Time between germination and first flowering of some perennial plants

B.G. Muir

Department of Conservation and Land Management, Murdoch House, 5 The Esplanade, Mt. Pleasant, Western Australia 6153. Present address: Dames & Moore, Consulting Engineers, 26 Lyall St., South Perth, Western Australia 6151.

Abstract

Muir, B. G. Time between germination and first flowering of some perennial plants. Kingia 1(1); 75-83 (1987). Time elapsed between germination and first flowering is presented for 198 plant species from the south-west of Western Australia. About 12% of the species examined required six or more years after germination before they first flowered. This has significance for the long term survival of such species in areas where the bushland is burnt in regular cycles of five years or less.

Introduction

The opinion is held by some land management agencies and a section of the public, that vegetation in the south-west of Western Australia should be burned as often as it will support fire. The reasoning behind this philosophy is generally that frequent burning is necessary to reduce fuel loads to levels which will not allow fierce wildfires to develop during the hot, dry, summer months.

The apparent fire tolerance of the vegetation is reflected in its rapid post-fire regeneration, increased flowering in some species following fire, and the lush look of new growth compared to the straggly appearance of older bushland. These factors give the layman the impression that recently burned bush "looks better", therefore frequent burning must be better for both flora and fauna. My own observations indicate that although many plants are fire tolerant they are not necessarily fire dependent. Evidence exists which indicates that burning too frequently can permanently alter floristic richness (Connell 1978, Westman 1975, Baird 1958). Similarly, physiognomy may be altered (Muir 1977, Cochrane 1966, Gill 1975), weed invasion may be exacerbated (Road Verge Committee Report 1970, Muir 1977) or fire-sensitive species may be removed (Wallace 1966).

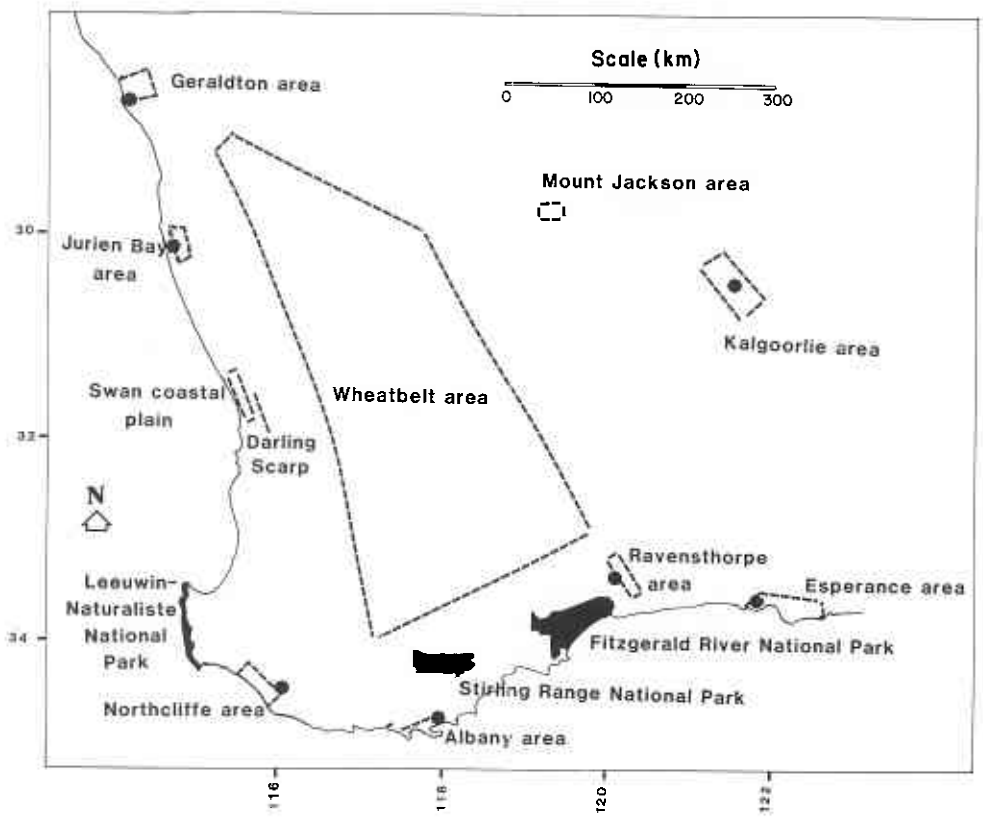
In order for native plant species to persist and to maintain the full potential of their gene pool, adequate seed set and plant regeneration must occur between fires. Frequent burning may destroy plants before flowering and seed set have occurred. Thus species which are obligate seed regenerators and flower within a year or two of being burned may be disadvantaged compared, for example, to species growing from rootstocks. Even seedstocks stored in the soil may be progressively depleted if seedlings are continually being burned before having the opportunity to flower and set further seed. Ultimately therefore, species may be lost from certain vegetation types as a consequence of too frequent burning.

