	Bamboo rush, greater wire rush restiad rushland	Oioi restiad- rushland/reedland	*Machaerina* sedgeland	Mānuka, tanglefern scrub/fernland	Herbfield [Ephemeral wetland]	Herbfield [Lakeshore turf]	Flaxland	Raupō reedland	*Coprosma Olearia* scrub	WL, Bog Mosaic (not assessed)	WL Bog/Fen mosaic (not assessed)	Kānuka scrub/forest	Mānuka, kānuka scrub	Broadleaved species scrub/forest
		–	CL1	CL6	CL10	DN2	DN5	GT2	MF4	MF24	SA1	SA4	SA7	UM1	WF4	WF5	WF7	WF7.1	WF7.2	WF7.3	WF8	WF9	WF10	WF11	WF12	WF13	WL1	WL2	WL3	WL10	WL11	WL12	WL14	WL15	WL18	WL19	WL20	–	–	VS2*	VS3*	VS5*
No overlap	–		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.9	0.66	1.0	0.2		0.8	1.0	1.0	1.0	0.4	1.0	1.0	1.0	1.0	1.0					
Silver fern – māhoe forest	A: BLPF4	0.33																								0.2 0.33																0.33
Tōwai – tawa forest	A: BLPF7																						0.1 0.4	0.33 0.6																		
Kānuka forest and tall shrubland	A: OF1																																						0.6	0.4	
Kānuka shrubland with Coprosma and prickly mingimingi	A: S1																																						0.75	0.25	
Kānuka – mānuka heath	AS8																									1.0 1.0															
Tawa forest	A: BLPF3*																									0.6															
Mānuka shrubland	A: S3*																											0.2				0.6									

* Types currently only identified (either from plots of the quantitative plot-based system, or defined in the expert-based system) outside Northland.

Table A3.6. Matrix of cross-walk between types in the quantitative plot-based (associations) and expert-based systems. Numbers indicate the level of fuzzy matching between types (see Table 2), with the colour indicating the direction (blue, upper text = cross-walk from expert-based to quantitative plot-based; red, lower text = quantitative plot-based to expert-based).

Quantitative plot-based system (associations)		Expert-based system: No overlap	Pōhutukawa treeland/flaxland/rockland	Hebe, whārangi flaxland/rockland	Kiokio fernland/rockland	Spinifex, pīngao grassland/sedgeland	Oioi, knobby clubrush sedgeland	Geothermally heated water and steam	Kahikatea forest	Rimu, tōwai forest	Mangrove forest and scrub	Shore bindweed, knobby clubrush gravelfield/ stonefield	Iceplant, glasswort herbfield/loamfield	Pōhutukawa tānekaha forest/scrub/rockland	Pōhutukawa, pūriri, karaka, broadleaved forest	Tōtara, kānuka, broadleaved forest [Dune forest]	Pūriri forest	Pūriri tōtara forest	Pūriri, taraire forest	Pūriri, kahikatea forest	Kahikatea, pukatea forest	Taraire, tawa, podocarp forest	Kauri forest	Kauri, podocarp, broadleaved forest	Kauri, podocarp, broadleaved, beech forest	Tawa, kohekohe, rewarewa, hīnau, podocarp forest	Mānuka, gumland grass tree, *Machaerina* scrub/sedgeland [Gumland]	Mānuka, greater wire rush restiad rushland	Bamboo rush, greater wire rush restiad rushland	Oioi restiad- rushland/reedland	*Machaerina* sedgeland	Mānuka, tanglefern scrub/fernland	Herbfield [Ephemeral wetland]	Herbfield [Lakeshore turf]	Flaxland	Raupō reedland	*Coprosma Olearia* scrub	WL Bog Mosaic (not assessed)	WL Bog/Fen mosaic (not assessed)	Matai, tōtara, kahikatea, broadleaved forest	Mānuka, lesser wire rush, tangle fern scrub/fernland/restiad rushland [Pakihi]	Tawa, kāmahi, podocarp forest	Kānuka scrub/forest	Mānuka, kānuka scrub	Mānuka scrub
		–	CL1	CL6	CL10	DN2	DN5	GT2	MF4	MF24	SA1	SA4	SA7	UM1	WF4	WF5	WF7	WF7.1	WF7.2	WF7.3	WF8	WF9	WF10	WF11	WF12	WF13	WL1	WL2	WL3	WL10	WL11	WL12	WL14	WL15	WL18	WL19	WL20	–	–	MF3*	WL4*	MF7*	VS2*	VS3*	VS4*
No overlap	–		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.75	1.0	1.0	1.0	1.0	1.0	1.0	1.0			1.0	0.3		1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.9	1.0	1.0								
Māhoe – pigeonwood – tawa forest	a: BL4	0.65																																							0.35			
Tōwai – tawa / kiekie – patē forest	a: BL7	1.0																								0.3 0.5															0.25			
Tawa – kāmahi forest – pigeonwood forest with hard and soft tree ferns	a: BLP3	0.25																																									
Matai – māhoe – red māpou forest	a: BLP9	0.75																																						0.25			
Kāmahi – pigeonwood forest with hard fern and kiekie	a: BLP15	0.75																																							0.25			
Tawhero – taraire – tawa forest with kohekohe and kauri	a: BLP16																						0.33 1.0																					
Tawhero – kauri forest with mānuka and rewarewa	a: K1																						0.4 0.65	0.33 0.35																				
Kānuka – silver fern – hangehange – māhoe forest	a: OF1																																								0.6	0.4	
Kohekohe – nīkau – māhoe forest	a: OF2	0.8													0.25 0.2																													
Kānuka shrubland with native shrubs	a: S1																																								0.75	0.25	
Grey scrub with kānuka and exotic grasses	a: S2																																								0.5	0.5	
Kānuka shrubland with exotic grasses	a: S3																																								1.0		
Mānuka shrubland with wire rush and tangle fern	a: S4																																							1.0			
Mānuka successional shrubland	a: S5																																										1.0
Gorse shrubland with cabbage trees	a: S6	1.0																																									
Leptospermum scoparium / *Gleichenia* spp. – *Baumea teretifolia* shrubland	AS8:a1																									0.5 1.0																		
Leptospermum scoparium – *Hakea sericea* / *Schoenus brevifolius* shrubland	AS8:a2																									0.5 1.0																		
Tānekaha–kānuka–kauri secondary forest	Ru_M1																						0.2 1.0																					
Kānuka – tōwai – ponga – māpere secondary forest	Wh_M1																																								0.75	0.25	
Tōwai / tāwari – kiekie forest (emergent kauri – tōtara)	WW_M2																						0.4 0.65	0.33 0.35																				
Tawa – kāmahi forest – pigeonwood forest with silver fern	a: BLP4*																									0.4																		
Leptospermum scoparium / *Phormium tenax* – *Coprosma ciliata parviflora* complex – *Coprosma propinqua* – *Blechnum novae-zelandiae* shrubland association	S.a5*																																		0.1									

