SUPPLEMENT TO FLORA OF THE YAMPI SOUND DEFENCE TRAINING AREA (YSTA), DERBY, WESTERN AUSTRALIA (BARRETT *ET AL.* 2001)

Environmental management issues on the Yampi Sound Defence Training Area (YSTA), Derby, Western Australia

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Abstract
From 10 to 15 March 2001 we participated in a floristic assessment of the Yampi Sound Defence Training Area (YSTA) commissioned by the Australia Heritage Commission. This supplement to the main report identifies some management issues. The condition of the YSTA is remarkably good. Communities containing fire sensitive species require protection. There are areas where past fire regimes have reduced sensitive elements of flora and fire is undoubtedly the most important management issue. Diversity in all flammable communities will be best served by a fire regime that produces a mosaic of fire intensities and fire ages at as fine a scale as is practicable as proposed in the fire management plan. We encountered no weed infestations needing urgent control measures. Nevertheless, pro-active vigilance to maintain that state is important. Feral cattle should be eradicated and the status of pigs should be ascertained and a control program instigated.

1. Background.

From 10 to 15 March 2001 ANS and TH assisted the Botanic Gardens and Parks Authority of Western Australia to undertake a floristic assessment of the Yampi Sound Defence Training Area (YSTA) commissioned by the Australia Heritage Commission (Barrett *et al.* 2001). A helicopter enabled us to sample most of the geomorphic units on which we expected to find distinctive vegetation associations.

The survey demonstrated that floristic composition and structure of vegetation associations on YSTA are heterogenous and dynamic, resulting in remarkable levels of biodiversity. Over millennia, heterogeneity has been effected by numerous natural (non-anthropogenic) processes including fire, geomorphological and climatic events. For perhaps 40,000 years Aboriginal people have modified some of those processes and over the last century European man has caused further hiatus by modifying Aboriginal practices (eg. fire regimes) and by imposing new factors (eg. importing exotic plants and animals). Some of these, if not managed appropriately, have the capacity to diminish biodiversity and other natural heritage values.

Our terms of reference did not extend to management issues. Nevertheless, for over 20 years ANS has been involved in management of natural lands for conservation purposes in Western Australia, mostly in the north of the State. Therefor, he instinctively took note of a number of management issues as we flew over country or worked on the ground while pursuing our primary task. In submitting the following observations, it must be understood that we did not go to the YSTA to review management issues; we were there to help document the flora. Therefor, these notes are not intended to be (and are not) a blueprint for management or even a comprehensive list of issues. Rather, their purpose is to draw attention to some pertinent issues and to expand some of the points raised by Barrett *et al.* (2001). We trust this is useful.

2. Fire.

Fire is undoubtedly the most important issue. Fire has been a driving force in the evolution of Australia s fauna, flora and landscapes. On the YSTA, there are some associations that can not burn (eg. mangroves) but most can and undoubtedly have burnt from time to time. Many of the species have evolved in the presence of fire and thus have life-strategies that enable them to live with fire in their environment.

Nevertheless, they vary in their degree of fire tolerance and thus, vulnerability to long-term degradation at the population/community level. Most associations will contain species with different tolerance levels and to retain the full array of species, fire regimes will have to cater for the least tolerant ones. In most areas that means wise use of fire, not fire exclusion. The Australian Defence Force (ADF) has commissioned a fire management plan (CALMfire 2000). Having now seen the area, ANS is satisfied that the plan encompasses most of the issues raised here.

Table 1 lists six vegetation groups that reflect the normal array of fire responses experienced in the area.

Table 1. Summary of vegetation types categorised by fire-regeneration mode and arranged in increasing order of fire tolerance. The table is highly simplified and more detail follows in the text.

