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Some Nullarbor vegetation communities have undergone ecological changes so dramatic the perennial species composition has been replaced by an annual component, and some areas are so eroded they no longer provide conditions for establishment of perennial plants (Figure 2). Early impacts came from rabbit plagues and changed fire regimes from ignitions from steam trains. High total grazing pressure from stock and kangaroos, combined with periods of drought, reinforced and extended the impacts from rabbits and fire.

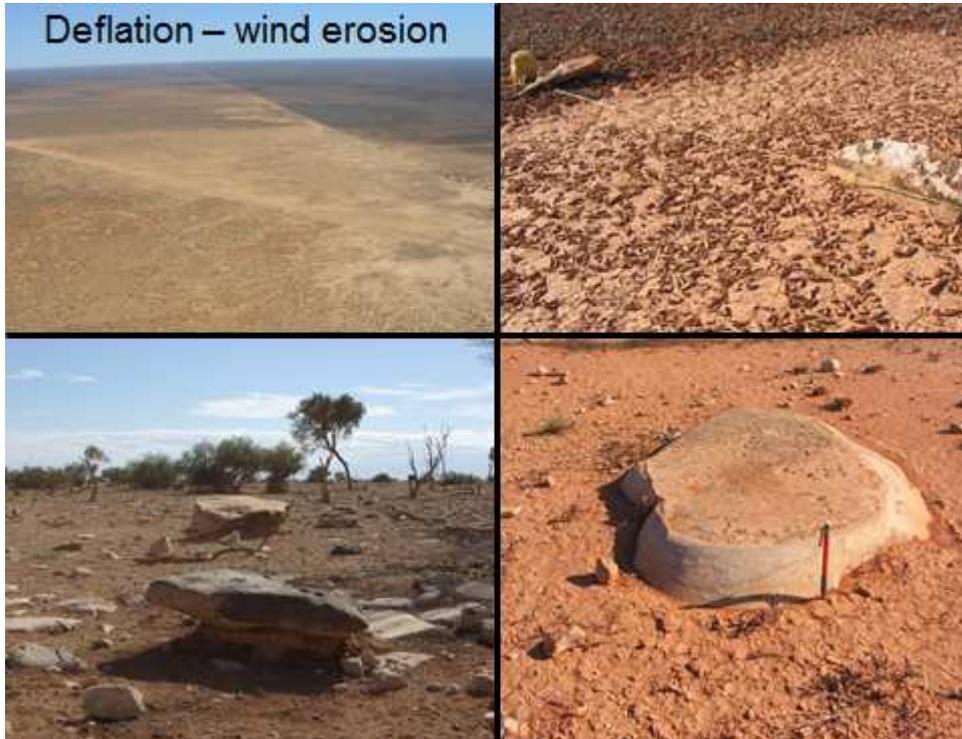


Figure 2. Wind erosion exacerbated by the effects of rabbits, fire and overgrazing on Nullarbor ecosystems (*P. Waddell (2005-2007)*).

The ecological transitions for Nullarbor chenopod shrublands and Nullarbor woodland and chenopod communities are illustrated in Figure 3 and depicted in Figures 4 and 5.

