SHORT COMMUNICATION

Whipcord plants: a comparison of south-eastern Australia with New Zealand

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Abstract: Whipcord plant is a term used for some dicot angiosperms with small, scale-like leaves closely appressed to the stem. So far, the term has mostly been used in this sense for plants from New Zealand. Here, I summarize the incidence and habitat relations of New Zealand whipcord plants and then use the literature to show that whipcord plants also occur in south-eastern Australia. New Zealand whipcord plants comprise nine species of *Hebe*, four of *Leonohebe* and six of *Helichrysum*, while in south-eastern Australia there are six species of *Ozothamnus* and one of *Leucophyta*. In both areas, some species are alpine to subalpine, while some are from lowland habitats with significant summer water deficits.

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Introduction

Since at least the publication of Cockayne (1928), the term whipcord plant has been used in the botanical literature for dicot angiosperms with small, scale-like leaves closely appressed to the stem, giving the shoots a cord-like appearance. The term has been used most for groups of New Zealand species within *Hebe* and *Helichrysum* (Wardle 1991). However, it is clear that the term whipcord is synonymous with the term cupressoid, the same morphology being common in the gymnosperm families Cupressaceae (e.g. *Libocedrus*) and Podocarpaceae (e.g. *Dacrydium*, *Halocarpus*) (Cockayne 1928, Wardle 1991). In fact, when the two cohabit, the whipcord *Hebe armstrongii* is almost indistinguishable from the podocarp *Halocarpus bidwillii* except when it is flowering (Wardle 1991).

As far as I know, the term whipcord has not been applied to angiosperms other than those from New Zealand except for some species of the Northern Hemisphere genus *Cassiope* (Ericaceae) (Huxley 1999; dealt with more fully below). For gymnosperms, it is widely used for a form of the North American western red cedar (*Thuja plicata*, Cupressaceae; Google search of 'whipcord', 2009). In this note, I start by summarizing the incidence and habitat relations of whipcord plants in the New Zealand angiosperm flora. I then document the occurrence of native whipcord angiosperms in south-eastern Australia and compare their habitat relations with the New Zealand data. The analogous cupressoid life form of some gymnosperms is not dealt with further.

Methods

The data were compiled solely from literature searches for angiosperm species with small, scale-like leaves closely appressed to the stem in adult plants. In young plants of whipcord species, it is common for the leaves to be more or less divergent from the stem (Cockayne 1928, Eagle 2006).

Species nomenclature follows http://nzflora.landcareresearch.co.nz (2009) (New Zealand) and Harden (1992), Puttock (1999) and Buchanan (2009) (Australia) unless specified. I am aware that some workers now include *Hebe* and *Leonohebe* within *Veronica* (e.g. Mabberley 2008). This is discussed more fully by Bayley & Kellow (2006).

I follow de Lange & Norton (2009) in including the penalpine and nival altitudinal zones of Wardle (1991) within the term alpine. The Australian term 'mallee' refers to vegetation dominated by multi-stemmed, tall shrub species of eucalypts, usually found in semi-arid areas drier than eucalypt woodland.

Table 1. New Zealand whipcord plants: leaf length of adult plants and habitat

Data from Allan (1961), Mark & Adams (1986), Wardle (1991), Widyatmoko & Norton (1997), Bayley & Kellow (2006), Eagle (2006). n.a. = not available

Family/species	Leaf length (mm)	Habitat
Plantaginaceae		
Hebe annulata	0.75 - 1	Subalpine
Hebe armstrongii	1	Montane to subalpine
Hebe hectorii	1.2 – 3	Subalpine to alpine
Hebe imbricata	1 – 2	Subalpine to alpine
Hebe lycopodioides	1.5 – 2	Subalpine to alpine
Hebe ochracea	1 – 1.5	Alpine
Hebe propinqua	1 – 2	Subalpine to alpine
Hebe salicornioides	1 – 2	Subalpine to alpine
Hebe tetragona	1.5 – 3.5	Subalpine to alpine
Leonohebe cheesemanii	1	Alpine
Leonohebe cupressoides	1 – 1.5	Lowland to alpine
Leonohebe tetrasticha	1 – 1.5	Subalpine to alpine
Leonohebe tumida	1 – 1.5	Subalpine to alpine
Asteraceae		
Helichrysum coralloides	5	Montane to alpine
Helichrysum depressum	n.a.	Montane to alpine
Helichrysum dimorphum	1.5	Lowland
Helichrysum intermedium	2 – 4	Lowland to alpine
Helichrysum parvifolium	2	Montane to alpine
Helichrysum plumeum	2-4	Montane to alpine

