# ENVIRONMENTAL VANDALISM?
# TOWARDS AN OBJECTIVE ASSESSMENT OF WEED STATUS

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*Summary.* Deliberate plant introductions for ornamental and agronomic purposes have inadvertantly diversified the weed flora in Australia. Recently protocols for screening plant introductions have been developed but suffer from lack of clear definitions of weediness, and inconsistent outcomes. Applying the weed opportunity triangle to define the frame of reference for weed assessment may overcome these problems. The weed opportunity triangle attempts to categorise the growth strategy of the candidate weed species, the selection pressures affecting the relative performance of preferred species, and the management priority operating within the target environment. The example of category number one environmental weed threat hymenachne

(*Hymenachne amplexicaulis*) is discussed in this paper.

## HISTORY OF PLANT INTRODUCTIONS

The history of deliberate European plant introductions into Australia commenced with the First Fleet in 1788. Originally the intention was to provide food, medicinal and ornamental plants to domesticate an alien landscape. The quest for improved exotic pastures from the 1880’s and the augmentation of native pastures with legumes in the 1960’s resulted in the replacement of many native pasture species (7). Unfortunately the productivity of many of these exotic introductions extended way beyond the original purpose of introduction. Many have adversely affected other management systems to such an extent that they have been proclaimed as noxious weeds, legally requiring land owners to control their growth.

Attributes of noxious weeds may include being poisonous or unpalatable to stock, harmful to humans, producing spines thorns or burrs, competitive, having a scrambling or climbing growth form or parasitic on other plants. Panetta (10) has estimated that 46% of Australia’s noxious weeds were introduced intentionally. However, the definition of noxious does not necessarily include adverse impacts on the natural environment. In the past, weed status has focussed on adverse impacts on agriculture and horticulture, but more recently the emphasis has shifted to the impact of weeds on the biodiversity of natural environments.

Garden and agricultural escapes invading natural environments are replacing many native species. To reduce this trend ecologists have highlighted the need to consider the risks of environmental weed invasiveness in evaluating potential plant introductions (5, 6). However, in contrast to the animal screening provisions of the Wildlife Protection Act (1982), there is no objective means of assessing weed potential. Several screening systems for plants have been proposed but none have been widely adopted (10). Lack of consistency in weed definitions and the subjective opinions of users of these models has resulted in conflicting outcomes of assessments of the same candidate plant species (11).