Studies on vegetation and flora in the Western Australian wheatbelt (Kitchener 1976, Muir 1978-79) by the author, and at other localities, generated numerous observations on the time between germination and first flowering. It was considered that information on the period of time between germination and first flowering would be of assistance in

estimating the minimum period necessary to allow successful propagation of some plant species. It is also possible that first flowering may be poor, that the seed set in the first one or two years of flowering may be sterile, e.g. *Dryandra sessilis*; or such small numbers of seeds may be set that all succumb to predators. If so, many fire-free years may be necessary to ensure the survival of even a single new plant. It should be borne in mind that the intervals between germination and first flowering listed in this paper may be atypically long or short depending on particular soils and climatic conditions during the study period (1975-84). Nonetheless, field observations are considered a fairly reliable guide to the time taken from germination to first flowering, at least of some plants. Data from cultivation, by contrast, are probably less reliable than field observations, but as all records reported here are from one site, the data provide a valid comparison.

Methods

Data on the time between germination and first flowering were collected during field studies in the Western Australian wheatbelt (Kitchener 1976, Muir 1978-79), and elsewhere in south-western Australia. Other studies and casual observations have been made during preparation of publications including Morris and Muir (1975), Muir (1979) and Muir (1983). Most field observations were based on studies of vegetation of various ages since fire. The presence of flowers or recent fruits on a plant was considered as indicating potential seed set although, as mentioned above in the case of *Dryandra sessilis*, this may not always be true. The age of the plant since fire was then noted. Care was



Map 1. Location and areas referred to in Appendix 1.

taken to ensure that all observations were made on plants arising from seed and not suckers or rootstocks. Fire age was determined from Local Authority records, information from farmers and from interpretation of aerial photographs.

Because of the wide range of distribution of some species the approximate geographic location of the field observations is presented in Appendix 1 and shown on Map 1. Data on time to first flowering in cultivation were recorded from plants grown in the author's garden. All cultivated specimens were grown from freshly collected seed planted at a single location at Boya, about 18 km east of Perth on the edge of the Darling Scarp. All were planted in sandy loam, loam, clay loam or sandy clay soils in May or June following initial germination in sand in pots. Hard seeds of *Acacia* were abraded with sand paper, but all other seeds were untreated. After planting, all were watered twice per week in their first summer and once per week in the second. During following years all plants were unwatered unless they showed signs of stress. No fertilizers were applied.

For the purpose of this paper "light" soils are those classed as sand (0-10% clay) to sandy clay loam (20-30% clay) and "heavy" soils range from clay loam (30-40% clay) to heavy clay (greater than 50% clay) (Northcote 1971).

Each species record presented in Appendix 1 is based on at least three separate field and/or cultivation observations, except those recorded as "wheatbelt" which are based on a minimum of five observations. The presence of at least two flowering individuals was taken as evidence of possible seed set within any stand of young plants.

Results and Discussion

Data collected on 198 species of plants are presented in Appendix 1. Minimum recorded number of years to first flowering and percentage of species which flowered for the first time in that year are presented in Table 1.

