

State and Transition Models

For the FSNCA project it was necessary to assign a 'State' (or identity) to an area that summarised characteristics of that particular area of land. The condition of this area can then be considered in the context of the purpose for which that area of land is managed, as well as alternative ecosystem services such as protection of soil, capacity to filter and purify water, potential for carbon storage and sequestration. Other primary and secondary purposes of an area of land may include livestock grazing, timber production, honey production or conservation. Thus, a particular area of land may have multiple purposes. For example: scattered trees among native grasslands have livestock production, conservation of biodiversity, carbon storage/sequestration and honey production potential and also regulate climate, water quality, and protect soil; a timber plantation where plantings are less dense can be used for livestock grazing, shelter, timber production and carbon storage/sequestration.

Identity states are well established for many native ecosystems in Australia. The frameworks that describe these identity 'states', and the transitions between states, are referred to as 'State and Transition' models (STMs). As outlined above, generally, in areas modified for agriculture, there has been a move towards lower tree cover and conversion of the ground layer vegetation from native species to exotic improved pastures and/or crops.

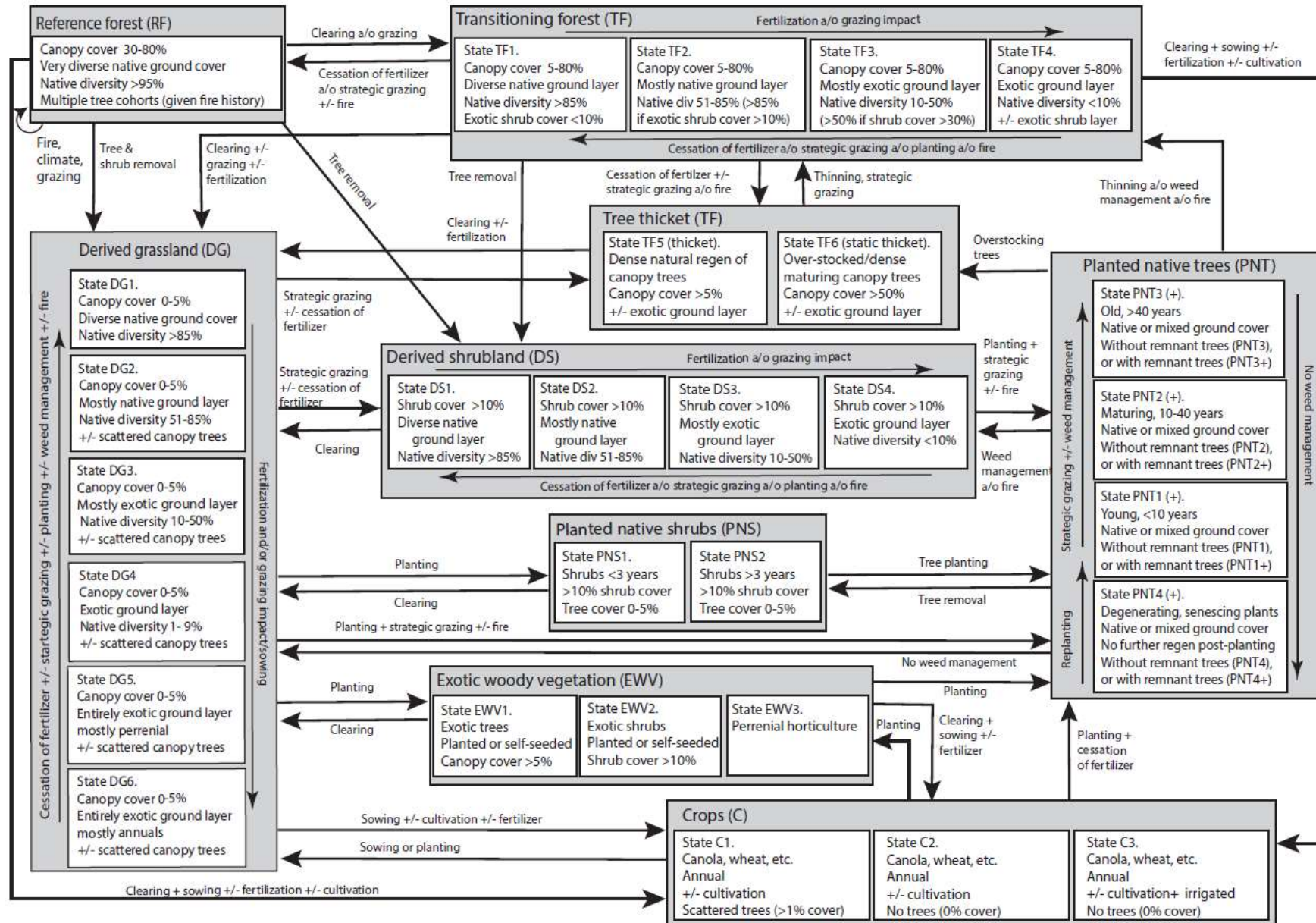
Some producers have chosen to restore characteristics of the original native ecosystem where there has been modification for agricultural production. However, the degree to which this is possible will depend on the level of modification of an area through past practices such as cultivation, fertiliser application, past cropping practices, and grazing management. 'Transitioning' to an identity state that more closely resembles the original native ecosystem is likely to impart greater resilience to a farm - as mentioned above. However, the end goal will depend on the goals of the landowners including whether the primary use for an area is for grazing production or for conservation. Management goals will also depend on the type of ecosystem services a farm business wishes to use as 'free inputs from nature' for livestock production i.e., the natural capital.

