DIVARICATE FAMILIES COMPARED WITH TIME

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Can a consideration of the age of first occurrence of families and genera in the geological record contribute to the debate (Atkinson and Greenwood 1989; McGlone and Clarkson 1993) about the origin of the high frequency of the divaricate habit in the New Zealand flora? The families, in alphabetical order, and genera of 22 forest divaricate species and the record of their earliest occurrence (Mildenhall 1980) are listed in Table 1.

Table 1. Geological periods of the first occurrences of plant families in New Zealand and their genera that include divaricate species.

Family	Genus	Period
Araliaceae	*Pseudopanax*	Eocene
Elaeocarpaceae	*Elaeocarpus*	Oligocene
Escaloniaceae	*Carpodetus*	Quaternary
Icaceae	*Pennantia*	Quaternary
Malvaceae	*Plagianthus*	?Lower Eocene
Moraceae	*Streblus* (*Paratrophis*)	Quaternary
Myrsinaceae	*Myrsine*	Oligocene
Pittosporaceae	*Pittosporum*	Middle Miocene
Podocarpaceae	*Prumnopitys*	Upper Eocene
Polygonaceae	*Muehlenbeckia*	Miocene
Rubiaceae	*Coprosma*	Upper Oligocene
Rutaceae	*Melicope*	Pliocene (?L. Miocene)
Violaceae	*Melicytus*	Middle Miocene

Of the 13 families, three start in the Eocene, three in the Oligocene, three in the Miocene, one in the Pliocene, and three in the Quaternary (Table 2)

Table 2. Plant Families related to time and selective influences

Family	Period	Selective influence
Escaloniaceae	Quaternary	Moa + climate etc.
Icaceae	Quaternary	
Moraceae	Quaternary	
Rutaceae	Pliocene (?L. Miocene)	
Pittosporaceae	Middle Miocene	Moa
Violaceae	Middle Miocene	
Polygoneaceae	Miocene	
Rubiaceae	Upper Oligocene	
Myrsinaceae	Oligocene	
Elaeocarpaceae	Oligocene	
Araliaceae	Eocene	
Malvaceae	?Lower Eocene	
Podocarpaceae	Upper Eocene	

Wallis and Trewick (2001) use 25 MY (base of the Miocene) as the defining time when moa browsing could have caused divaricateness, whereas after 25 MY climate may have had a partial influence (Table 2). Since mountain uplift probably did not begin until the end of the Miocene, climate variation due to this uplift is unlikely to have had an influence on the development of the divaricate habit in nine (69%) of the families.

While it is not possible to determine if a plant is divaricate without fossil twigs, Holden (1983) has illustrated leaves that could have belonged to divaricate plants from the Oligocene and Miocene i.e. before high altitude climate had become an influencing factor. Their relative size and shape is used here as an indicator of the possibility that a fossil leaf could have come from a divaricate plant i.e. small leaves. I have applied this indication to families from Table 2 to suggest how this approach could be applied to her large number of fossil leaves. It is noted that a warmer climate, provided it was not arid, would result in larger leaves.

Table 3. Possibility of leaf fossils being representative of divaricate species based on information in Holden (1983) and Wolfe (1993).

Family	**Figure Holden (1983)**	**Nomenclature Holden (1983)**	**Leaf size and shape category (Wolfe 1993)**	**Possibility of divarication**
Araliaceae	30.4	?Araliaceae	Microphyll II	Possible
Myrsinaceae	30.8, 30.11	?Myrsinaceae	Microphyll II	Possible
Myrsinaceae	31.1	*Myrica*	Microphyll II	Unlikely
Podocarpaceae	18.5–18.8	?Podocarpaceae	Microphyll II	Unlikely
Rubiaceae	13.14–31.15	*Coprosma* spp.	Microphyll III	Unlikely
Rutaceae	29.8	?Rutaceae	Microphyll II	Possible
Violaceae	21.3	?Melicytus	Notophyll	Unlikely

The indication is that leaves characteristic of the divaricate habit occur amongst fossils from the Oligocene and Miocene. This favours the opinion that moa had a selective influence on the evolution of this habit form. Identification of divaricate twig fossils in Oligocene and Miocene records would strengthen this opinion.

References

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