

Is tuart (*Eucalyptus gomphocephala*) decline detrimental for fauna?

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Declaration

I declare that this thesis is my own account of my research and contains as its main content work which has not previously been submitted for a degree at any tertiary education institution.

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ABSTRACT

Tree declines, characterised by gradual but widespread loss of vigour and subsequent death of either single or several tree species, are a global phenomenon with landscape-scale consequences. Tree declines can be caused by a wide range of biotic (e.g. pests and pathogens) and abiotic (e.g. salinity and drought) factors. In turn, both biotic and abiotic elements of the environment are modified as a result of tree decline. Despite the massive scale of these changes, the effects of tree decline upon fauna are not clearly understood and are still poorly researched. For example, empirical evidence exists for the effects of tree declines upon fauna only in a handful of bird, small mammal and reptile studies, conducted mainly in North America. The majestic tuart (*Eucalyptus gomphocephala*) tree once dominated the Swan Coastal Plain in Western Australia (WA). Today, tuart woodlands occur over less than a third of their former range, and the remnant woodlands are heavily affected by decline of unknown cause(s). This study examines the effect of tuart decline upon reptiles, birds and mammals.

Research was conducted in twenty-four 1-ha sites in Yalgorup National Park. Sites were selected for high tuart density and ranged from declining (characterised by crown dieback, dead branches and even dead trees) to healthy (i.e. dense canopy with no dieback). The health of individual tuart in the 24 sites was quantified for comparison between sites. Other habitat covariates quantified were the amount of litter, coarse woody debris, vegetation structural attributes and woody plant species composition. Reptile and mammal data were gathered through a system of trapping lines established for each site, while bat abundance was determined by recording their unique echolocation calls with Anabat recorders. The presence of bird species was quantified by area searches at each site. As complex combinations of environmental factors typically determine the presence or absence of faunal species, multiple regression

analyses were used to identify habitat parameters significantly associated with the distribution of these taxa. To quantify differences between vertebrate communities in healthy and declining sites, analyses of similarity (ANOSIM) were conducted. Multi-dimensional scaling (MDS) were conducted to visually represent differences in vertebrate communities in ‘healthy’ and ‘declining’ tuart sites.

Tuart decline brought about significant changes to fauna habitat, particularly with reference to canopy characteristics, litter and understorey density. ‘Healthy’ and ‘declining’ tuart stands were significantly different (ANOSIM), based upon the habitat variables found at each site. These changes clearly affected vertebrates. The assemblage composition of reptile, bat and bird species in ‘healthy’ and ‘declining’ sites were significantly different, while it was not the case with non-volant mammals. Reptile, bird and mammal species reacted variably to tuart decline and associated habitat parameters.

The abundance of several reptile species was significantly correlated with vegetation structure and the amount of litter. For example, *Acritoscincus trilineatum* skinks were associated with dense canopy and understorey, and tuart decline negatively affects this species.

Contrary to expectations, several bird species and guilds were significantly positively associated with tuart decline, particularly hollow-nesters, canopy insectivores and granivores. Diversification of habitat (e.g. tuart with some dead branches and epicormic growth) seems to benefit these birds. These benefits can be linked to the Intermediate Disturbance Hypothesis where moderate levels of disturbance benefit biodiversity. By contrast, some specialist foragers (e.g. nectarivores) were negatively affected by tuart decline. The negative effect of tuart decline on nectarivores is a source of concern as it implies potential major ecological effects on the ecosystem through the disruption of pollination services.

The abundance of only one non-volant mammal species, *Isoodon obesulus*, was positively correlated with a habitat parameter (shrub cover), while the other non-volant mammal species were not affected by tuart decline. By contrast, vegetation structure was an important bat habitat element for *Vespadelus regulus* and *Nyctophilus* spp. bats, which were significantly correlated with canopy cover of trees taller than 10m. *Falsistrellus mackenziei* was negatively affected by tuart crown dieback, and given the limited distribution and close association of this bat species with tall trees, it is suggested that *F. mackenziei* be used as indicator species to assess the effect of tuart decline upon fauna.

Characteristics of post- tuart decline plant communities will ultimately determine the extent of the effect of tuart decline upon fauna. Successional plant species with similar characteristics (e.g. canopy cover and litter production) and function as tuart may result in amelioration of the negative effects of tuart decline. If modification of vegetation structure and changes to leaf litter characteristics and microclimate are within the tolerance threshold of faunal species and their prey, the effect of changes in tuart health may be less severe than initially anticipated. On the other hand, successional plant species with very different characteristics than that of tuart will result in modified environmental parameters that may negatively affect fauna associated with tuart woodlands through altered habitat and food resources on which they depend, and could ultimately result in the loss of fauna species.

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