* Types currently only identified (either from plots of the quantitative plot-based system, or defined in the expert-based system) outside Northland.

Table A3.7. Cross-tabulation based on plot locations, showing the number of plots in an ecosystem type mapped according to the expert-based system (columns), and the alliance to which plots were classified by the quantitative plot-based system (rows). Green shading and bold numbers indicate the types are similar in composition based on the cross-walk analysis (see Tables A3.1–A3.6). The ecosystem types represented by the codes are provided in Appendix 1.

	CL1	DN2	MF24	WF4	WF5	WF8	WF9	WF10	WF11	WF13	WL1	WL Bog/Fen mosaic	WL, Fen mosaic	WL, Swamp mosaic
A: BLPF4	–	–	–	–	–	–	22	13	167	**–**	–	–	–	–
A: BLPF7	–	–	13	–	–	–	30	**54**	**124**	–	–	–	–	–
A: OF1	–	–	–	7	–	1	–	–	12	–	–	–	–	–
A: S1	–	–	–	–	–	–	–	–	1	–	–	1	–	–
AS8	–	–	–	–	–	–	–	–	27	–	**15**	18	7	–
Noise/outlier	–	1	5	9	3	–	27	9	94	–	9	2	1	–
Not classified	4	–	–	2	–	–	138	38	224	38	–	–	–	1

Table A3.8. Cross-tabulation based on plot locations showing the number of plots in an ecosystem type, mapped according to the expert-based system (columns), and the associations to which plots were classified by the quantitative plot-based system (rows). Green shading and bold numbers indicate the types are similar in composition based on the cross-walk analysis (see Tables A3.1–A3.6). The ecosystem types represented by the codes are provided in Appendix 1.