As the case studies in this project are situated within the temperate grassy woodland biome (and similar vegetation), we use published 'state' and 'transition' identity classes for that biome as outlined in Whitten et al., (2010). We apply these identity states to areas on a farm that retain general characteristics of the original native ecosystem such as remnant trees and some native herbaceous species. In some areas the original vegetation might have been a native grassland and the STM model used also applies to grasslands. In some places the original vegetation may have been more dense and scrubby forest but, for the purposes of this project, the basic principles in the simplified STM apply also. In the context of this project, determining the 'state' or 'transition' identity of an area enables a determination of the potential for provision of a range of ecosystem services. For the purposes of this project, we also created an extended State and Transition model to account for modified ecosystems that are common where land is managed for agriculture (Table A3 and A4).

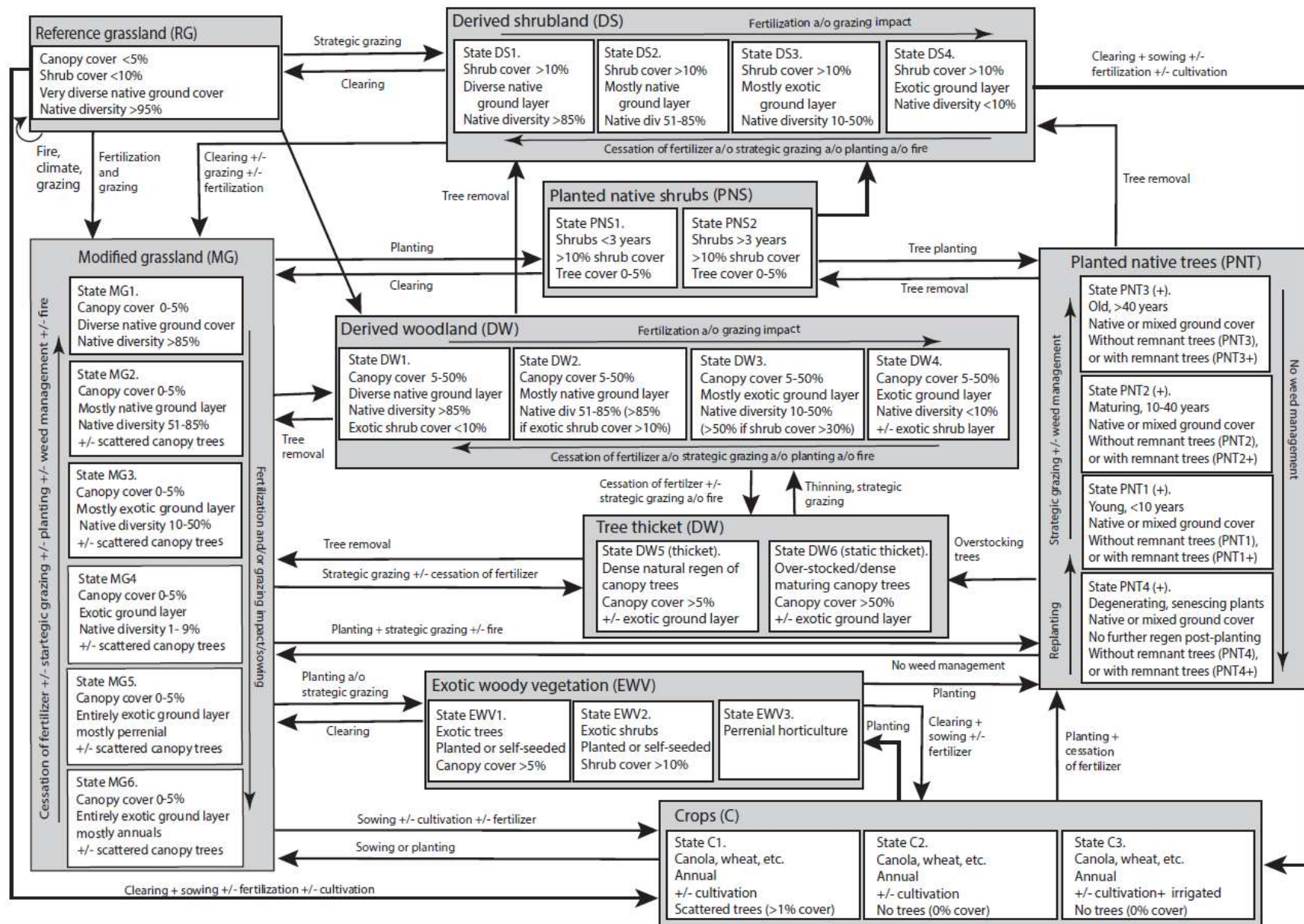
Each 'state' or 'transition' identity implies no value judgement. A value judgement only exists once management and production goals are considered. For example, a management goal for wool production may be to have persistent and palatable forage as well as areas for stock to shelter. These ecosystem services can be provided by a less modified native ecosystem or by an area forested with exotic or native timber if the canopy is open enough to allow good forage as well as timber production.

If, however, the primary management goal for an area is conservation and to serve markets for biodiversity should they emerge, it would be desirable to be moving towards an identity/state closer to 'reference' condition. It is all context and goal dependant.

