The impact of environmental weeds on rare or threatened plants in Victoria

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Summary

Environmental weeds are a major menace to Victoria's rare and threatened flora. Nevertheless, they have been consistently overlooked as efforts are concentrated on the final extinction event and neglected long-term habitat changes that have led to species rarity. Directions for future research and the plants most likely to be threatened by environmental weeds are indicated.

Rare or threatened plants

There are 924 taxa (species/subspecies) of native vascular plants that are rare or threatened in Victoria (Gullan *et al.* 1990, personal communications) out of a total native flora of 3145 taxa (Ross 1990). However, not all are equally rare or subject to the same threat.

Victoria's native vascular flora has been divided into six categories that summarize the security and the immediacy of the threat (Gullan *et al.* 1990). Five categories indicate the degree of threat, with the remaining category 'not threatened'. These categories are based on the national categories of Briggs and Leigh (1988) (Table 1), which are themselves based on the categories recommended by the International Union for the Conservation of Nature and Natural Resources (IUCN) (Anon. 1980). The categories used in Victoria are intended to be a subset of the national categories, but there are two notable discrepancies. 'Poorly Known' (K) is a national category that was not used to indicate the Victorian status of plants. The Victorian flora is well known and very few taxa are only known from the original collection, as frequently occurs elsewhere in Australia. 'Depleted' is an IUCN-recommended category that was not used by Briggs and Leigh (1988) but was found to be useful for a few threatened plant species in Victoria. It includes species that may not be rare and yet are threatened, as regeneration is inadequate to replace losses and populations are continuing to decline. Similar categories have been defined for the flora of other states (e.g., for Tasmania by Kirkpatrick *et al.* 1991) and elsewhere (e.g., for New Zealand by Wilson and Given 1989).

Threats

Plants vary enormously in their habits and habitats. The threats that affect their distributions and abundances also vary greatly and it is difficult to classify these comprehensively. Ideally, species management or recovery plans should be individually devised, with the recommended actions linked to the species' life histories and ecology. But, only a small number of plant species have had their biology investigated. It is therefore possible for land managers to only consider the major threats when devising interim management strategies. Until more information is available, rare or threatened plants can only be managed by controlling their threatening processes.

As there is a tendency to concentrate on remnant populations and the final extinction events, rather than the long-term processes that have led to a species' rarity and vulnerability, it is important to distinguish the causes of species rarity from the causes of species extinctions. Plant populations are not constant, but fluctuate depending on seasonal conditions, grazing pressure, abundance of specific pollinators, prevalence of disease etc. Simultaneously there may be increases or decreases in species populations, depending on major climatic changes and other long-term processes. Major historical changes, such as alienation and clearing, affect the long-term trends in plant populations. At the same time the short-term seasonal fluctuations still operate. As a result, the final cause of extinction may not be the cause of that plant's increased rarity (and threat of extinction) (Figure 1). When populations become very small, a short-term perturbation that would normally produce no more than a temporary decrease in numbers or vigour (such as a drought) may cause extinction.

Alienation and clearance for agriculture, extensive stock grazing, changed fire regimes and grazing by introduced pests (notably rabbits) have been among the principal historical reasons for reductions in plant species' abundances and distributions, and these factors are continuing to operate on many species (Hopper and Muir 1984, Leigh *et al.* 1984, Parsons and Browne 1981, Scarlett and Parsons 1982). These impacts are obvious, measurable and usually well documented. However, the effects of competitive interactions are difficult to determine and elucidate. For most field naturalists and other keen observers 'competition' is an academic concept that cannot be seen in the field, but can only be resolved after intensive study. Nevertheless, all plants are subject to competition for living space and changes to these competitive interactions affect the survival prospects and vigour of species.

Environmental weeds and their impacts

Plant species' distributions and abundances decrease, perhaps to extinction, because their habitats change, such that their particular niche disappears. Plant introductions (intentional or unintentional) change the ecological framework, and thus the competitive interactions, for all component species of that habitat. Plant introductions may be environmental weeds.

Environmental weeds are novel competitors for space, nutrients, moisture and other environmental features. The result of

Table 1. Categories of threats facing native vascular plants in Victoria (based on Briggs and Leigh (1988))

National Status	State status
X (Presumed Extinct) – Not found in recent years despite thorough searching or not collected for 50 years and known only from areas now intensively settled.	**x** (extinct) – no post-1950 records, in spite of field searches specifically for the plant, or intensive field searches (since 1950) at all known sites have failed to record the plant.
E (Endangered) – Serious risk of disappearing from the wild within 1 or 2 decades if present causal factors continue to operate.	**e** (endangered) – rare and at risk of extinction if present land use and other causes continue.
V (Vulnerable) – not presently endangered but at risk of disappearing from the wild over a longer period through continued depletion, or largely occurring where changes in land use could threaten survival.	**v** (vulnerable) – rare, not presently endangered but likely to soon become so, or occurring at sites likely to experience changes that would threaten the plant, or with populations that are so low that natural perturbations have become a major threat.
R (Rare) – rare but not currently endangered or vulnerable, i.e. in low numbers but not further threatened.	**r** (rare) – rare (i.e. in low numbers), but not otherwise threatened.
	d (depleted) – not rare, but threatened as the regeneration is inadequate, doubtful and problematic and populations continuing to decrease.
K (Poorly Known) – suspected, but not definitely known to belong to one of the above categories.	

indigenous species' evolution are precise adaptations to a particular environmental niche – a niche that did not formerly include environmental weeds. That niche may have become irrevocably altered by the introduction and establishment of new competitors leading to rarity and extinction in certain of the indigenous species.