Vegetation type	Frequency tolerated	Intensity tolerated	Significance of area (size) burnt	Preferred season
Mangrove & samphire	N/A	N/A	N/A	Not flammable
Rainforest	Very low/never	Very low/no fire	Any fire is likely to be detrimental	Burning not recommended
Perennial obligate seeders	Infrequent	Some individuals of many species survive very cool burns	Important to species that must recolonise eg. mistletoes	Variable
Stem re-sprouters	Frequent but need some longer fire-free periods.	Hot fires but a regime should include a range	Important to species that must recolonise eg. some fauna	Regime should include a range
Root re-sprouters	Frequent but a regime should include a range	Hot fires but a regime should include a range	Important to species that must recolonise eg. some fauna	Regime should include a range
Annuals	Frequent but a regime should include a range	Hot fires but a regime should include a range	Important to species that must recolonise eg. some fauna	Important to species composition. eg cane grass invasion

2.1 Rainforest patches.

Attributes. Nodes of diversity, refugia, many regionally endemic plants and animals, some invertebrates are endemic to individual patches (McKenzie *et al.* 1991).

Occurrence on the YSTA. Small, isolated patches in a variety of situations (see Barrett *et al.* 2001).

Fire sensitivity.

- Vulnerability; very vulnerable.
- Fire response; killed.
- Recovery time; very long. If a whole patch burns, single fires can cause local extinction of poorly mobile species. NB some snail and earthworm species are endemic to individual rainforest patches).

- Recovery mode; expansion from intact remnant, usually by seed.

Prescription. Exclude fire. Where appropriate, protect from wildfire by strategic, adjacent burns.

Notes.

- Their importance to conservation and biodiversity is disproportionate to their area.
- Excluding cattle is important because they facilitate fire ingress.
- Many patches in the Kimberley have been reduced in area by fire, often leaving a treeless grassland between the current rainforest edge and adjacent savanna woodlands.

2.2 Perennial obligate seeders

Attributes. Floristically and structurally important. Principal components of some very widespread communities (including pindan). Important elements in others (eg. cypress pine). Important to fauna.

Occurrence on YSTA.

- *Pindan*. Obligate seeders are amongst the most important taxa in the pindan (personal observation).
- *Heaths*. The top of Saddle Hill mesa supports an interesting and, as far as we know, unique heath assemblage of obligate seeders which probably require >5 years to re-regenerate sufficiently to replenish seed banks after each fire (eg. see Russell-Smith *et al.* 1998). Species included a *Hibbertia*, a *Boronia*, a *Scaevola*, *Acacia* species, *Calytrix* species and *Grevillea* species. The circumscription of the mesa by cliffs has provided respite from widespread frequent fires of the surrounding country. However the area is not immune from occasional fire (possibly lightning strikes). Charcoal in the area we visited showed that the area had been burnt at some time in the past. Regular creation of small burnt patches (<10% of the area per year) would do no harm and perhaps provide some insurance against the whole mesa top being taken out by one wild fire, but they should be small.
- *Cypress Pine.* This tree species was once widespread in the Kimberley (eg. see Easton 1922; Gardner 1923), but fire has eliminated much of it and over most of its range relict populations are disappearing (G. Graham[1] personal communication; Bowman and Panton 1993). Occasional, old, isolated trees on the ridges between the homestead and the Trent River showed that this has happened on the YSTA. However, on the spur of the King Leopold Range south of Walcott Inlet there are excellent stands that include many young plants. This population is significant at a regional level and should be protected.
- *Mistletoes.* Contrary to popular perceptions, mistletoes are important elements of indigenous plant communities and vital to many fauna species. They are unique in fire-prone environments because most species have no mechanism for survival within burnt areas. Fires that are hot enough to scorch host canopies kill most mistletoes. Recovery requires importation of seed by birds from beyond the burn area. Hot fires over large areas can eliminate them where fire frequency exceeds the rate of recolonisation. Recolonisation is incremental and slow. Where hosts are also killed by fire (eg Cypress pine, acacias) the recolonisation can not commence until hosts have regenerated (Start 1998). Their scarcity in most parts of the YSTA probably reflects past fire regimes.

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Fire sensitivity.

- Vulnerability; Vulnerable to very vulnerable.
- Fire response; killed.
- Recovery time; moderate to long. Not recovered until seed banks are replenished (usually > 5 years, sometimes longer).
- Recovery mode; seed germination and seedling establishment (seed of many mistletoes must be imported).