Table 1. Minimum recorded number of years to first flowering and percentage of species which flowered for the first time in that year.

Minimum recorded years to first flowering	% of total number of species
1	1.5
2	12.1
3	20.7
4	34.3
5	17.7
6	10.6
7 or more	2.0

Although many species flowered within five years of germination, over 12% required six or more years before flowering. The presence of even one or two species of this type in a stand of vegetation points to a corresponding minimum frequency at which deliberate control burning can be carried out if species are not to be lost. Any additional constraints such as poor first flowering, sterile seed or excessive seed predation would necessitate even longer between-fire intervals to permit the build up of a sufficient seed store to permit survival of the species.

The difference in time to first flowering was compared between those species where data were available from both the field and cultivation. These results are presented in Table 2.

Table 2. Source of data, mean time to first flowering in years, the standard deviation (SD) within the groups and number (n) of observations.

Source	Mean time to first flowering (yrs)	SD	n
Field	4.35	3.51	152
Cultivation	3.46	1.15	178

Although the means are not significantly different there is a suggestion that most plants flower slightly earlier in cultivation. With water supplements over summer, a higher rainfall than inland areas of Western Australia, less competition and some predator control this is not unexpected, but further research is required.

Observations on species which were recorded on both light and heavy soil types were compared. Where a species was recorded in each soil type in the field, preference was given to this data rather than to cultivation data (if it was available).

Twenty-seven species provided data for flowering in both light and heavy soils. Of these 10 species showed no difference in time to first flowering. A further 14 species showed that flowering occurred earlier in light soils, while 4 species showed earlier flowering on heavy soils. Although no results were statistically different there was some suggestion of a trend to earlier flowering in some species on lighter soils, perhaps because of easier establishment of root systems.

References

Baird, A. M. (1958). Notes on the regeneration of vegetation of Garden Island after the 1956 fire. Journal of the Royal Society of Western Australia 41: 102-107.

Cochrane, G. R. (1966). Bushfires and vegetation regeneration. Victorian Naturalist 83: 4-10.

Connell, J. H. (1978). Diversity in tropical rainforests and coral reefs. Science 199: 1302-1310.

Gill, A. M. (1975). Fire and the Australian flora: a review. Australian Forestry 38: 1-25.

Gill, A. M. (1981). Adaptive responses of Australian vascular plant species to fires. Chap. 11. "Fire and the Australian biota". Australian Academy of Sciences Canberra. pp. 243-271.

Kitchener, D. J. (1976). Preface to the biological survey of the Western Australian wheatbelt. In: Biological survey of the Western Australian wheatbelt. Records of the Western Australian Museum Supplement No. 2: 3-10.

Morris, K. and Muir, B. G. (1975). Vegetation: In: "A Spring, 1975, biological survey of the proposed Mussel Pool Complex and recommendations for its future development". Western Australian Museum report to the Metropolitan Regional Planning Authority.

Muir, B. G. (1977). Vegetation and habitat of Bendering Reserve. In: "Biological survey of the Western Australian wheatbelt". pt. 2. Records of the Western Australian Museum Supplement No. 3: 3-142.

Muir, B. G. (1978-79). "Some nature reserves of the Western Australian wheatbelt". Parts 1-28, Perth: Department Fisheries and Wildlife Reports.

Muir, B. G. (1983). Drainage, swamp structure and vegetation succession at Melaleuca Park, northern Swan Coastal Plain. Western Australian Herbarium Research Notes No. 9: 27-39.

Northcote, K. H. (1971). "A factual key for the recognition of Australian soils". C.S.I.R.O./Rellim.

Road Verge Committee Report (1970). "Conservation of road verges". W. R. Wallace, Chairman.

Wallace, W.R. (1966). Fire in the Jarrah forest environment. Journal of the Royal Society of Western Australia 49: 33-44.

Westman, W. E. (1975). Pattern and diversity in swamp and dune vegetation, North Stradbroke Island. Australian Journal of Botany 23: 339-354.