	CL1	DN2	MF24	WF4	WF5	WF8	WF9	WF10	WF11	WF13	WL1	WL Bog/Fen mosaic	WL, Fen mosaic	WL, Swamp mosaic
a: BL4	–	–	–	–	–	–	2	–	–	0	–	–	–	–
a: BL7	–	–	–	–	–	–	47	2	10	29	–	–	–	–
a: BLP3	–	–	–	–	–	–	1	–	–	**–**	–	–	–	–
a: BLP9	–	–	–	1	–	–	–	–	–	–	–	–	–	–
a: BLP15	–	–	2	–	–	–	–	–	–	–	–	–	–	–
a: BLP16	–	–	9	–	–	–	29	43	**166**	–	–	–	–	–
a: K1	–	–	–	–	–	–	–	**6**	**9**	–	4	–	–	–
a: OF1	–	–	–	5	–	–	2	–	49	–	–	–	–	–
a: OF2	2	–	–	**1**	–	–	61	7	164	2	–	–	–	–
a: S1	–	–	–	4	–	–	–	–	2	–	–	1	–	–
a: S2	–	–	–	1	–	–	5	–	2	–	–	–	–	–
a: S3	–	–	–	1	–	–	–	–	–	–	–	–	–	–
a: S4	–	–	–	–	–	–	–	–	1	–	–	–	–	–
a: S5	–	–	–	–	–	–	2	–	5	–	1	–	1	–
a: S6	–	–	–	–	–	–	–	–	2	–	–	–	–	–
AS8.a1	–	–	–	–	–	–	–	–	17	–	**9**	5	7	–
AS8.a2	–	–	–	–	–	–	–	–	10	–	**6**	13	–	–
Ru_M1	–	–	–	–	–	–	6	**–**	93	–	1	–	–	–
Wh_M1	1	–	–	1	–	–	20	–	38	–	–	–	–	1
WW_M2	–	–	–	–	–	–	13	**49**	**11**	7	–	–	–	–
Noise/outlier	1	1	7	4	3	1	29	7	70	–	3	2	–	–

Appendix 4 – Example fact sheets

Manaaki Whenua
Landcare Research

1 Overview

Scientific name: *Kunzea ericoides – Cyathea dealbata – Geniostoma rupestre – Melicytus ramiflorus / Coprosma rhamnoides – Leucopogon fasciculatus* forest

Colloquial name: Kānuka – silver fern – hangehange – māhoe forest

Short code: a: OF1

Hierarchy level: Association

Description: This association, dominated by *Kunzea ericoides* and *Cyathea dealbata* is a successional short forest/tall shrubland. Sites range from gentle (10º) to steeply sloping (40º). Altitudes range from near sea level to 420 m.

Threat status: A threat assessment is yet to be performed for this association

Diagnostic characteristics: No data available

Rationale for diagnostic characteristics: Indicator species analysis has yet to be performed for this association

Similar types from the typology (and notes): No data available

2 Vegetation

Physiognomy and structure: Short-statured with an average height of 10 m (range 6 to 15 m).

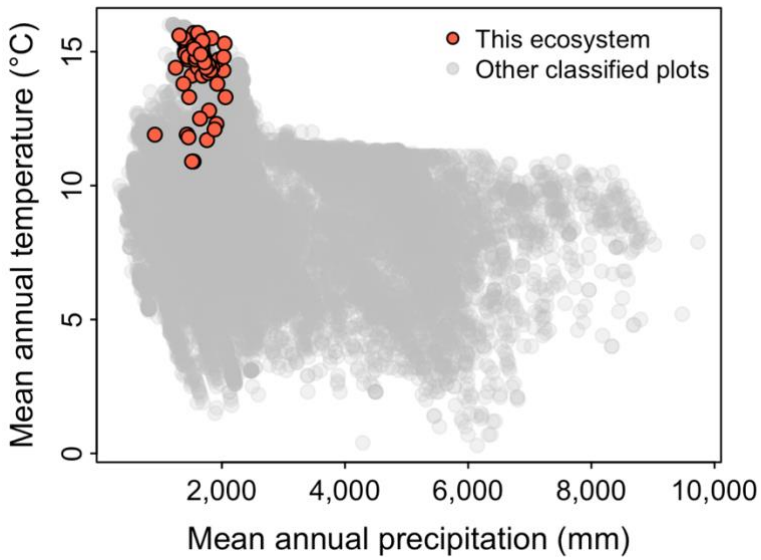
Floristics: The forest is dominated by *Kunzea ericoides*, typically with an understory of *Coprosma rhamnoides*, *Leucopogon fasciculatus*, *Geniostoma rupestre*, and *Cyathea dealbata*. This forest association tends to be species rich with, on average, 37 species on a 400 m^2 plot, which can reach as many as 59. On average, 7% of species in this association are non-native.

Dynamics: This successional association frequently occurs in areas recovering from forest clearance.

3 Environment and associated fauna

Environmental description: This association is known to occur in cold-to-warm areas (mean annual temperature 10–16°C) areas with moderate-to-high rainfall (900–2,100 mm per year). According to the geological map (QMAP), it is primarily distributed in areas mapped as greywacke,

sandstone, and to a lesser extent basalts; and on ultic, brown, and granular soils (soils map; Fundamental Soil Layers).



Associated fauna: No data available

4 Distribution

Geographic range: This 98,300 ha association has been sampled largely from sites north of Auckland but also from sites in East Cape, Lake Taupo, the Marlborough Sounds, and coastal north Canterbury.