Table 2. South-eastern Australian whipcord plants: leaf length of adult plants, distribution and habitat

Data from Curtis (1963), Harden (1992) and Puttock (1999). For distribution, NSW = New South Wales; Q = Queensland; SA = South Australia; T = Tasmania; V = Victoria

Family/species	Leaf length (mm)	Distribution	Habitat
Asteraceae			
Leucophyta brownii	1.5-14	SA, T, V	Exposed coasts
Ozothamnus adnatus	1-4	NSW, V	Dry forests and woodlands
Ozothamnus diotophyllus	2-5	NSW, Q	Mallee
Ozothamnus hookeri	1-2	T	Alpine
Ozothamnus pholidotus	1.5-4	SA, V	Mallee
Ozothamnus scutellifolius	0.4-1.5	T	Dry hillsides
Ozothamnus species 1	1.5-4	NSW, V	Subalpine to alpine

Fig. 1. Whipcord plant of *Ozothamnus hookeri*, Mt. Field, Tasmania. Photo by David Tng.

Fig. 2. Whipcord plant of *Ozothamnus scutellifolius*, Tasman Peninsula, south-east Tasmania. Photo by David Tng.

Results

New Zealand

All of the whipcord plants are in the genera *Hebe*, *Helichrysum* and *Leonohebe* (Table 1). Except for the liane *Helichrysum dimorphum* (see Allan 1961, Eagle 2006), all are shrubs. At least one is also a cushion plant (*Helichrysum coralloides*, Eagle 2006).

In selecting the whipcord species of *Hebe*, I have followed Bayley & Kellow (2006) in recognizing nine species (Table 1). In the genus *Leonohebe*, they describe the four species of Section *Leonohebe* as 'the Semiwhipcords'. Three of the four species obviously meet the definition of whipcord (see Table 1) but I have excluded *Leonohebe ciliolata* as its leaves clearly diverge from the stem (see the figures in Mark & Adams (1986), Bayley & Kellow (2006) and Eagle (2006)). The other Section, *Aromaticae*, consists solely of *Leonohebe cupressoides*. While it differs from the other whipcord species in having widely spaced leaves (Bayley & Kellow 2006), it still meets the whipcord definition, so I treat it as a whipcord, as does Allan (1961).

Nearly all whipcord species of *Hebe* and *Leonohebe* occur in alpine areas and extend downslope into the subalpine zone (Table 1). Only *Leonohebe cupressoides* extends even further down into lowland areas, on 'alluvial terraces or colluvial slumps' (Widyatmoko & Norton 1997).

The six whipcord species of *Helichrysum* occur on cliffs and rock outcrops (Wardle 1991). Four have a montane to alpine range (Table 1), while *Helichrysum dimorphum* occurs in scrub on the walls of lowland river gorges (Wardle 1991); *Helichrysum intermedium* has a form on coastal cliffs (Wardle 1991).

South-eastern Australia

The whipcord species from this area are all shrubs in the tribe Gnaphalieae of the Asteraceae and comprise six species of *Ozothamnus* and one of *Leucophyta* (Table 2 and Figs. 1, 2, 3 and 4). Of the *Ozothamnus* species, two are from subalpine to alpine habitats, while the others are from lowland areas with significant summer water deficits (Table 2). *Leucophyta brownii* is a cushion plant from foredunes and cliffs on exposed coasts (Table 2). A number of other small-leaved species of both *Ozothamnus* (e.g. *Ozothamnus lycopodioides*) and *Olearia* (e.g. *Olearia teretifolia*) resemble whipcord species but fall outside the definition by having leaves which diverge somewhat from the stem.

