

VARIATION IN LEAF SHAPE OF *HAKEA EPIGLOTTIS*

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INTRODUCTION

Hakea epiglottis Labill. is a Tasmanian endemic species, which typically grows as a shrub or small tree, and occurs from sea level to high altitudes. The distribution map in Brown *et al.* (1983) shows it to be most widespread in the east, south and west of the State, and least common in the north. In eastern Tasmania, *H. epiglottis* is often associated with insolated or exposed sites on dolerite, including rock plates, gorges and coastal landforms.

Hakea epiglottis is common in coastal landforms on the Tasman Peninsula. During a survey of *Euphrasia amphisysepala* habitat on Dolomieu Point, within Abel Tasman Forest Reserve, *H. epiglottis* was found growing in two distinct habitats. Close to the waterline, on relatively exposed rock slabs, cliffs and ledges, *H. epiglottis* grows as a semi-prostrate shrub. Its wind-twisted stems emerge from crevices where soil and moisture accumulate and some protection from the elements is provided. Immediately upslope from the coastal fringe, on south-facing slopes where the microclimate is less severe and a veneer of soil is present, a dense scrub has developed. The scrub may have originated after a wildfire which burnt much of Dolomieu Point in the early 1980's. Common scrub species include *Bedfordia salicina*, *Callistemon pallidus*, *Leptospermum scoparium* and *H. epiglottis*, in this case growing as an erect shrub to a height of 4m.

Leaves of *H. epiglottis* at Dolomieu Point varied greatly in their morphology. Curtis (1963) describes the leaves of the species as "terete (i.e. cylindrical), rigid, mucronate and pungent (i.e. with a needle-like point), often curved upward, 2-10cm long". All shrubs observed in the exposed coastal habitat at Dolomieu Point had leaves which were consistent with this description. However, leaves of *H. epiglottis* in the dense scrub varied from terete, rigid leaves as described by Curtis (1963), to flat, linear-lanceolate leaves which were far from rigid. Trends in leaf form seemed to relate to their position on the stem.

This paper documents the variation in leaf morphology of *H. epiglottis* at Dolomieu Point, and speculates on reasons for this variation.

METHODS

Several branches of *H. epiglottis* were collected from the scrub environment, and one branch was collected from a crevice near the waterline (i.e. coastal environment). Four branches from the scrub plants were selected for

measurements of leaf dimensions; these branches all contained a range of leaf forms. The selected branches contained apical leaves (growing near branch tips at the top of the canopy), mid-stem leaves (growing in middle sections of branches within the canopy) and basal leaves (growing towards the base of branches, below the canopy). Similar measurements were made on apical, midstem and basal leaves on the branch from the coastal environment. An average of 16 leaves were randomly selected and measured from different sections of each branch of the scrub plants, and 11 leaves were measured from the coastal plant. The t-test for independent samples was used to compare:

- leaf morphology in different sections of the scrub plant branches;
- leaf morphology in different sections of the coastal plant branch;
- leaf morphology in plants growing in the two environments.

All specimen sheets of *H. epiglottis* in the Tasmanian Herbarium (about 100 sheets in all) were examined to see if the range of leaf variation observed at Dolomieu Point occurred elsewhere in the State. Fourteen of the specimen sheets were from Tasman Peninsula, most of the plants being collected from coastal or near-coastal environments. Specimens of most other Tasmanian species of *Hakea* (*H. lissosperma*, *H. microcarpa*, *H. teretifolia*, *H. nodosa*, *H. sericea* and *H. ulicina*) were also examined to see if other species had comparable variation in leaf morphology.

RESULTS

Leaf morphology of Hakea epiglottis from Dolomieu Point

Basal and mid-stem samples were grouped for both scrub and coastal specimens as length and breadth of leaves did not differ significantly between these leaf positions.

For scrub plants, length of leaves was not significantly different between the apical and mid-stem/basal positions. However, breadth of leaves was significantly greater for the mid-stem/basal position compared to the apical position ($t=-8.7$, $df=60$, $p<0.001$; Table 1). Apical leaves were mainly terete, and matched the description given in Curtis (1963), but some were distinctly flattened. Leaves were much more crowded towards the tip of the branches, and became progressively sparser towards their bases. Midstem and basal leaves were occasionally terete, but mainly flattened, with the widest leaf measurement being 6 mm. The flattened leaves had markedly thickened midribs and margins, were widest towards their tip and narrowed towards the petiole (Fig. 1).

For the coastal plant, breadth and length of leaves was the same regardless of leaf position. All leaves were terete, rigid and pungent (Fig. 1), as described by Curtis (1963). Leaf density was similar on all sections of the stem. The breadth of mid-stem/basal leaves was significantly different between coastal and scrub specimens ($t>3.7$, $df=27$, $p<0.001$; Table 1). However, breadth of apical leaves