Known regions: Northland, Auckland, Waikato, Bay of Plenty, Gisborne, Hawke's Bay, Marlborough, Canterbury

5 Confidence level

Confidence level: High

Confidence level comments: Derived quantitatively, represented by 80 plots nationally.

6 Synonymy

Relationship	Name	Author
Partial overlap	Mānuka, kānuka scrub (VS3)	Singers and Rogers (2014)
Partial overlap	Mānuka scrub (VS4)	Singers and Rogers (2014)
Includes	Kānuka–mānuka heaths: Kānuka and mānuka heath on dry sites	Wardle (1991)

7 Hierarchy

Level	Name	Short code
Formation class	Not yet defined	–
Formation subclass	Not yet defined	–
Formation	Not yet defined	–
Division	Not yet defined	–
Macrogroup	Not yet defined	–
Group	Not yet defined	–
Alliance	Kānuka forest and tall shrubland	A: OF1
Association	Kānuka – silver fern – hangehange – māhoe forest	a: OF1

8 Authorship and version

Concept author(s): Susan K. Wiser

Author of description: James K. McCarthy, Susan K. Wiser

Version: 1.0

Version date: 19 June 2025

9 Further reading

Singers NJD, Rogers GM 2014. A classification of New Zealand's terrestrial ecosystems. Science for Conservation 325, Wellington, https://www.doc.govt.nz/Documents/science-and-technical/sfc325entire.pdf, Department of Conservation.

Wardle P 1991. Vegetation of New Zealand. Cambridge, UK, Cambridge University Press.

Wiser SK, De Cáceres M 2013. Updating vegetation classifications: an example with New Zealand's woody vegetation. Journal of Vegetation Science 24: 80–93.

Wiser SK, McCarthy JK, Bellingham PJ, Jolly B, Meiforth JJ, Warawara Komiti Kaitiaki 2022. Integrating plot-based and remotely sensed data to map vegetation types in a New Zealand warm temperate rainforest. Applied Vegetation Science 25: e12695.

10 Links

https://www.landcareresearch.co.nz/publications/woody-ecosystem-types/other-forest-alliances/ (component association within Alliance factsheet)

11 Photos

***Kunzea ericoides*, *Cyathea dealbata* and *Melicytus ramiflorus* are characteristic of the canopy of stands of this association. Abel Tasman National Park. [Image credit: Susan Wiser]**

***Kunzea ericoides* and *Cyathea dealbata* in the canopy of a stand of this association. *Ulex europeaus* (in flower) occurs very rarely in these stands. Abel Tasman National Park. [Image credit: Susan Wiser]**

***Geniostoma ruprestre* and *Leucopogon fasciculatus* in front of *Cyathea dealbata* in a stand of this association. Abel Tasman National Park. [Image credit: Susan Wiser]**

***Leucopogon fasciculatus*, *Geniostoma ruprestre* and *Melicytus ramiflorus* in a stand of this association. Abel Tasman National Park. [Image credit: Susan Wiser]**

1 Overview

Scientific name: *Dysoxylum spectabile – Rhopalostylis sapida – Melicytus ramiflorus* (*Beilschmiedia tarairi*) / *Freycinetia banksii – Cyathea dealbata – Ripogonum scandens* forest

Colloquial name: Kohekohe – nīkau – māhoe forest

Short code: a: OF2

Hierarchy level: Association

Description: This association, dominated by *Dysoxylum spectabile*, *Rhopalostylis sapida*, and *Melicytus ramiflorus*, with *Freycinetia banksii*, *Cyathea dealbata*, and *Ripogonum scandens* in the understorey, is a tall forest that often occurs in wet gullies or faces. Sites range from flat to steeply sloping (51º). Altitudes range from 40 to 550 m.

Threat status: A threat assessment is yet to be performed for this association

Diagnostic characteristics: No data available

Rationale for diagnostic characteristics: Indicator species analysis has yet to be performed for this association

Similar types from the typology (and notes):

- Tawa – māhoe – pigeonwood forest with silver fern (a: BLP1): this association is also a member of the alliance A: BLPF4, and has *Beilschmiedia tawa* and *Hedycarya arborea* in the canopy instead of *Dysoxylum spectabile* and *Rhopalostylis sapida*.

