

Fig. 1. *Fatoua pilosa*. The mature and highly fertile adult from outdoors at Takou Bay (AK 284037), and seedling from Auckland Domain heated glasshouse (AK 296495). Upper left: a ripe "seed" from this adult, showing bifid style, basal stalk, and shape in t.s. (dashed line), "seed" body is 0.8 mm diam.

#### Acknowledgements

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## Tree Architecture in the Vicinity of Auckland

Francis Hallé & P. Barry Tomlinson

### Summary

The vegetative architecture, or programmed developmental pattern, of 55 tree species was examined in the Auckland area during a 25 day visit. This showed a considerable diversity of tree architectural models, which was interpreted as further indicative of the strong tropical influence on the New Zealand forest flora.

### Introduction

It has been long established that New Zealand forests are subject to a strong tropical influence, both physiognomic and taxonomic (Cockayne 1910). Here we further substantiate this conclusion by adding tree architecture to these components. Apart from the evergreen appearance of these forests, evident

The AK specimen annotations below show the progress of *F. pilosa* through northern New Zealand. It (and the related *F. villosa*, which may just be an annual form of that species; from what I can make of the literature) are apparently bad glasshouse weeds the world over.

### Specimens

29 Jul 2002, *T.J. Martin 157*, AK 258652, Takou Bay, Martin property, in glasshouse and shadehouse, arrived here with palms from nearby commercial greenhouse where the species is a major weed.

22 Oct 2002, *T.J. Martin 261*, AK 258856, loc. cit., common throughout the glasshouse, to c.1.2 m tall, begins to flower when c.10 cm tall.

18 May 2003, *T.J. Martin 408*, AK 284037, loc. cit., propagation area between glasshouses, one plant c.40 cm tall growing on accumulated humus on weedmat.

2 Mar 2006, *C. Sinclair*, AK 296494, Auckland Domain, in heated glasshouse, and a few plants established outside this summer (now all sprayed).

2 May 2006, *E.K. Cameron 13859*, AK 296495, loc. cit., weed in heated glasshouse, on scoria under bench, flowering at 3.5 cm tall; evidently never cultivated here.

physiognomic features include an abundance of palms and tree ferns, the occurrence of climbing plants from different families (e.g., *Freycinetia*, *Metrosideros*, *Parsonsia*, and *Ripogonum*) and an abundance of vascular epiphytes, mostly ferns, but some monocotyledons (e.g. *Astelia*). Taxonomic composition refers to the representation of several families which are regular constituents of tropical forests, although in New Zealand these are often represented by only one genus or species (e.g., the palm *Rhopalostylis*). Furthermore, some New Zealand trees "look tropical" because they are thick-twigged, with limited branching and large leaves (e.g. *Meryta*). The conspicuous presence of several Podocarpaceae is also distinctive.

Despite its isolation, the phytogeographic affinities of the New Zealand flora are with New Caledonia, New Guinea, Polynesia, Australia and South America. This representation reflects an oceanic and relatively wet but mild climate, especially in the North Island. Our approach was to establish the incidence of tree architectural models, especially those well represented in the tropics, based on the descriptive system of Hallé et al. (1978). We do not address the distinctive features of heteroblasty and divarication in the New Zealand flora, about which much has been written.

### Material and methods

Our observations were made mainly in the Auckland area during the period February 20 to March 13, 2006, on trees in several reserves (representing natural forest) as well as trees planted on streets and in public parks. Reserves included Alice Eaves Bush and Wenderholm Regional Park (in Orewa) and Totara Park (Manurewa) and off parks particularly Cornwall Park, Epsom. The most extensive study of planted trees was carried out in the Auckland Regional Botanical Garden, Manurewa, and was supplemented by a brief visit to the Wellington Botanic Garden. We prospected along made paths in order to examine trees at various stages of development. Field sketches were made from selected specimens as free as possible from reiteration which modifies the basic architecture. These field drawings were subsequently redrawn to produce a single stylized representation of a given model of which Figs. A-L are but a sampling. Identification was made from field guides (e.g. Poole and Adams, 1994), floras (e.g. Allan, 1961) and illustrated descriptions (e.g. Salmon, 1980). Added to this was our personal experience in New Zealand (P.B.T.) and the tropics generally (F.H.). We investigated 55 species, of which 45 were endemic.

### Results

We recognize here the existence of 12 architectural models, according to the Hallé et al. (1978) system, as illustrated here, our descriptions also serving as captions to the illustrations. Rauh's model (Fig. L) is by far the most frequent and was seen in 19 species belonging to 16 families. In New Zealand, as elsewhere, this architecture can be hard to recognize because branches are frequently leaning, although intrinsically orthotropic, and branch tiers are often obscure. In this respect New Zealand trees are comparable to trees of other temperate latitudes, where Rauh's model is also common.