Prescription. Minimum fire frequency must exceed time required to replenish seed store (probably = at least two seed crops after first flowering. Five years to first flowering seems to be a rule-of-thumb minimum time for many species. Longer fire intervals are preferable. Ideally, fire management should aim for a mosaic of small, different age patches including many long unburnt areas. Strategic burns, some at greater frequency, may be needed to limit extent of wild fire and facilitate development of mosaics, especially in pindan. This may require sacrifice of some strategic sites which will change floristically to contain a higher proportion of the categories listed below. Hot fires are acceptable if infrequent. Some shrub species will survive very cool (wet/very early dry season) burns, including cypress pine.

Notes.

- They are vital to conservation and biodiversity.
- Many shrub species, especially acacias, have long-lived, soil-stored seed banks. Their decline in a frequent-fire regime is progressive over long time frames. This is a two-edged sword. It provides some resilience but apparent persistence after frequent fires has contributed to a common misconception that frequent fire is tolerated, or (worse) an appropriate regime. Pindan is a good example.
- Most if not all communities containing obligate seeders also contain more fire tolerant annuals and re-sprouters. Some thrive on frequent, even annual, fires. If fire is too frequent the obligate seeders will drop out. Although at face value the country seems to recover , there will be insidious but progressive structural change and a net loss of biodiversity. Increase in the proportion of fire-tolerant species often leads into a vicious circle by generating large annual fuel loads. (eg. increase in annual grasses, particularly cane grass, *Sorghum* sp.).

2.3 Stem re-sprouters.

Attributes. Numerous perennial species. Structurally and floristically important. Includes many trees (including eucalypts), shrubs, grasses and sedges . Cycads, palms, pandanus and other plants that grow on from sheltered apical buds after fire can be included here for simplicity.

Occurrence on YSTA. Present in most habitats except rainforest (and mangal, samphire, wetland etc.; habitats that seldom/never burn). Often this and the next two groups collectively predominate at sites that have experienced a long history of frequent and/or hot fires, in some cases probably because more fire-sensitive species have been eliminated.

Fire sensitivity.

- Vulnerability; low.
- Fire response; resprout from above ground.
- Recovery time; from re-sprouts, annual (but not necessarily to seeding in that time). From seed (see below) one year may be sufficient, but some species may require longer.
- Regeneration; They die eventually, necessitating some recruitment from seed in the long term.

Prescriptions. Will tolerate frequent fire. Communities dominated by these species may be useful for more frequent strategic burns to protect less tolerant communities. However, note other effects of frequent fire (soil carbon, nutrient, stability etc.). Whilst this is a fairly resilient group, fire management should aim at generating a mosaic, including long-un-burned areas, and a varied regime in terms of frequency and intensity. Smaller burn areas are preferable.

Notes.

- This and the next group now dominate large areas of savanna woodland.
- Many species will eventually succumb to fires that are too frequent and/or too intense.
- Some species, (eg. some spinifex species) dominate communities and contribute the bulk of the available fuel. The time required for them to build up sufficient fuel to carry fire may vary from one growing season to several years and that will determine minimum fire intervals.

2.4 Root re-sprouters.

Attributes. As for stem re-sprouters with which they often co-occur.

Occurrence on the YSTA. As for stem re-sprouters with which they often co-occur.

Fire sensitivity.

- Vulnerability; Very low.
- Fire response; resprout from roots or other subterranean organs.
- Recovery time; from re-sprouts, annual. From seed one year may be sufficient, but some species may require longer for fire-tolerant seedling establishment? Some (eg. Eucalypts) may require many fire free years for seedling or coppice to mature and produce seed. If fire is too frequent they could disappear from the tree layer and persist only as coppice shoots, affecting vegetation structure and fauna etc.
- Recovery mode; re-sprout from below ground level. Theoretically able to live indefinitely without recourse to seedling recruitment.

Prescriptions. As for stem re-sprouters with which they often co-occur.

Notes.

Widespread and often prominent in frequently burnt areas.

2.5 Herbs and Forbs (Annual/biennial obligate seeders).

Attributes. Mostly annual or short lived. Important initial colonisers of disturbed ground, including post-fire sites. Grasses contribute substantially to some fuels and ecosystems. Add substantially to species composition of most communities.

Occurrence on the YSTA. Components of most community types.

Fire sensitivity.

- Vulnerability; low. Some (eg. annual cane grasses) may be promoted by fire and may replace perennial species with important (potentially negative) feed back loops to rate of fuel accumulation and hence fire frequency/intensity etc. Usually shed seed before country cures.
- Fire response; phenology ensures limited seed exposure to fire risk.
- Recovery time; annual/seasonal.
- Recovery mode; obligate seeders.