2 Vegetation

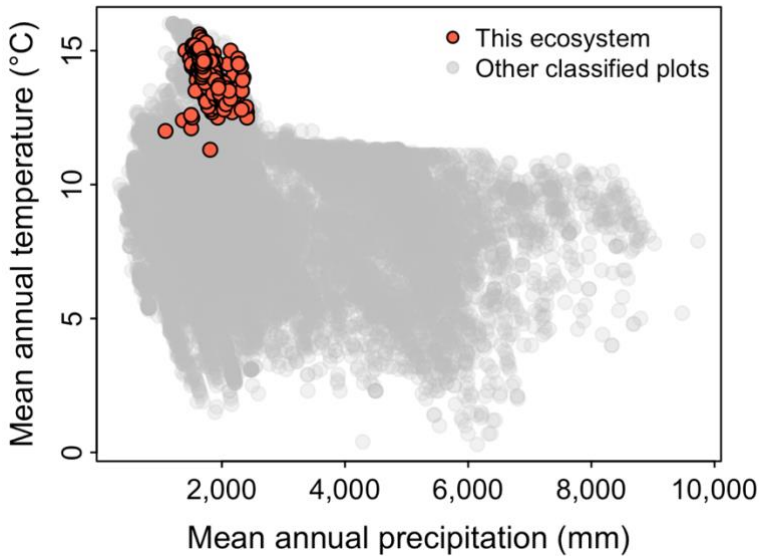
Physiognomy and structure: On average, this forest association is 19 m tall but can reach 38 m.

Floristics: This forest is dominated by *Dysoxylum spectabile*, *Rhopalostylis sapida*, and *Melicytus ramiflorus* typically with an understory of *Freycinetia banksii*, *Cyathea dealbata*, and *Ripogonum scandens*. It tends to be species rich with, on average, 51 species on a 400 m^2 plot with very few (less than 1%) being non-native.

Dynamics: No data available

3 Environment and associated fauna

Environmental description: This association is known to occur in cold-to-warm areas (mean annual temperature 10–16°C) areas with moderate-to-high rainfall (1,100–2,400 mm per year). According to the geological map (QMAP), it is primarily distributed in areas mapped as basalt, greywacke, sandstone, and volcanic breccia on geological maps; and on, brown, granular, and recent soils (soils map; Fundamental Soil Layers).



Associated fauna: No data available

4 Distribution

Geographic range: This 98,300 ha association has been sampled from largely coastal sites on the northern half of the North Island, and also near Wellington.

Known regions: Northland, Auckland, Waikato, Bay of Plenty, Wellington

5 Confidence level

Confidence level: High

Confidence level comments: Derived quantitatively, represented by 287 plots nationally.

6 Synonymy

Relationship	Name	Author
Partial overlap	Pōhutukawa, pūriri, karaka, broadleaved forest (WF4)	Singers and Rogers (2014)
Includes	Conifer/broadleaved forests of lower altitudes: Mixed forests of Northland and Auckland	Wardle (1991)
Includes	Conifer/broadleaved forests of lower altitudes: Volcanic Plateau	Wardle (1991)

7 Hierarchy

Level	Name	Short code
Formation class	Not yet defined	–
Formation subclass	Not yet defined	–
Formation	Not yet defined	–
Division	Not yet defined	–
Macrogroup	Not yet defined	–
Group	Not yet defined	–
Alliance	Silver fern - māhoe forest	A: BLPF4
Association	Kohekohe – nīkau – māhoe forest	a: OF2

8 Authorship and version

Concept author(s): Susan K. Wiser

Author of description: James K. McCarthy, Susan K. Wiser

Version: 1.0

Version date: 19 June 2025

9 Further reading

Singers NJD, Rogers GM 2014. A classification of New Zealand's terrestrial ecosystems. Science for Conservation 325, Wellington, https://www.doc.govt.nz/Documents/science-and-technical/sfc325entire.pdf, Department of Conservation.

Wardle P 1991. Vegetation of New Zealand. Cambridge, UK, Cambridge University Press.

Wiser SK, De Cáceres M 2013. Updating vegetation classifications: an example with New Zealand's woody vegetation. Journal of Vegetation Science 24: 80–93.

Wiser SK, McCarthy JK, Bellingham PJ, Jolly B, Meiforth JJ, Warawara Komiti Kaitiaki 2022. Integrating plot-based and remotely sensed data to map vegetation types in a New Zealand warm temperate rainforest. Applied Vegetation Science 25: e12695.

10 Links

https://www.landcareresearch.co.nz/publications/woody-ecosystem-types/broadleaved-podocarp-forest-alliances-including-kauri/silver-fern-mahoe-forest/ (component association within Alliance factsheet)

Manaaki Whenua
Landcare Research

11 Photos

No photos available.

Manaaki Whenua
Landcare Research

1 Overview

Scientific name: *Weinmannia silvicola – Beilschmiedia tarairi – Beilschmiedia tawa* – (*Dysoxylum spectabile – Agathis australis*) / *Freycinetia banksii – Dicksonia squarrosa* forest

Colloquial name: Tawhero – taraire – tawa forest with kohekohe and kauri

Short code: a: BLP16

Hierarchy level: Association

Description: This association, dominated by *Weinmannia silvicola*, *Beilschmiedia taraire*, and *B. tawa*, and *Freycinetia banksii* and *Dicksonia squarrosa* in the understorey is a tall forest that occurs in the top half of the North Island. Sites range from flat to steeply sloping (50º). Altitudes range from 70 to 650 m.