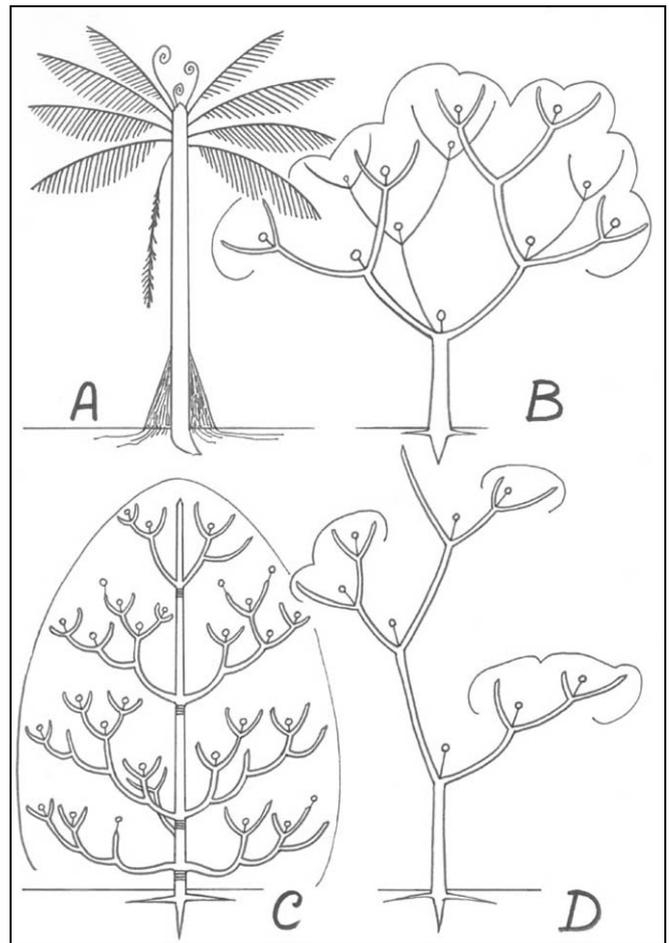
Our summary observations are described as follows:

**Fig. A.** Corner's model in the tree fern *Cyathea medullaris* (Forster f.) Swartz (Cyatheaceae). Axis unbranched. Tree fern leaves, being large are represented in the drawing; but in Figs. B to L leaves are too small to be drawn and they are collectively represented as an approximate photosynthetic envelope. Addition: *Rhopalostylis sapida*.

**Fig. B.** Leeuwenberg's model in *Meryta sinclairii* (Hook. f.) Seemann (Araliaceae). Axes determinate by flowering and all orthotropic. Addition: *Cordyline australis*.

**Fig. C.** Scarrone's model in *Pittosporum crassifolium* Cunn. (Pittosporaceae). Trunk axis monopodial, with rhythmic growth, branches sympodial by flowering. Addition: *Corynocarpus laevigatus*.

**Fig. D.** Koriba's model in *Entelea arborescens* R.Br. (Tiliaceae). Axes determinate by flowering, trunk axis made by secondary erection of one member of each successive branch tier. Addition: *Pomaderris kumeraho*.



**Fig. E.** Massart's model in *Carpodetus serratus* Forster & Forster f. (Escalloniaceae). Trunk axis with continuous growth, branches in tiers and plagiotropic but here distinctly zig-zag.

**Fig. F.** Roux's model in an unidentified *Coprosma* species (Rubiaceae). Trunk axis monopodial and with rhythmic growth, branches plagiotropic with lateral flowers. Addition: *Hedycarya arborea*.

**Fig. G.** Fagerlind's model in *Elingamita johnsonii* Baylis (Myrsinaceae). Trunk axis with rhythmic growth, branch axes tiered, each branch plagiotropic and sympodial by terminal flowering of each unit.

**Fig. H.** Aubréville's model in *Beilschmiedia tarairi* (Cunn.) Kirk (Lauraceae). Trunk axis monopodial with rhythmic growth, tiered branch axes plagiotropic but sympodial by apposition and with lateral flowers.

**Fig. I.** Attims' model in *Olearia solandri* Hook. f. (Asteraceae). Trunk axis with diffuse branching, all axes essentially orthotropic and with lateral flowers.