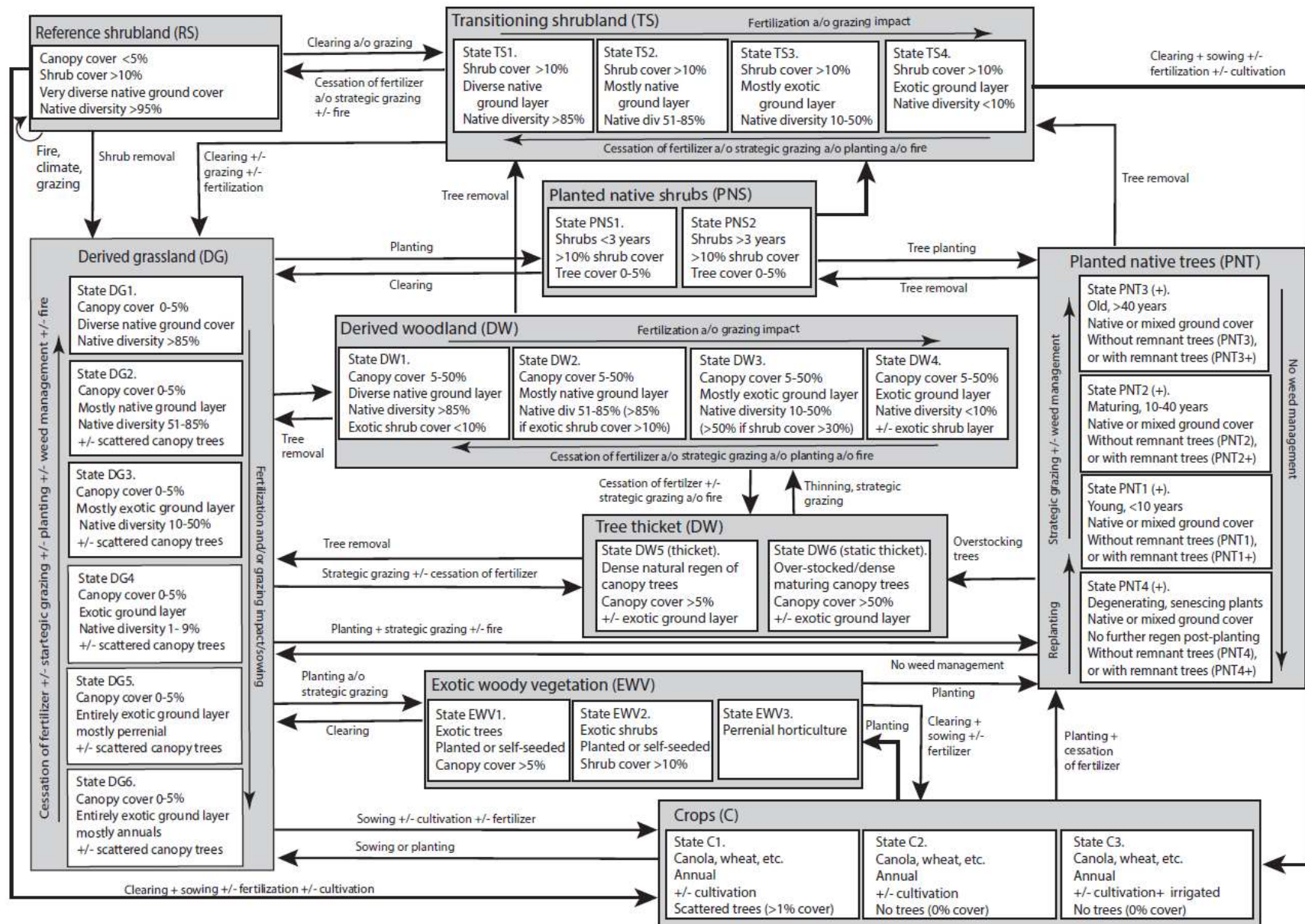
Forest State and Transition Model



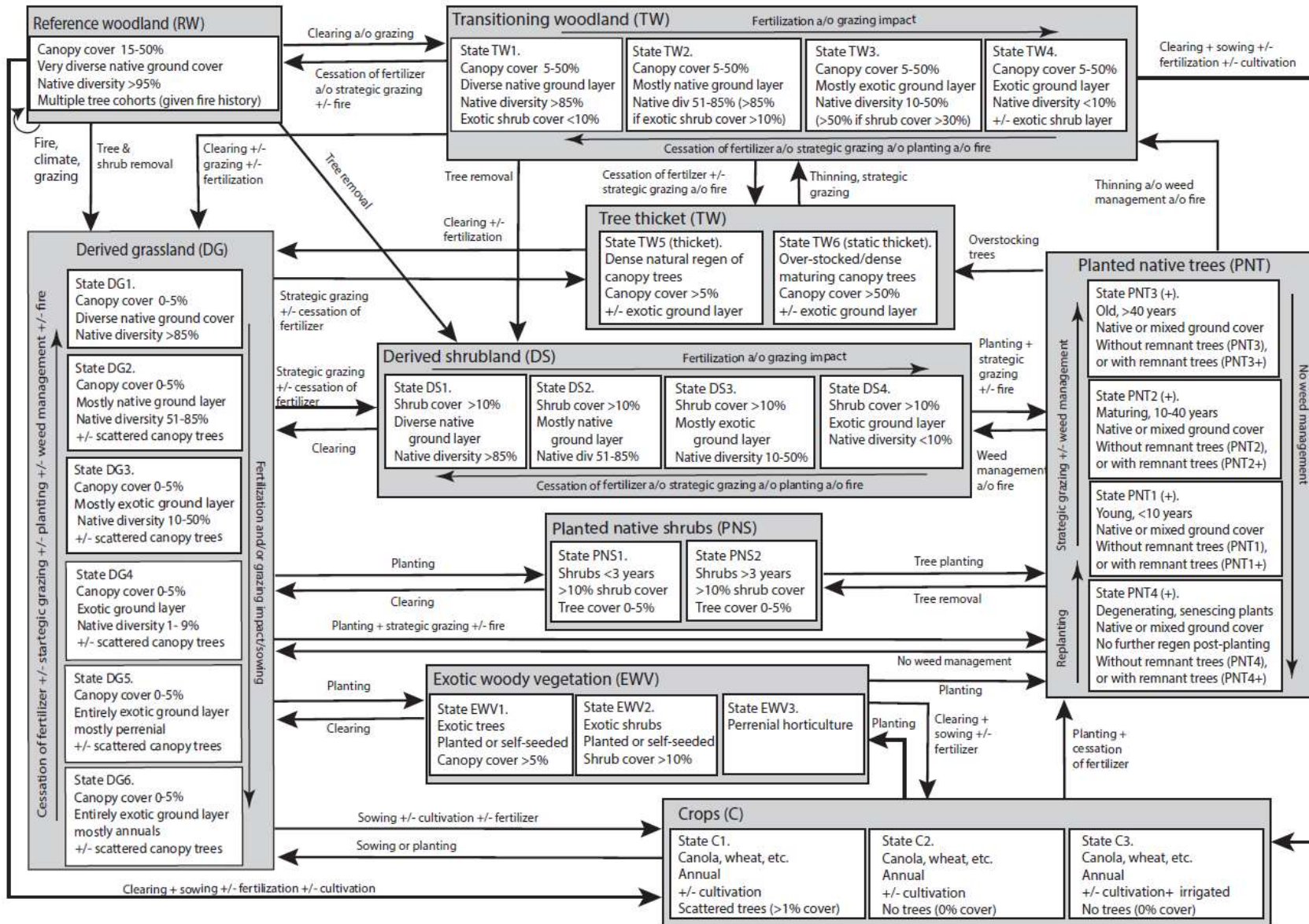
Grassland State and Transition Model



Shrubland State and Transition Model



Woodland State and Transition Model



Grazing Classifications

Grazing classes from Latrobe FSNCA project. Condition of the land for grazing - the capacity of the land to respond to rain and produce useful forage.

Category	Description
A	Very high levels of groundcover ¹ (>90%), including perennial and palatable species and litter that contribute to soil protection and water and nutrient retention and an appropriate ² mix of perennial, palatable and persistent species. Few invasive weeds ($\leq 5\%$) are present and soil erosion is absent. A good amount of biomass is retained (e.g., a cricket ball wouldn't be easily seen from a few metres away), even when livestock are present, or after a grazing event.