Appendix 1. List of species with time to first flowering (in years) as determined from observations in the field and under cultivation.

Soil types are shown as L (light: sand to sandy clay loam) or H (heavy: clay loam to heavy clay). The location of the seed source refers to the areas shown on Map 1.

Species	Age at flowering and substrates		Source area
	Field	Cultivated	
Acacia			
acuminata	5L5H	5H	wheatbelt
aneura	4H	3H	Mt. Jackson
assimilis	6H		wheatbelt
blakelyi		2L	wheatbelt
brachyclada	6L		wheatbelt
celastrifolia		3L	wheatbelt
daviesioides	4L	5L	wheatbelt
drummondii	2L	2L	Leeuwin-Naturaliste
ericifolia	3L	3L	wheatbelt, Jurien Bay
filifolia	3H	2L	wheatbelt
glaucoptera	3H	2L	Ravensthorpe
gonophylla		4L	wheatbelt
hemiteles	3H	2L	wheatbelt
lasiocalyx	3L	3H	wheatbelt
ligustrina	3L3H	2L	wheatbelt
mackeyana	5H		wheatbelt
merinthophora	6L		wheatbelt
microbotrya	4H	2H	wheatbelt
multispicata	5H	5L	wheatbelt
myrtifolia	2L	5L	wheatbelt
pentadenia		5L	Northcliffe
pulchella	2H	2L	wheatbelt, Northcliffe
rostellifera		3L	Swan Coastal Plain
saligna	3L	3L	Swan Coastal Plain, wheatbelt, Northcliffe
signata	6L		wheatbelt
stenoptera		3L	wheatbelt
tetragonophylla	5H	4L	wheatbelt, Kalgoorlie
truncata		5L	wheatbelt
willdenowiana		3L	wheatbelt
Actinodium			
cunninghamii		2H	Stirling Range
Adenanthos			
meisneri	3L	2L	Darling Scarp
Agonis			
flexuosa	5L	4H	Leeuwin-Naturaliste
juniperina	4L	2L	Northcliffe
marginata		4L	Darling Scarp
Allocasuarina			
acutivalvis	5L	4L	wheatbelt
campestris	3H	4H	wheatbelt
corniculata	4L		wheatbelt
drummondiana	4L	5L5H	Jurien Bay
fraseriana	3L	2L	Swan Coastal Plain
huegeliana	4H	4H	wheatbelt, Darling Scarp
humilis	2L3H	2L	Darling Scarp, wheatbelt
microstachya	4L	3L	wheatbelt
pinaster	5L		wheatbelt
Alyogyne			
hakeifolia	2L	2H	Fitzgerald River National Park
Anigozanthos			
bicolor	3H	2L	Darling Scarp
flavidus		3L	Albany
humilis	2L	2L	wheatbelt, Darling Scarp
manglesii	2L	2L	Swan Coastal Plain
pulcherrimus		3L	wheatbelt, Jurien Bay
rufus		3L	Stirling Range
viridis	3L	2L	Swan Coastal Plain