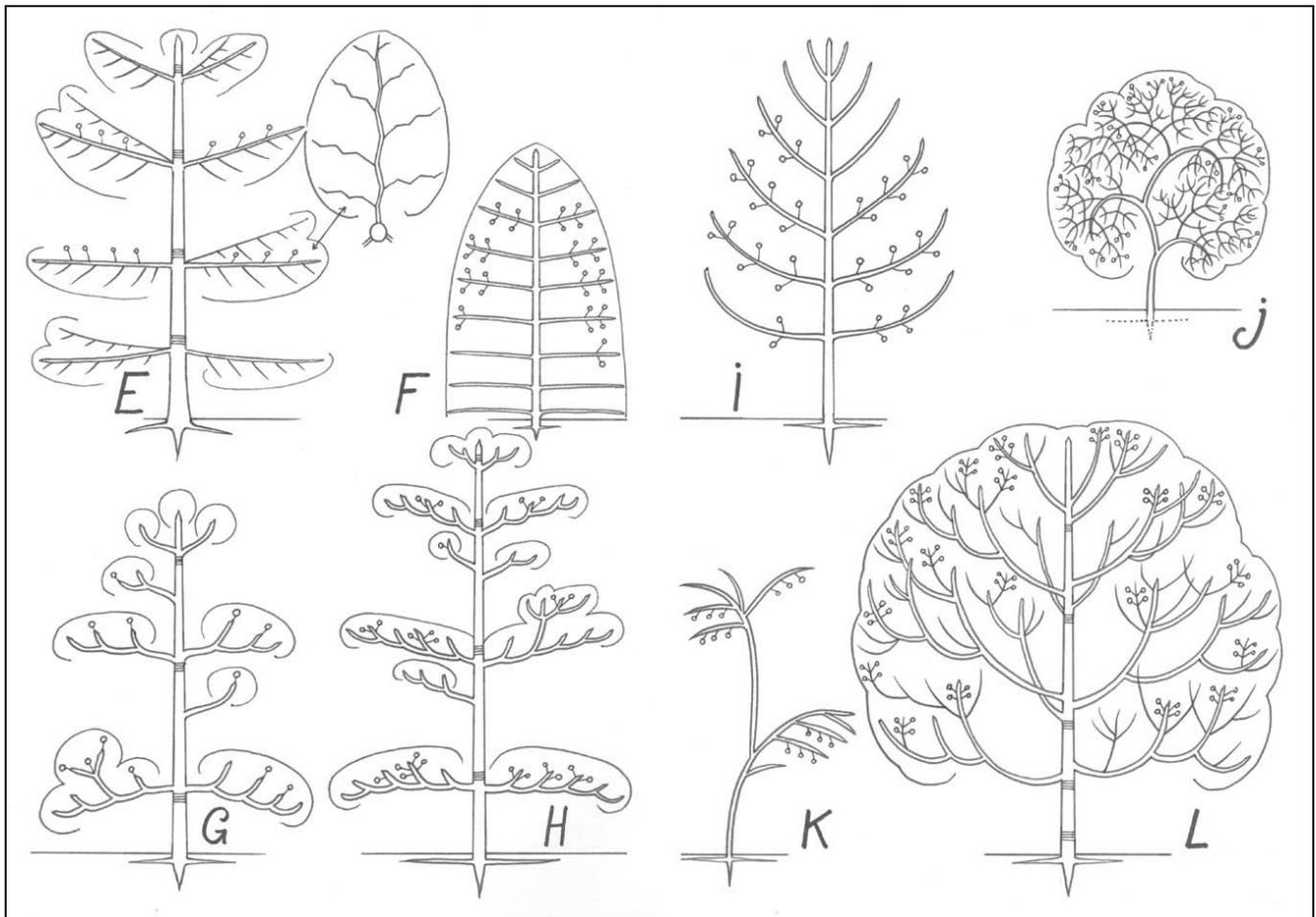
**Fig. J.** A divaricating shrub in *Coprosma rhamnoides* Cunn. (Rubiaceae). An aberrant architecture; all axes inherently plagiotropic, but cf. Champagnat's model.

**Fig. K.** Troll's model in *Carmichaelia* sp. (Fabaceae). All axes plagiotropic, the trunk developed by

superposition of the basal portion of successive branches.

**Fig. L.** Rauh's model in *Vitex lucens* Kirk (Verbenaceae). All axes orthotropic, with rhythmic growth; flowering is always lateral and does not influence architecture. The model is often more easily recognized in young trees, which grow in the more stable environment of the forest understorey.

Addition: *Melicytus macrophyllus* (Violaceae), the first example in this family of this common model; and in *Alectryon*, *Dysoxylum*, *Hoheria*, *Vitex*.



### Discussion

Clearly our results, based on a limited survey, are preliminary, but they do draw attention to the marked variety of trees to be found in New Zealand forests, reflecting a combination of climate, growth form and wide geographic representation. This is almost a unique situation for temperate forests, to which can be added the phenomena of heteroblasty and divarication. Auckland's latitude at 37 degrees corresponds approximately to that of Seoul, Athens, Mar del Plata, San Francisco and Washington D.C.,

where tree architectural diversity is limited. Adding this information to the list of tropical features provides a new perspective on the complexity of forest types in New Zealand. One can presume that biological interactions among different tree forms will have a dynamic effect in the forest canopy, because tree architecture must be the controlling influence on canopy construction. Clearly our results are but a beginning but they suggest that the topic is worth looking at in much greater detail.