B	High levels of groundcover (70-90%) with some decline in perennial and palatable species, including grass species and litter compared to class A and likely to be a minor presence of invasive weeds (>5-15%). There may be signs of previous erosion and potential for current erosion in some areas. Reasonable biomass (e.g., a golf ball wouldn't be easily seen from a few metres away) is retained even where grazing animals are present.
C	Moderate groundcover (40-70%), a low diversity of palatable and perennial species, and persistent species that protect soil assets in poor times are missing. Annual and/or perennial invasive weeds are significant (>15-50%). A high proportion of bare ground is likely to be present (up to 50%) and obvious signs of past erosion with current susceptibility to erosion high. Low biomass (e.g. a golf ball would very easily be seen from a few m away).
D	Low levels of groundcover (<40%) with a high proportion of bare ground (>50%), low pasture biomass most of the time and likely to very low in extended dry times, a low diversity of perennials and dominated by unpalatable species and/or annual weeds. Clear signs of past and current erosion present.
E	Few (if any) perennial species are present and it is a severe and hostile environment for plant growth (i.e., scalding, salinity, severe and continuing gulying in susceptible areas). Potential and likelihood of weed invasion is high.

¹ groundcover includes living plants and litter

² appropriate to the management goals, e.g., for an improved/sown pasture 6-7 desirable species would be ideal (i.e., Very good/Class A) for persistence and palatability (i.e., Cocksfoot, Phalaris, Rye, two species of clover, chicory, plantain). In native pastures, the presence of the typical dominant native grasses and at least the most common native forbs is the minimum appropriate mix of species.