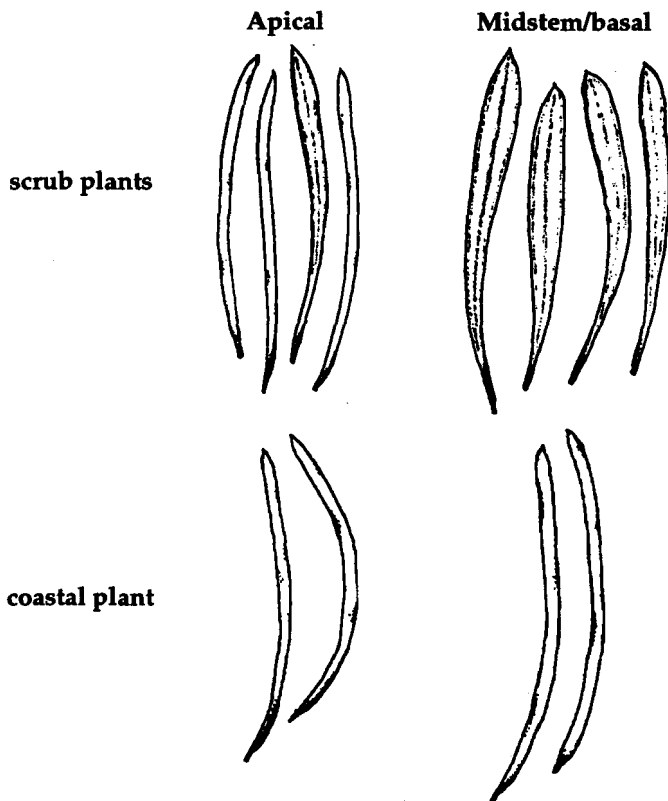


Fig. 1. Examples of leaves of *Hakea epiglottis* from Dolomieu Point.

was not significantly different between coastal and scrub plants. Length of apical and mid-stem/basal leaves did not differ between coastal and scrub plants.

Comparisons of Dolomieu Point and herbarium specimens

All leaves of the herbarium specimens of *H. epiglottis* were terete, rigid and pungent, irrespective of their position on the branches. Considerable variation was evident in some other leaf characteristics. Width varied from less than 1 to 3 mm. Length varied from 15 to over 200 mm. Long leaves tended to have

Table 1. Leaf characteristics (Mean \pm SD, in mm) for *H. epiglottis* from Dolomieu Point.

	apical position	mid-stem/basal position
Scrub plants		
length	7.28 \pm 1.76	7.47 \pm 1.91
breadth	0.22 \pm 0.10	0.48 \pm 0.13
sample size	40	22
Coastal plants		
length	6.33 \pm 1.40	7.11 \pm 1.96
breadth	0.20 \pm 0.00	0.20 \pm 0.00
sample size	4	7

narrower diameters. Specimens with very short leaves had invariably been collected from exposed sites, both in coastal environments (e.g. Cape Raoul) and at high altitudes.

Specimens of *H. lissosperma*, *H. nodosa*, *H. teretifolia*, *H. microcarpa* and *H. sericea* all had leaves which were terete or near-terete, as described in Curtis (1963). *Hakea ulicina*, a species confined (in Tasmania) to the Furneaux Group, had flat, linear leaves on all specimens examined. The key to *Hakea* species in Curtis (1963) separates *H. ulicina*, from the other Tasmanian species, on the basis of its flat leaves.

DISCUSSION

The great difference in form between plants growing on the coastal rock slab and plants growing in the scrub (less than 50m away) can be attributed to influences of the physical and biological environment. On the rock slab, exposure to wind, spray and drought, and the absence of competition from other shrubs, has encouraged a low, spreading habit. The development of dense scrub, further back from the waterline, has encouraged an erect growth habit in shrubs (of all species) because of competition for light. Not surprisingly, very few seedlings were present under this canopy. Regeneration of shrub species would depend on fire occasionally removing the canopy, and providing a receptive seed bed for seed released from the protective capsules of fire-killed shrubs (e.g. *H. epiglottis*, *Leptospermum scoparium*), or seed disseminated from unburnt vegetation in the area (e.g. *Bedfordia salicina*). The latter might include seed from rock slab (coastal) *H. epiglottis* plants, which would be relatively protected from fire by expanses of bare rock.

The flattened *H. epiglottis* leaves growing under the dense scrub canopy at Dolomieu Point seem to be atypical, even though the species demonstrates variability in other aspects of leaf morphology (particularly length). Relatively low light levels under the dense shrub canopy are the most likely explanation for the development of wider leaves on lower (shaded) sections of the stems of scrub plants. Flattened leaves would increase leaf area available for photosynthesis. At the same time, amelioration of the climate under the canopy would lessen the usefulness of the terete and rigid apical leaves, which would better tolerate the more severe climate at the top of the canopy. Experimental treatments might show whether this response is phenotypic (i.e. directly attributable to the environment) or genotypic (i.e. resulting from natural selection over several generations). There are many examples in the literature of selection for genetically different forms over very short distances, and the ability to make plastic responses can itself be genetically determined (Brown 1983).

The tendency of leaves to reduce surface area in response to drought or exposure, and to increase surface area in response to shade or high moisture levels, can be seen in many Tasmanian woody taxa, both mesophytic (e.g. *Tasmania lanceolata*, *Bedfordia salicina*, *Nothofagus cunninghamii*) and xerophytic or sclerophyllous (e.g. *Telopea truncata*, *Eucalyptus vernicosa*). However, in most cases, leaves on these plants respond more or less similarly to such environmental influences, rather than exhibiting the marked heterophylly which occurred in *H. epiglottis* in the scrub community at Dolomieu Point.

The review of herbarium specimens suggests that the heterophylly at Dolomieu Point is very uncommon, if not unique. However, specimen notes indicate that most of the specimens were collected from fairly open and often exposed environments. It would be interesting to determine, by field observations or experiment, if other populations of *H. epiglottis* respond to different levels of exposure, insolation or light, in a similar manner to plants at Dolomieu Point.

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