Threat status: A threat assessment is yet to be performed for this association

Diagnostic characteristics: No data available

Rationale for diagnostic characteristics: Indicator species analysis has yet to be performed for this association

Similar types from the typology (and notes): No data available

2 Vegetation

Physiognomy and structure:. This forest association is, on average, 21 m tall but can range from 2 to 37 m.

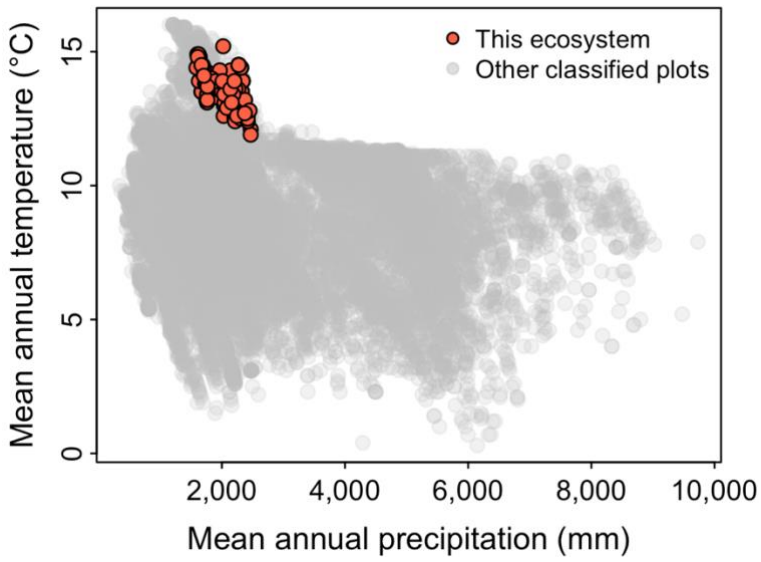
Floristics: Stands are consistently dominated by *Weinmannia silvicola*, *Beilschmiedia taraire*, and *B. tawa* in the canopy, and *Freycinetia banksii* and *Dicksonia squarrosa* in the subcanopy. *Dysoxylum spectabile* and *Agathis australis* frequently occur in the canopy. This forest association tends to be species-rich with an average of 65 species on a 400 m^2 plot which can range from 56 to 81. On average, there are very few (less than 1%) non-native species present.

Dynamics: No data available

Manaaki Whenua
Landcare Research

3 Environment and associated fauna

Environmental description: This association is known to occur in moderate-to-warm areas (mean annual temperature 12–15°C) areas with high rainfall (1,600–2,500 mm per year). According to the geological map (QMAP), it is primarily distributed in areas mapped as basalt on geological maps; and on ultic, granular, and brown soils (soils map; Fundamental Soil Layers).



Associated fauna: No data available

4 Distribution

Geographic range: This 37,800 ha association has been sampled primarily from the far north of the North Island but also from the northern tip of the Coromandel Peninsula and the Waikato coast.

Known regions: Northland, Auckland, Waikato

5 Confidence level

Confidence level: High

Confidence level comments: Derived quantitatively, represented by 252 plots nationally.

6 Synonymy

Relationship	Name	Author
Included within	Kauri, podocarp, broadleaved forest (WF11)	Singers and Rogers (2014)
Includes	Conifer/broadleaved forests of lower altitudes: Mixed forests of Northland and Auckland	Wardle (1991)

7 Hierarchy

Level	Name	Short code
Formation class	Not yet defined	–
Formation subclass	Not yet defined	–
Formation	Not yet defined	–
Division	Not yet defined	–
Macrogroup	Not yet defined	–
Group	Not yet defined	–
Alliance	Tōwai – tawa forest	A: BLPF7
Association	Tawhero – taraire – tawa forest with kohekohe and kauri	A: BLP16

8 Authorship and version

Concept author(s): Susan K. Wiser

Author of description: James K. McCarthy, Susan K. Wiser

Version: 1.0

Version date: 19 June 2025

9 Further reading

Singers NJD, Rogers GM 2014. A classification of New Zealand's terrestrial ecosystems. Science for Conservation 325, Wellington, https://www.doc.govt.nz/Documents/science-and-technical/sfc325entire.pdf, Department of Conservation.

Wardle P 1991. Vegetation of New Zealand. Cambridge, UK, Cambridge University Press.