Species	Age at flowering and substrates		Source area
	Field	Cultivated	
Astartea			
ambigua		3L	Stirling Range
fascicularis	4L6H	4L	Darling Scarp, Northcliffe
heteranthera	3H	2L	wheatbelt
Baeckea			
camphorosmae		4L	Darling Scarp
muricata	4H	4L	wheatbelt
Banksia			
ashbyi		3L	Fitzgerald River National Park
attenuata	4L	3L	Jurien Bay, Swan Coastal Plain
baueri	4L	3L	wheatbelt, Stirling Range
baxteri		4L	Fitzgerald River National Park
caleyi		5L	Stirling Range
grandis	5L	4L	Darling Scarp
media	5L4H	3L	Esperance
menziesii	3L		Swan Coastal Plain
prionotes	4L	4L	Jurien Bay, wheatbelt
sceptrum	4L	4L	Geraldton
sphaerocarpa	4H	3H4L	Jurien Bay, wheatbelt
Beaufortia			
decussata		4L	Stirling Range
elegans		4L	Swan Coastal Plain, Esperance
heterophylla		4L	Kalgoorlie, Ravensthorpe, Stirling Range
micrantha	6H		wheatbelt
sparsa	4L	4L	Stirling Range, Northcliffe
Boronia			
alata		4L	Stirling Range, Northcliffe
crenulata		1L	Northcliffe, Darling Scarp, Stirling Range
heterophylla	4L	4L	Northcliffe
megastigma	2L	2L	Northcliffe
Bossiaea			
eriocarpa		4L	wheatbelt
Brachychiton			
gregorii	8H	6H	Mt. Jackson
Brachysema			
aphyllum	5H	4L	wheatbelt
celsiana		4L	wheatbelt
daviesioides	4H		wheatbelt, Kalgoorlie
Bursaria			
spinosa		4L	wheatbelt
Callistemon			
phoeniceus	4H	4H4L	wheatbelt
speciosus	5L	5L5H	Albany
Calothamnus			
blepharospermus		4L	wheatbelt, Geraldton
chrysantherus	4H	3L4H	wheatbelt
gilesii		4L	wheatbelt, Kalgoorlie, Mt. Jackson
gracilis		4L	Fitzgerald River National Park
lateralis	2L	2L	Northcliffe
longissimus		5L	Jurien Bay
oldfieldii		4L	Geraldton
planifolius	5L	3L	Stirling Range
quadrifidus	3L	4L	wheatbelt, Darling Scarp
sanguineus	3L	2H3L	Darling Scarp, Stirling Range
villosus		2L	Swan Coastal Plain, Darling Scarp

Species	Age at flowering and substrates		Source area
	Field	Cultivated	
Calytrix			
angulata		5L	Darling Scarp
fraseri	3L	3L	Swan Coastal Plain
stipulosa		5L	wheatbelt
Cassia			
nemophila	5H	4L	wheatbelt
pleurocarpa		3L	Mt. Jackson, Kalgoorlie
Casuarina			
obesa	5H	4H	Swan Coastal Plain
Chamelaucium			
axillare		3L	Esperance
ciliatum	5H	5L	wheatbelt, Stirling Range
megalopetalum	4L	3L	Fitzgerald River National Park
uncinatum	2L	2H	Geraldton
Darwinia			
citriodora	2H	3L2H	Darling Scarp
Dianella			
revoluta	3L5H	4L	Swan Coastal Plain, Darling Scarp, wheatbelt
Dodonaea			
attenuata	4H	2L4H	wheatbelt
inaequifolia	3H	3L	wheatbelt
Dryandra			
carduacea	4H	4H	wheatbelt
cirsioides	6L		wheatbelt
fraseri		3L	wheatbelt
nobilis	5H	5H	wheatbelt
polycephala	4H	3L	wheatbelt
proteoides	6H	5H	wheatbelt
sessilis	3L2H	2H	wheatbelt, Darling Scarp, Swan Coastal Plain, Jurien Bay
Eremaea			
beaufortioides	3L	3L	Swan Coastal Plain, Jurien Bay
fimbriata		4L	Swan Coastal Plain
pauciflora	4L	4L	wheatbelt, Jurien Bay
violacea	4L	4L	Jurien Bay
Eremophila			
clarkei		2L	Mt. Jackson, wheatbelt
decipiens	2L3H	1H	wheatbelt
glabra	4H	3H	wheatbelt
Eriostemon			
deserti	6H		wheatbelt, Kalgoorlie
Eucalyptus			
burdettiana		4L	Fitzgerald River National Park
caesia		5H	wheatbelt
calophylla	2H	2H	Darling Scarp
cylindriflora	4H	3H	wheatbelt
erythrocorys	5H	7H	Jurien Bay
gardneri	5H	5H	wheatbelt
loxophleba	4H	4H	wheatbelt
macrocarpa	3L	3L	wheatbelt
platypus	4H	3H	Stirling Range
salmonophloia	5H	4H	wheatbelt, Kalgoorlie
tetragona	3L	3L	Fitzgerald River National Park, Esperance
torquata	2H	2H	wheatbelt