Fig. 3. Whipcord plant of *Leucophyta brownii*, Scamander, east coast Tasmania. Photo by David Tng.

Fig. 4. Whipcord plant of *Ozothamnus pholidotus*, Glenisla Flats near the Grampians Ranges, Victoria. Photo by Bruce Fuhrer.

Discussion

Although use of the term 'whipcord' for some angiosperms has so far been virtually confined to New Zealand plants, it is not surprising to find that there are plants of identical life form in related lineages and habitats in Australia (Table 2) and elsewhere (see below). The most striking feature of the whipcord life form is small leaf size, which is clearly related to high levels of environmental stress (Wardle 1991). Four of the five whipcord genera dealt with here have some alpine to subalpine species where the main stresses will be a complex mixture of low temperature and low water supply effects (Korner 2003). However, both *Helichrysum* and especially *Ozothamnus* have some lowland species from habitats where the major stress will be periodic water deficit, well-known as one of the selective forces for small leaf size (Wardle 1991). In all cases, the whipcord life form may be regarded as a late stage in the evolutionary transition from large leaves to leaflessness as stress increases (see also Wardle 1991). In addition, the fact that the leaves of whipcord species are closely appressed to the stem will reduce their transpiration rate and, in the case of *Leucophyta brownii* and some populations of *Helichrysum intermedium*, the area exposed to salt spray.

Regarding the degree of phylogenetic relationship between the New Zealand *Helichrysum* whipcords and the Australian *Ozothamnus* ones, both genera are in the Tribe Gnaphalieae (Ward & Breitwieser 1998). All the whipcord species of *Helichrysum* will be relocated to other genera, but those genera do not include *Ozothamnus* (Ward & Breitwieser 1998, Breitwieser & Ward 2003).

It would be amazing if the whipcord habit was confined to Australasia and in fact, of the eight species of the Northern Hemisphere arctic-alpine evergreen shrub genus *Cassiope* (Ericaceae) described fully by Huxley (1999), six fall clearly within the whipcord definition and are actually referred to as 'whipcord-like' (Huxley 1999). Also, from the descriptions and illustrations, it is clear that the following South African Ericas are whipcords: *Erica alfredii* Guthrie & Bolus, *Erica corifolia* L., *Erica lutea* Berg., *Erica melanacme* Guthrie & Bolus, *Erica rhopalantha* Dulfer and *Erica scytophylla* Guthrie & Bolus (Baker & Oliver 1967), as are *Erica dominans* Killick (Killick 1997), *Erica juniperina* E.G.H. Oliv. (Oliver & Oliver 1995) and *Erica lachneaefolia* Salisb. (E.G.H. Oliver pers.comm.).

In the Cape region of South Africa, the shrub genus *Stoebe (Asteraceae)* includes three species, *Stoebe microphylla* DC, *Stoebe rugulosa* Harv. and *Stoebe schultzii* Levyns, which fall within the whipcord definition (Goldblatt & Manning 2000, Koekemoer 2002). Also, the bizarre South African shrub *Phaenocoma prolifera* (L.)D.Don (Asteraceae), where the tiny leaves 0.7mm long are carried on short side shoots up to 4mm long, also meets the whipcord definition (Hind 1996). All of the Asteraceous whipcord genera mentioned above are in the tribe Gnaphalieae. Within that tribe, enough phylogenetic data are available to show that the whipcord habit has arisen independently in a number of separate lineages (Bayer *et al.* 2000, 2002).

A final possible African connection comes from the name *Helichrysum selago*, previously used for the New Zealand whipcord *Helichrysum intermedium*. The specific epithet is explained as 'resembling *Selago*, an African genus'(Mark & Adams 1986), *Selago* being a genus in the Scrophulariaceae (previously including *Hebe*).

The only other whipcord species known to me is the north African-Eurasian tree *Tamarix aphylla*, which has tolerance to both drought and salinity (Parsons & Cuthbertson 2001). Detailed work may reveal further whipcords amongst scale-leaved members of the family Tamaricaceae.

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