Wiser SK, De Cáceres M 2013. Updating vegetation classifications: an example with New Zealand's woody vegetation. Journal of Vegetation Science 24: 80–93.

Wiser SK, McCarthy JK, Bellingham PJ, Jolly B, Meiforth JJ, Warawara Komiti Kaitiaki 2022. Integrating plot-based and remotely sensed data to map vegetation types in a New Zealand warm temperate rainforest. Applied Vegetation Science 25: e12695.

Manaaki Whenua
Landcare Research

10 Links

https://www.landcareresearch.co.nz/publications/woody-ecosystem-types/broadleaved-podocarp-forest-alliances-including-kauri/towai-tawa-forest/ (component association within Alliance factsheet)

Manaaki Whenua
Landcare Research

11 Photos

No photos available.

Manaaki Whenua
Landcare Research

1 Overview

Scientific name: *Leptospermum scoparium* / *Gleichenia* spp. – *Baumea teretifolia* shrubland

Colloquial name: Not yet defined

Short code: AS8:a1

Hierarchy level: Association

Description: These shrublands, dominated by low-growing *Leptospermum scoparium*, occur on wet sites in the northern North Island and in north Westland. These communities are often referred to as 'gumlands' (northern North Island examples) and 'pakihi' (northwestern South Island examples). Species of *Gleichenia* and *Baumea teretifolia* frequently occur in the understorey. Sites range from flat to gently sloping (19º). Altitudes range from near sea level to 300 m.

Threat status: A threat assessment is yet to be performed for this association

Diagnostic characteristics: No data available

Rationale for diagnostic characteristics: Indicator species analysis has yet to be performed for this association

Similar types from the typology (and notes):

- *Leptospermum scoparium – Hakea sericea / Schoenus brevifolius* shrubland (AS8:a2): this association represents the most common gumland type with dense *Leptospermum*, and includes the non-native species *Hakea sericea*.
- *Leptospermum scoparium / Empodisma minus – Gleichenia* spp. – *Baumea rubiginosa* rushland (AR1:a1): this association represents the pakihi vegetation of south Westland, and includes *Baumea teretifolia*.

2 Vegetation

Physiognomy and structure: Very short-statured with heights ranging from 0.2 to 2 m.

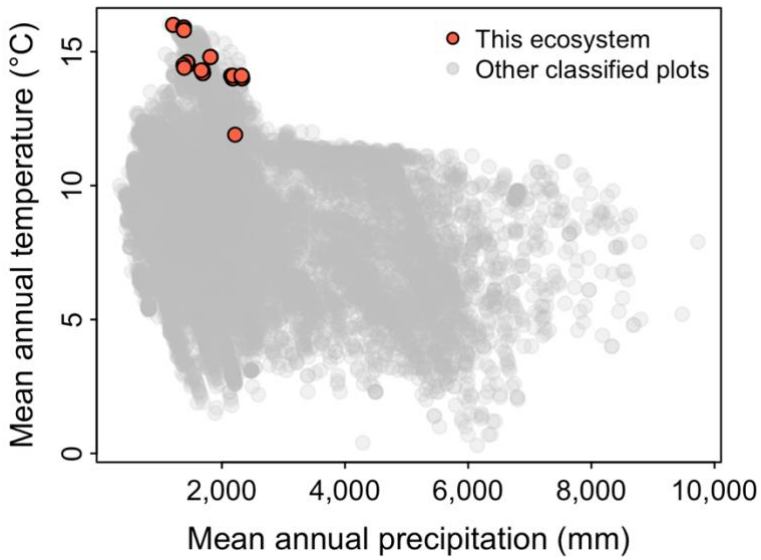
Floristics: These shrublands are dominated by *Leptospermum scoparium* interspersed with *Gleichenia* and *Baumea teretifolia*. This shrubland association has, on average, 12 species on a 400 m^2 plot. On average, 6% of species in this association are non-native.

Dynamics: These ecosystems are shaped by long-term soil and disturbance dynamics. In northern examples of this association ('gumlands'), nutrient-poor parent material and deposition of acidic

kauri leaf litter over thousands of years have produced podzol soils of low fertility that drain poorly and remain saturated for long periods. In northern Westland ('pakihi'), these ecosystems are also on soils of low fertility with poor drainage, often due to an impermeable iron 'pan'. Fire is a key driver, periodically resetting the system. Many plants are either fire-resistant, regenerating from underground rhizomes, or fire-promoted, like mānuka, which quickly colonises exposed ground.

3 Environment and associated fauna

Environmental description: This association is known to occur in cold-to-warm areas (mean annual temperature 12–16°C) areas with moderate-to-high rainfall (1,200–2,300 mm per year). According to the geological map (QMAP), it is primarily distributed in areas mapped as sand and mudstone on geological maps; and on podzols and ultic soils (soils map; Fundamental Soil Layers).