### Acknowledgements

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## Bibliography

- Allan, H.H. 1961: Flora of New Zealand Vol. 1. Government Printer. Wellington.  
Cockayne, L. 1910: New Zealand Plants and their Story . Government Printer. Wellington.  
Hallé, F., Oldeman, R.A.A., & Tomlinson, P.B. 1978: Tropical Trees and Forests: an Architectural Analysis. Springer Verlag. Berlin, New York.  
Poole, A.L. & Adams, N.M. 1994: Trees and Shrubs of New Zealand. Manukai Press, Auckland.  
Salmon, J.T. 1980: The Native Trees of New Zealand. A.H. & A.W. Reed Ltd. Wellington.

# Significance for Dummies: a case study from the southern end of Lake Taupo

Rhys Gardner

Question: How do you stop a botanist from doing field work?

Answer: Say you want to know the site's Significance too.

## Introduction

The Resource Management Act gives our Regional Councils responsibility for protecting "areas of significant indigenous vegetation and significant habitats of indigenous fauna", and states that such protection is "a matter of national importance". Does this mean then there might be non-significant areas of vegetation etc. the protection of which is not generally of national importance? If so, who should protect them? Or is 'significance' a concept to be applied in a scale: Local Significance, Ecological District Significance, Regional Significance, National Significance, etc.?

For a while I got relief from Venn Diagrams (Edwards 2004) but more to the point was an essay by versatile ex-Forest Service botanist Mark Smale (1994). This, together with his references, which included a primary statement by ex-DSIR Botany Division ecologist Geoff Kelly (1980), provided a theory-laden background for fieldwork I did in August on the shore of Lake Taupo, at a place which could soon be filled with new holiday homes. In this article I attempt to stand on the shoulders of these giants, in the hope of forging what might come to serve as a useful botanical thought-tool.

## Significance Explained

The Lake Taupo study area is essentially a broad streamside strip of kanuka (*Kunzea ericoides*) scrub by the Whareroa Stream, c. 15 km north of Tokaanu. The subdivision is to be placed on a terrace above the mouth of the stream on its northern side, where the streamside strip expands up along the terrace edge (Fig. 1).

How should one go about assessing the Significance of this at first sight not especially marvellous piece of habitat? Firstly, since the land is in Maori ownership, and it is these owners that are wanting to make the subdivision, one has to suppose that it has no great spiritual or historic significance. Nor are there any threatened plants here (see SPECIES LIST).

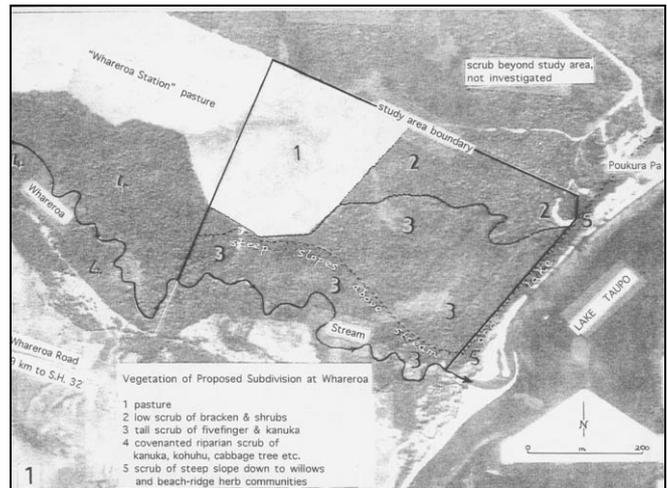


Fig. 1. Whareroa Stream mouth, south-west shores of Lake Taupo. Vegetation and other features. Based on colour aerial photograph (NZ Aerial Mapping) flown 15 Oct 2002.

Secondly, is it reasonable to try to assess Significance for just the study area alone? Would not this tend to lead to the court-feared Death by a Thousand Cuts (each small threatened part of a landscape being much less Significant than the unthreatened remainder ...)? A broader approach seems preferable, especially here where the study area has good-quality natural continuations along the lake and also upstream (this riparian kanuka scrub already being covenanted as trout-spawning habitat). But such an approach can also lead to absurdity - "everything is connected, man", or at least, impracticality — it is seldom feasible to survey the extended area when the client controls the budget.

I suggest the way off this dilemma is to concentrate on the study area (not entirely, of course), and assess its Significance as a function of three variables, expressed by the formula:

Significance = f(R, C, U) where R is Representativeness, C is Connectedness (including Buffering) and U is Unique Features.

Its Representativeness, that is, how comprehensive a sample the study area is of the vegetation (species diversity/habitat type) it is considered an example of, is, in the first place, likely to be proportional to its size. Additionally, its Representativeness will be greater the