However, extinction is not immediate and each input to a species' niche does not operate in isolation from other determining features. For example, a novel grazing pressure from domestic stock may be imposed while fire regimes have changed and new species (environmental weeds) have entered the site. The adverse impacts resulting from the introduction and establishment of environmental weeds are usually compounded if other environmental changes are taking place at the same time. The establishment and spread of environmental weeds (and the competitive superiority of those weeds over rare or threatened indigenous plants) is usually assisted by associated habitat disturbance, such as grazing, fire regime changes and clearance (Mallen 1986). The relative contributions of each of these perturbations are difficult to determine, but it appears that competition from environmental weeds is often a major influence on long-term population trends and habitat suitability.

Environmental weeds are clearly a major threat to some threatened species. Lunt (1987) considered competition from introduced shrubs and herbs to have been a major reason for the lack of regeneration of the vulnerable *Discaria pubescens* (Brongn.) Druce. Scarlett (unpublished) discussed the status and threats to many threatened plants, and environmental weeds were proposed as a major threat for many of these (such as *Euphrasia collina* R. Br., *Lepidium aschersonii* Thell., *Lepidium hyssopifolium* Desv., *Taraxacum cygnorum* Handel-Mazzetti). Nevertheless, the impacts of environmental weeds are usually overlooked as management is focused on species about to become extinct, and thus the long-term threats are neglected in favour of the short-term impacts.

Weeds and rare plants

A few ecological studies on the impact of environmental weeds have been undertaken, and all show that these plants have major impacts on species and community composition (even in ostensibly 'native' vegetation). Lunt (1987) considered that competition from introduced species (including environmental weeds such as *Ulex europaeus* L.) may inhibit regeneration in many populations of the endangered *D. pubescens* and further implicated such competition in the almost total lack of seedling regeneration. Intensive autecological work on the endangered *Thelymitra epipactoides* F. Muell. (Cropper *et al.* 1989) led to management recommendations that included control of competition by the judicious application of fire, and thus reduction in competing environmental weeds, such as *Acacia sophorae* (Labill.) R. Br.

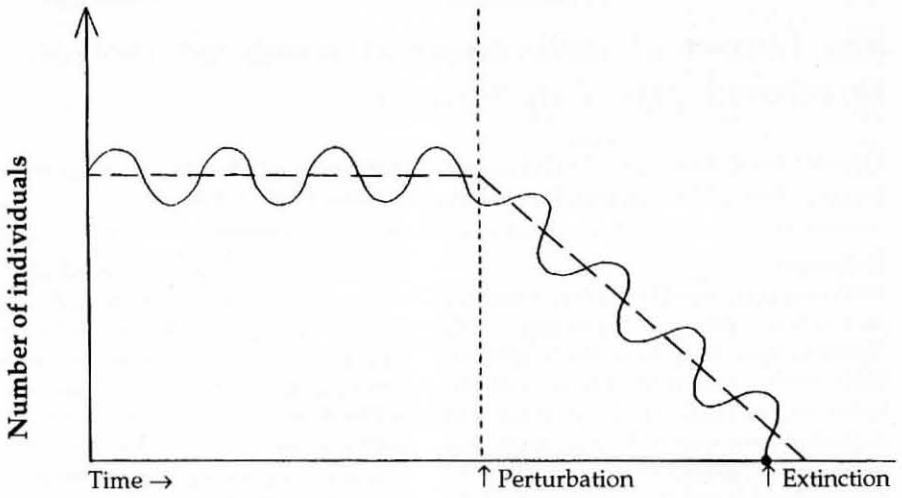

Figure 1. Impact of disturbance, such as the introduction of a competitive weed, on population trends. Note: the immediate cause of extinction is not the cause of the species' rarity or threatened status. Seasonal fluctuations (——) and long term trends (– – –).

Synecological (community-based, rather than species-based) studies have particularly appreciated the roles and threats of environmental weeds. Two notable threatened communities, including their more susceptible flora, are Plains Grasslands of the western basalt plains and Coastal Podsol Heathlands. From a study site in the former community, Lunt (1990) investigated the seedling regeneration of many herb species, particularly after fire. Indigenous species were notably absent (or nearly so) from post-fire regeneration, which was dominated by exotic species. It is tempting to conclude that the post-fire vigour of regenerant weeds interfered with post-fire establishment of native herbs. Offor (1990) discussed the impacts of invasion of coastal heathland by the woody weeds *Kunzea ambigua* (Smith) Druce and *Leptospermum laevigatum* (Sol. ex Gaertner) F. Muell. As with all environmental weed problems this invasion and replacement has been insidious and thus has been largely overlooked. It is obviously a major threat to both the subject communities and their component species, particularly those that are rare or threatened. The work by Gleadow and Ashton (1981) has also demonstrated the impacts of the environmental weed, *Pittosporum undulatum* Vent., on the total species composition of plant communities and on community processes.