Associated fauna: No data available

4 Distribution

Geographic range: This association is restricted to the northern North Island ('gumlands'), and north Westland ('pakihi').

Known regions: Northland, West Coast

5 Confidence level

Confidence level: High

Confidence level comments: Derived quantitatively, represented by 39 plots nationally.

6 Synonymy

Relationship	Name	Author
Includes	*Leptospermum–Gleichenia* shrubland	Clarkson et al. (2011)
Included within	Mānuka, gumland grass tree, *Machaerina* scrub/sedgeland [Gumland] (WL1)	Singers and Rogers (2014)
Includes	Kānuka–mānuka heaths: Mānuka heaths of the gumlands	Wardle (1991)
Includes	Oligotrophic lowland mires and wet heaths: Wet heath communities: Moraines and fluvioglacial terraces in Westland and Western Nelson	Wardle (1991)

7 Hierarchy

Level	Name	Short code
Formation class	Not yet defined	–
Formation subclass	Not yet defined	–
Formation	Not yet defined	–
Division	Not yet defined	–
Macrogroup	Not yet defined	–
Group	Not yet defined	–
Alliance	*Kānuka – mānuka* heath	AS8
Association	*Leptospermum scoparium / Gleichenia* spp. – *Baumea teretifolia* shrubland	AS8:a1

8 Authorship and version

Concept author(s): Susan K. Wiser

Author of description: James K. McCarthy, Susan K. Wiser

Version: 1.0

Version date: 19 June 2025

9 Further reading

Clarkson BR, Smale MC, Williams PA, Wiser SK, Buxton RP 2011. Drainage, soil fertility and fire frequency determine composition and structure of gumland heaths in northern New Zealand. New Zealand Journal of Ecology 31: 96–113.

Enright NJ 1989. Heathland vegetation of the Spirits Bay area, far northern New Zealand. New Zealand Journal of Ecology 12: 63–75.

Esler AE, Rumball PJ 1975. Gumland vegetation at Kaikohe, Northland, New Zealand. New Zealand Journal of Botany 13: 425–436.

Hoare, RJB 2011. Lepidoptera of gumland heaths – A threatened and rare ecosystem of northern New Zealand. New Zealand Entomologist 34: 67–76.

Johnson P, Gerbeaux P 2024. Wetland types in New Zealand. Wellington, NZ, Astra Print for the Department of Conservation.

McCrae DP 1990. A survey of the orchid flora of Te Paki Farm Park. Auckland Botanical Society Journal 45: 29–44.

Mew G 1983. Application of the term "pakihi" in New Zealand – A review. Journal of the Royal Society of New Zealand 13: 175–198.

Rigg HH 1962. The pakihi bogs of Westport, New Zealand. Transactions of the Royal Society of New Zealand 7: 92–108.

Singers NJD, Rogers GM 2014. A classification of New Zealand's terrestrial ecosystems. Science for Conservation 325, Wellington, https://www.doc.govt.nz/Documents/science-and-technical/sfc325entire.pdf, Department of Conservation.

Smale, M 2011. Gumlands: Forgotten treasures of the North. New Zealand Geographic 110.

Taylor RM, Stavert JR, Pou DL, Wilmshurst JM, Perry GLW 2025. Ecology, history, threats, and management of gumland ecosystems in Aotearoa | New Zealand. New Zealand Journal of Ecology 49: 3589.

Wardle P 1991. Vegetation of New Zealand. Cambridge, UK, Cambridge University Press.

Williams PA, Courtney C, Glenny D, Hall G, Mew G 1990. Pakihi and surrounding vegetation in North Westland. Journal of the Royal Society of New Zealand 20: 179-203.

Wiser SK, Thomson FJ, De Cáceres M 2016. Expanding an existing classification of New Zealand vegetation to include non-forested vegetation. New Zealand Journal of Ecology 40: 160–178.

10 Links

https://www.landcareresearch.co.nz/publications/naturally-uncommon-ecosystems/wetlands/gumlands/

https://www.landcareresearch.co.nz/publications/naturally-uncommon-ecosystems/wetlands/pakihi/

https://teara.govt.nz/en/kauri-gum-and-gum-digging

https://www.nrc.govt.nz/resource-library-summary/publications/wetlands/gumlands-factsheet/gumlands/

https://www.tiakitamakimakaurau.nz/discover-tamaki-makaurau/learn-about-your-area/wl1-manuka-gumland-grass-tree-machaerina-scrub-and-sedgeland/

Manaaki Whenua
Landcare Research

11 Photos

***Leptospermum scoparium*, *Gleichenia* sp., and *Baumea teretifolia* are characteristic of this association. Ahipara. [Image credit: Susan Wiser]**