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Threat syndromes and conservation of the Australian flora

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ABSTRACT

The status of the Australian flora was reviewed by compiling published information on all critically endangered and endangered species listed federally in 2004. Threatening processes were categorised and their contributions to past, present and future declines were assessed. The information was cross-referenced against State agency information and field knowledge. Land clearance for agriculture (grazing and cropping) and urbanization have been the primary causes of range contractions and habitat loss in the past, responsible for the current status of the majority of threatened Australian plants. In the future, land clearance will remain important but new issues are emerging. Many species are now at risk from demographic and environmental uncertainty alone. Threats growing in importance include disease, salinity, invasive species and changed disturbance regimes. Many species are subject to common, landscape-level threats. A key issue to emerge from our analysis is that most species are threatened by a number of interacting factors – threat syndromes. Several future risks may be mitigated effectively by simple, low-cost changes in policy, such as more stringent controls on land clearance, strategic fire management, and firmer control on the importation of plant species. Other factors will require greater effort and new strategies to mitigate, including social and legal initiatives in urban landscapes and broad strategies for pathogens, climate change and other landscape-level processes.

1. Introduction

Many government agencies use lists of threatened species to allocate recovery resources, design reserve systems, constrain development and report on the state of the environment (Possingham et al., 2002a). Threatened species lists are an important part of decisions about conservation priorities (Lamoreux et al., 2003).

Leigh et al. (1981) compiled and subsequently revised lists of threatened Australian plants (Leigh et al., 1984; Leigh and Briggs, 1992; Briggs and Leigh, 1988, 1996). In several compilations, the most recent in 1996, they included a table summarizing the causes of past, present and future threats to the Australian flora. This table was particularly useful because it provided a continental-scale intuitive overview of the processes affecting the conservation status of numerous vascular plant species. While all lists of threatened species are incomplete and uncertain, Leigh et al.'s summaries represent a substantial sample of species at the threatened end of the conservation spectrum because conservation status reflects the relative likelihood of extinction.

The Australia federal government took up the role of maintaining and publishing the list of threatened Australian plants in 1996. The classification system underpinning the

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federal list is based broadly on the Red List system devised by the International Union for the Conservation of Nature and Natural Resources (IUCN, 2001). In the Red-listing process, species are assigned to categories including extinct, extinct in the wild, critically endangered, endangered, vulnerable, and near threatened.

Effective conservation involves the identification of the causes of environmental change, and the implementation of practices to manage those changes (Caughley and Gunn, 1996). A threatening process is one that may detrimentally affect the survival, abundance, distribution or potential for evolutionary development of a native species or ecological community. The notion of characterizing and managing threatening processes has been a focus for conservation biology for some time (Falk, 1990; Bradstock et al., 1995), and the Australian Federal Government's Environment Protection and Biodiversity Conservation Act (EPBC Act, 1999) makes provision for nominating threatening processes. Threatening pro-

Table 1 – Definitions of threats and threatening processes

Agriculture edge effects: Including most of the local processes found in road/rail verge environments, but with fewer road maintenance and vehicle disturbance effects. Herbicide and fertiliser applications and altered drainage are prevalent.

Clearing for agriculture: Including broad scale clearing for crops and pasture improvement, draining swamps and wetlands (excludes rural residential subdivision, which is included under urban).

Collection/harvesting: Including collecting specimens by rare plant enthusiasts and ornamental plant traders, moss removal, scrub worm collection, collection of fruit for bush food, and root suckers for propagation, seed collection for horticulture.

Extreme environment: Flooding, drought, drought following fire, extreme fires that are a consequence of extended drought.

Feral grazing: Rabbits, goats, pigs, cattle, camels etc, including trampling by feral animals and damage caused by rabbit warrens and pig wallows. Includes grazing by limicid slugs and other introduced invertebrates.

Fire: Changes in components of fire regimes, including season, extent, intensity, or frequency, inhibiting regeneration from seed or by vegetative reproduction. Generally, inappropriate fire regimes lead to the competitive disadvantage of the threatened species against local and introduced species, or represent a future threat if fire recurs before plants are mature and seed is produced (in obligate seeders; e.g., *Persoonia micranthera*).

Forestry: Plantation establishment, native forest harvesting and silviculture, roading for forest management.

Fragmentation: Populations reduced to a few relatively isolated subpopulations between which dispersal is unlikely (e.g., *Prostanthera eurybioides, Tetratheca gunnii*), excluding cases of natural metapopulations (e.g., *Leucopogon gnaphalioides*).

Hydrology: Changed stream flow conditions, altered site characteristics affecting ground water discharge or recharge, dams and weirs, timing and extent of seasonal flooding.

Lack of supportive habitat: Supportive habitat includes co-occurring plants, fungi, animals that provide the niche requirements necessary for long-term survival of the species in question.

Low numbers: Few (generally <250) reproductively mature individuals, sometimes associated with symptoms of genetic effects including low seed set (e.g., *Acacia insolita* subsp. *recurva*) and susceptibility to insect attack (e.g., *Acacia enterocarpa*), making the species susceptible to demographic and environmental stochasticity.

Mining: Including mine site development, gravel extraction, exploration, roading, peat mining.

Narrow habitat: Refers to species restricted to a type of habitat that has limited geographic extent (the area of potential occupancy is small). e.g., *Isoglossa eranthemoides* is restricted to lowland subtropical rainforest on volcanic soils in complex notophyll vine forest.

Native grazing: Includes herbivory of leaves, roots, seeds and whole plants by kangaroos, rats, wombats, slugs, snails, insects (locusts) and other species.

Pollution: Including contaminants from farms (herbicides and pesticides) that enter theair, streams and rivers affecting plants off-site, contaminants in catchments arising from sewage, sediment and nutrients from urban gardens affecting native species (e.g., *Microstrobos fitzgeraldii*), spills, point source and diffuse contamination from industries and transport.

Recreation: Off-road vehicles, bush access tracks, 4-wheel-drive tracks, trail bike riding.

Road/rail verge conditions: This term summarises a range of threats to which plants remaining in these remnants are exposed. They include disturbance during road/rail and fire break maintenance, accidental clearing during road maintenance and farming, frequent fires, incremental road widening, weeds, herbicides to control weeds, reduced fire probability, runoff of herbicides and nutrients from adjacent areas, herbicide and pesticide spray drift, grazing by feral animals and domestic stock, slashing, mowing, construction of drainage channels, power line and optical cable installation and maintenance, gravel extraction and storage for roadworks, mistletoe, disease, grading road reserves, altered drainage, constructing drainage channels (e.g. *Banksia cuneata*).

Roads: Habitat loss resulting from creation of new roads. This term differs from road verge conditions (above) in representing the construction of new roads, rather than summarizing conditions experienced by plants in remnant verge environments.

Small range: The extent of occurrence of a species whose longest axis is <100 km. The distance of 100 km is relatively large; many species have ranges considerably smaller than this. However, this scale is important because it is approximately the scale at which landscape processes such as fire and climate change may be managed.

Trampling: Tourist/recreation foot traffic, orienteering, absailing, camping, hunting, walk trail construction and maintenance. These activities lead to trampling of plants, soil compaction, erosion, and introduction of disease.

Urban and coastal development: The consequences of land development for urban expansion, private and public land development within the limits of existing cities, coastal development.

Weeds/competition: Includes invasive alien species (defined as species originating outside Australia), native Australian species outside their natural range, and local native species that have an unusual competitive advantage against threatened species in modified habitat on road and railway verges and in other modified or disturbed habitat, or under altered climatic or fire conditions.

Definitions are omitted for threats in Figs. 1–5 whose title makes the definition self-evident.