Legislation and rare plants

The Victorian *Flora and Fauna Guarantee Act* 1987 provides the legislative setting for conservation of threatened plants. That Act has been discussed and summarized elsewhere (Anon. 1987). A critical part of the protection offered threatened plants under that Act is the requirement for the preparation of Action Statements (a summary statement of actions that will be undertaken to arrest decline and secure the future of the threatened species). After four years, six Action Statements have been published, two of them for the plant species *Calochilus richiae* Nicholls and *Eucalyptus crenulata* Blakely & Beuzev. Of the plant taxa considered rare in the state, 0.2% are threatened.

Of these two species, *E. crenulata* is threatened by long-term climatic changes and past clearance for agriculture (Pryor 1981); environmental weeds are not likely to have been a notable cause of decline or current threat. However, *C. richiae* is a terrestrial orchid that occurs in forest vegetation in which a number of introduced plant species have become well established. Environmental weeds may have affected the status of *C. richiae* but these have received no consideration in the Action Statement. The impact of environmental weeds cannot be reliably assessed in short visits of inspection. Ecological study of either the plant species or its habitat is required to determine the impacts of environmental weeds. As a result, environmental weeds have received scant consideration in the Action Statements produced so far, in spite of the likelihood that they are a major threatening process and a major factor in species decline.

Most management recommendations for rare or threatened plants are framed after the species has become rare or threatened; that is, after long-term impacts, such as environmental weeds, have had their effects (Leigh *et al.* 1984, Wilson and Given 1989). As such, these recommendations concentrate future intervention on the (potential) causes of extinction, rather than the causes of rarity.

Reservation and/or protection

The dramatic impacts of environmental weeds clearly indicate that reservation

and/or legislative protection of threatened plants is frequently an inadequate response. Many plant species have restricted distributions for reasons other than the changes wrought by European settlement. They have restricted habitat preferences and could be considered ecological specialists. If they also occur in habitats that have not been notably altered then reservation or protection is adequate to ensure their survival (at least in the short to medium-term). However, reservation and legislative protection do not address ecological processes such as competition with environmental weeds. Management intervention is required to ensure survival of those species threatened by environmental weeds. Unfortunately, long-term insidious threats, such as environmental weeds, have been overlooked as land managers and their advisers have concentrated on reservation, assuming that 'reservation' is synonymous with 'conservation' (Briggs and Leigh 1988, Davies 1982, Kirkpatrick *et al.* 1991).

Future impacts

From an assessment of the current lists of rare or threatened plants (Briggs and Leigh 1988, Gullan *et al.* 1990, Kirkpatrick *et al.* 1991) and an appreciation of the extent and locality of environmental weed problems, it is possible to indicate groups of plants or communities that are especially threatened. Plants of the following life-form categories/taxonomic groups are particularly threatened by environmental weeds:-

1. Terrestrial orchids, notably those of fertile soils, as these are usually palatable to grazers, often have narrow distributions and have particularly intimate relationships with a very limited array of pollinators.
2. Perennial herbs of fertile grasslands and woodlands (most of which are now subject to stock and rabbit grazing, thus advantaging introduced winter-growing annuals over the native warm-season perennials).
3. Herbaceous legumes (introduced legumes, such as *Medicago* spp. and *Trifolium* spp., have replaced native herbaceous legumes, such as *Lotus* spp., *Psoralea* spp. and *Swainsona* spp., most of which are now rare or threatened?).

Remnants of the following communities are also particularly threatened by environmental weeds:-

1. Grasslands and Woodlands of fertile soils in the lowlands (Land Conservation Council 1987, Lunt 1990, Parsons and Browne 1981, Scarlett and Parsons 1982).
2. Coastal Scrub and Heathlands (Offor 1990).

The implications for future management of environmental weeds are clear.

Directions

1. Synecological research is necessary to understand ecological processes and thus predict the impacts of environmental weeds, and the management required to ameliorate their effects.
2. Autecological research is necessary to devise Species Recovery Plans, Action Statements or the like that precisely target particular threatened species and thus give greatest likelihood of success (the constraints on single species research are discussed in Cheal 1989).
3. Comprehensive survey and monitoring are necessary to determine the effectiveness of management intervention and the species for which such intervention is required.

Finally, intimate contact between research ecologists and other botanists and the land managers who implement their recommendations is basic to arresting species decline, managing environmental weed problems and ensuring that effort is not wasted. Such contact necessitates the maintenance of an 'expertise bridge' between the botanical knowledge in research institutes and the public and the management and legislative responsibility in government organizations.

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