Species	Age at flowering and substrates		Source area
	Field	Cultivated	
Grevillea			
bipinnatifida	2H	2H	wheatbelt
didymobotrya	6H		wheatbelt
"excelsior"	4L	3L	wheatbelt
nematophylla	4L	3L	wheatbelt
paniculata	4H	4L	wheatbelt
Hakea			
adnata	5H	6H	wheatbelt
bucculenta		3L	Geraldton
coriacea	6L		wheatbelt
cucullata		4L	Albany, Stirling Range
falcata	6H	3L	wheatbelt
incrassata		3L4H	wheatbelt
laurina	3H	3H	wheatbelt, Fitzgerald River National Park
multilineata	5L	4L4H	wheatbelt
petiolaris	4L	3H	wheatbelt
platysperma	5H	4H	wheatbelt
scoparia	3L	3L	wheatbelt
subsulcata	6L6H	4L5H	wheatbelt
victoria	4L	4L	Fitzgerald River National Park
Hypocalymma			
angustifolium	4L	5L	Swan Coastal Plain, Jurien Bay, wheatbelt
robustum	4L	4L	Jurien Bay, Swan Coastal Plain
Kunzea			
baxteri	4H	4L	Esperance
pulchella	3L	2L3H	wheatbelt
recurva		4L	Northcliffe
vestita	4L	4L	Swan Coastal Plain
Lechenaultia			
biloba	2L	2L	Darling Scarp
formosa	1H	1L	wheatbelt
Lepidosperma			
drummondii	6L6H		wheatbelt
pubisquameum	6H		wheatbelt
Leptospermum			
erubescens	4L	4L	wheatbelt, Darling Scarp
Melaleuca			
acuminata	4H	4L	wheatbelt
conothamnoides		2L	wheatbelt
cordata	6L		wheatbelt
cymbifolia	4H	4H	wheatbelt, Kalgoorlie
diosmifolia	7L	6L	Northcliffe
elliptica	5H	4H	Fitzgerald River National Park, wheatbelt
fulgens	4H	4H	wheatbelt
lanceolata	3L	3L	Leeuwin-Naturaliste
lateritia	5H	4L5H	Swan Coastal Plain, Leeuwin-Naturaliste
laxiflora	6L	3L	wheatbelt
oldfieldii	4L4H	3L	wheatbelt, Geraldton
pungens	6L	4L	wheatbelt
radula	3H	4L2H	Jurien Bay, Geraldton, wheatbelt
scabra	6L	5L	wheatbelt, Fitzgerald River National Park
subtrigona	6H	5L	wheatbelt, Fitzgerald River National Park
uncinata	6L	4L	wheatbelt
Olearia			
axillaris	4L	4L	Leeuwin-Naturaliste, Northcliffe

Species	Age at flowering and substrates		Source area
	Field	Cultivated	
Paraserianthes lophantha	2H	2L	Darling Scarp
Pelargonium australe	1L2H	1L1H	Swan Coastal Plain, Jurien Bay
Petrophile ericifolia	5L	3L	wheatbelt
serruriae	4H	3H	Darling Scarp, wheatbelt
Phyllanthus calycinus	2H	2H	Darling Scarp
Pimelea physodes	4H	2L	Fitzgerald River National Park
Pittosporum phylliraeoides	7H	7H	wheatbelt
Regelia ciliata	5L	5L	Swan Coastal Plain
megacephala	3L	3L	Jurien Bay
velutina	5H	5L	Fitzgerald River National Park
Santalum acuminatum	8H		wheatbelt
Templetonia retusa	4L	3L	Swan Coastal Plain, Leeuwin-Naturaliste, Northcliffe
Verticordia chrysantha	6H	4L	wheatbelt
multiflora	3L	3L	Stirling Range, Fitzgerald River National Park
roei	5L	5L	Darling Scarp, wheatbelt
Xanthorrhoea nana	5L6H		wheatbelt