Prescription. Wet season or early dry season fires may control cane grass however this may also restrict seed production in many other species. Frequent late hot fires will promote it.

Notes.

Management of cane grass is an important issue. Hot frequent fires may facilitate invasion/proportional increase of cane grass, even into some spinifex (*Triodia*) grasslands.

2.6 Conclusions.

- Except where there are fauna or flora species with special needs, fire programs should aim to provide for all species and vegetation structural types in a community. For practical purposes, this can be managed by considering the effects of fire on vegetation and the regeneration requirements of fire-vulnerable species.
- In communities used for prescribed burns, rotation of burn areas is preferable because this will create a mosaic. Where rotation is not a practical option, sacrificial areas may be necessary to protect larger areas. (but note the effects of frequent fire on soil and nutrient properties, etc)
- Mosaics should also contain variety in season, frequency and aerial extent. Season relates to intensity, scorch and patchiness. Frequency relates to representation of post-fire serial stages. Aerial extent relates to the capacity of some fauna and some flora to recolonise from beyond the burn areas and loss of heterogeneity.
- It will be important that a good fire history is maintained.

3. Weeds.

Most parts of the YSTA are remarkably weed free. Exotic species are identified by Barrett *et al.* (2001). The heaviest concentration of exotic species was the vicinity of the homestead and airstrip. They included many herbs that would have been introduced accidentally. Most are not highly invasive or serious environmental weeds and they seem to be largely restricted to disturbed areas (eg. mowed areas, track sides). Some, including two species of *Stylosanthes* have been widely used in the Kimberley for pasture improvement while others were probably introduced for ornamental purposes.

Probably the most significant environmental weed species is the wild passion vine, *Passiflora foetida* (see Smith 1995). It is present along many waterways and around ephemeral wetlands (Figs. 19 and 30 in Barrett *et al.* 2001). Birds distribute seeds and eradication is probably impractical and, in any case, at its present level of infestation it is probably not a serious threat to the integrity of any entire communities. Other weeds of moderate concern are *Clitoria ternata* and *Hyptis suaveolens* (see Smith 1995).

It is important that managers rigorously minimise the risk of introducing serious, new, environmental weeds by ensuring all equipment brought onto the YSTA is clean of weed propagules and that they remain vigilant for any weeds that may appear. There should be a process for collecting and identifying any suspicious plants. CALM or AQIS can provide support.

4. Feral animals.

4.1 Cattle.

Some stock remains on the YSTA. Feral cattle can pose significant risks to biodiversity in several ways. eg.

- Browsing and trampling.
- Ground disturbance facilitates weed invasion and erosion.
- Seeds of many weed species can be transported by cattle.
- Cattle have been implicated in rainforest patch decline through fire because they facilitate ingress of flammable grasses.

It would be desirable to eliminate remaining stock and it is important that numbers are not allowed to increase.

4.2. Pigs.

We encountered feral pigs in riparian areas. Where populations seemed to be locally high there was considerable disturbance. It was notable that the heaviest population of the weed *Hyptis suaveolens* (which thrives in riparian areas disturbed by exotic herbivores) that we encountered was in a riparian area heavily disturbed by pigs (Fig 19 in Barrett *et al.* 2001). As recommended in Barrett *et al.* (2001), pig control should be a priority. Determining the distribution and density of pig populations (even requiring troops on exercise to record where they are encountered) would be a useful first step.

5. Conclusion

The condition of the YSTA is remarkably good. There are areas where past fire regimes have reduced sensitive elements of flora, and fire is undoubtedly the most important management issue. The ADF has commissioned a fire management plan (CALMfire 2000) and fire management programs (eg. CALMfire 2001) which takes into account much of the information provided here and, if implemented, it will be effective. Communities containing fire sensitive species require protection. Diversity in all flammable communities will be best served by a fire regime that produces a mosaic of fire intensities and fire ages at as fine a scale as is practicable. We encountered no weed infestations that need urgent control measures. Nevertheless, pro-active vigilance to maintain that state is important. Feral cattle should be eradicated and the status of pigs should be ascertained and a control program instigated.

6. References

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