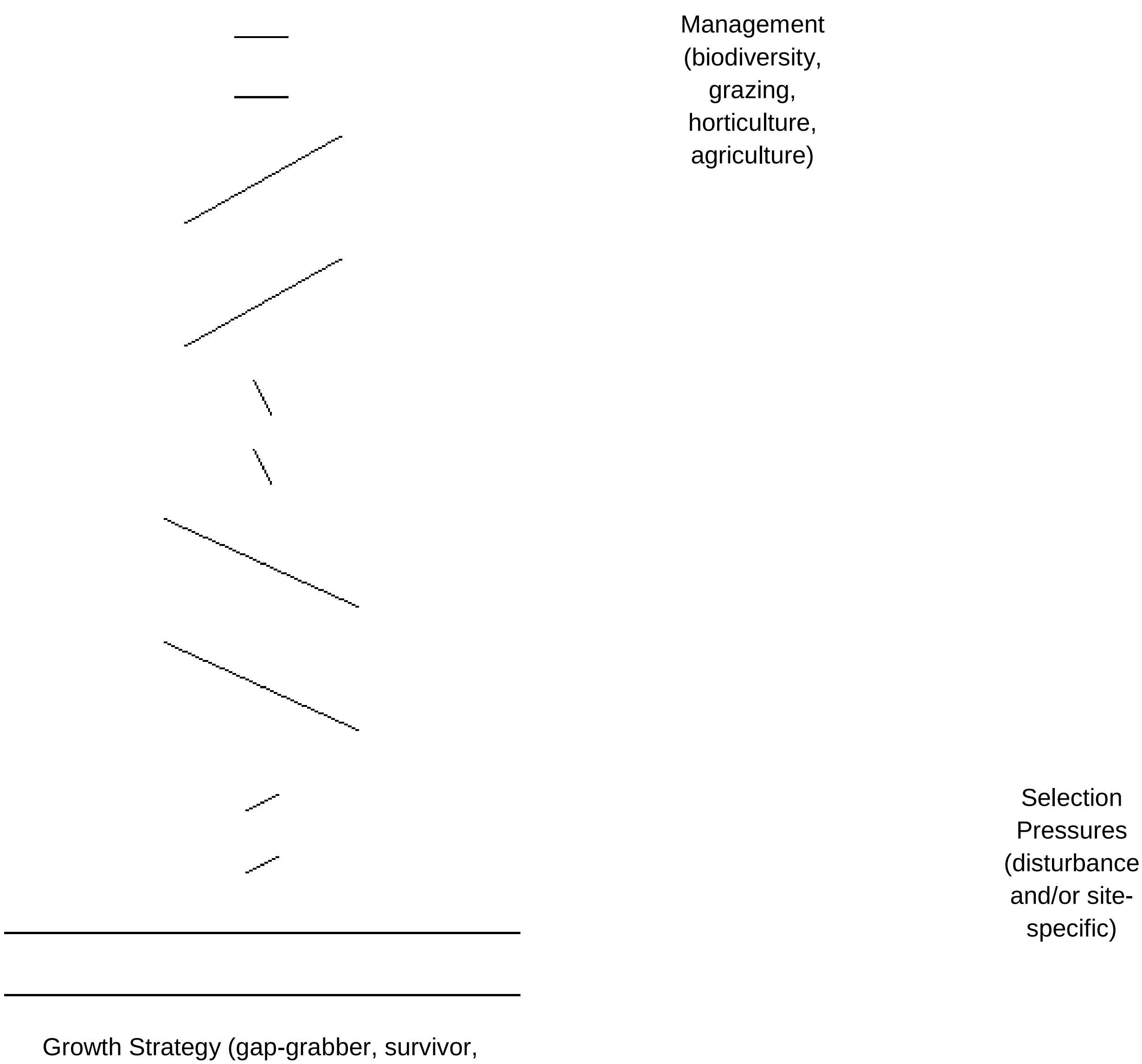
## DEFICIENCIES OF MODELS DEVELOPED FOR WEED ASSESSMENT

Most of the proposed models attempt to define weediness in a general context. However there is no one suite of characters that can be linked directly to weediness (8). One species with a given set of characters will be a weed in one environmental context (managed and/or natural), and not in another. Panetta (10) suggests that the only reliable way of predicting weediness of a plant species in the Australian context is to document the weedy behaviour of the same taxon under similar environmental conditions both in Australia and elsewhere in the world.

However the evaluation of weediness must also consider the management objectives for that environment. Amor and Kloot (1) highlighted how the spectrum of priority weeds within cropping systems has changed over time in response to the selection pressures imposed by changes in tillage and herbicide technologies. Within natural environments, fire regimes, eutrophication and natural grazing selection pressures will also largely determine the nature of opportunities for weed invasion (4). Therefore weed invasiveness is not static over time or space, and risk assessment must consider the effects of management and other key selection pressures on providing the opportunity required for invasion. We propose that weed assessment should consider the growth strategy of the plant itself, the site selection pressures and the management priorities for the environment under consideration.

## THE WEED OPPORTUNITY TRIANGLE AND HYMENACHNE AS A CASE STUDY

We have combined these factors into the weed opportunity triangle (Fig. 1). Within the natural environment, ecosystems only become at risk when disturbances push selection pressures beyond the range within which the majority of species have adapted. In minimally disturbed ecosystems plants have evolved to competitively exploit the available niches. Such ecosystems are relatively resilient to weed invasions (3). Weed invasion is more likely to occur when disturbance alters selection pressures in favour of the ecophysiological attributes of exotic species. Therefore to become a weed a species must have the ecophysiological attributes that match the opportunity provided, and must be present at the right time.



swamper)

Figure 1. The weed opportunity triangle : The relationship of factors determining the opportunity required for a plant to become a weed.

Ecologists have defined the most successful weed invaders in terms of the ecophysiological attributes required to exploit disturbance opportunities. At the simplest, categories describing the growth strategies of these species are gap-grabbers, survivors and swampers (8). Gap-grabbers are characterised by very vigorous early growth, short life cycles and are typically seed dispersed. Swampers include species with mass-germination and vigorous seedling growth or a climbing habit, smothering existing vegetation. In contrast survivors are longer-lived, exploiting environments beyond the tolerance of other species.

*Hymenachne amplexicaulis* (hymenachne) is an aquatic grass recently introduced into Australia from South America (9). Hymenachne is the preferred grass species for planting into artificial wetlands (ponded pastures) at depths greater than 60 cm. Ponded pastures are a strategy for impounding runoff from summer rains to improve the provision of high quality green forage for cattle over the seasonally dry winter. Graziers have been one of the main agents for spread, primarily via cuttings, although seed is also used.

Hymenachne is an emergent macrophyte, with stems elongating from preformed and newly initiated internodes in response to inundation. Tillering is not profuse, flowering is determinate and seedling recruitment appears to be required for the local persistence of plant populations. Hymenachne has recently been listed as Australia’s number one environmental weed threat (5). Some environmentalists have recommended that all current plantings of hymenachne be destroyed. However, these recommendations were made on very little objective evidence other than the fact that the plant is dispersed by seed, is from an aquatic habitat, and originates from South America. No consideration was given to the dynamics of wetlands perceived to be at risk, nor to the ecophysiological attributes of this species and the opportunity required for invasion.

Hymenachne grows in water depths which other species cannot tolerate - a survivor strategist. Observations in both South America (2) and Central Queensland indicate that this plant cannot grow in permanently flooded conditions and does not compete well with pre-existing flood-tolerant species. The selection pressure favouring hymenachne in artificial ponds is the drowning of dryland species and eutrophication. The most vigorous stands of hymenachne have been observed where nutrient-enriched cane field run-off is impounded. Therefore the cause of invasiveness for this species is primarily the altered site-selection pressures.

According to the weed opportunity triangle concept (Fig. 1), as a survivor strategist, if hymenachne is to invade, site selection pressures within wetlands must disadvantage existing competitors. Targeting the eradication of hymenachne as a control measure will not necessarily restore the biodiversity of such affected areas. Instead, management for biodiversity must include the imposition of site selection pressures favouring the preferred native species. Only then will the opportunity for invasion by hymenachne, or indeed any other equivalent survivor strategist, be reduced.

## CONCLUSIONS

The subjectivity and lack of consistancy in weed definition has reduced the usefulness of proposed protocols for screening plant introductions for weediness. An objective approach should consider the interactions between plant growth strategy, management priority and environmental site selection pressures in determining the opportunity required for a plant to become invasive. The weed opportunity triangle concept attempts to integrate these factors into a more objective assessment of weed status. The implications of this concept are that species attributes alone do not determine invasiveness. Site selection pressures and management priorities must also be considered.

With reference to *Hymenachne amplexicaulis*, site selection pressures are of more importance in determining invasiveness than species attributes. Controlling hymenachne as a species in disturbed natural wetlands reserved for biodiversity will not solve the problem. Instead, management for biodiversity must focus on returning the selection pressures within that environment to the competitive advantage of native species.

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