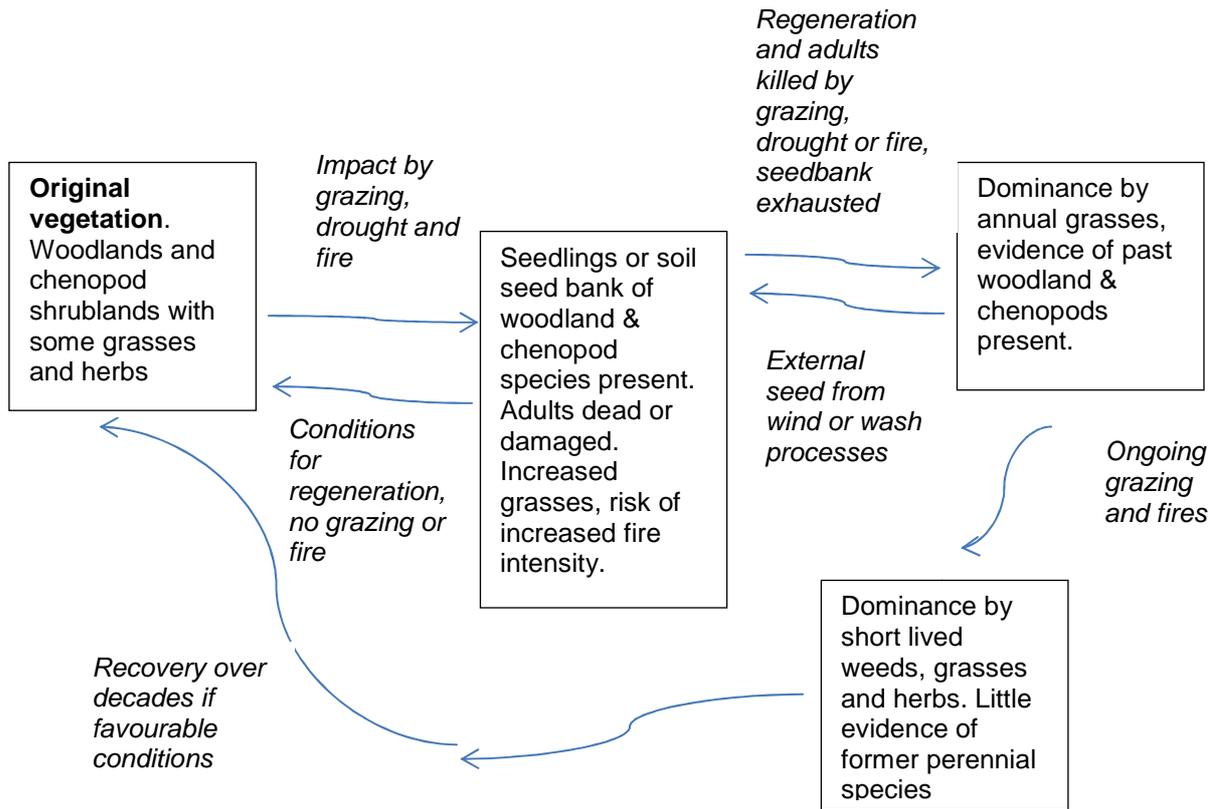


Figure 3. Ecological transitions in Nullarbor ecosystems (adapted from Waddell *et al.* 2010).



Figure 4. Grazing impact in donga groves on *Pittosprum angustifolium* and loss of saltbush and other perennial understory species (P. Waddell (2006).

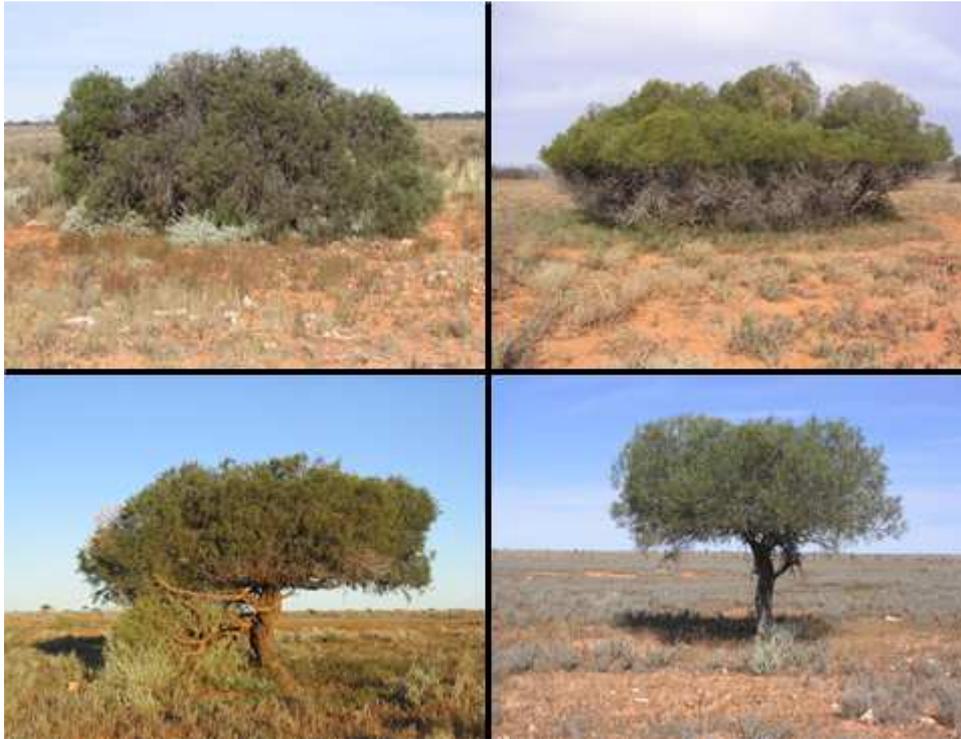


Figure 5. Grazing impact on *Acacia oswaldii* and loss of understory species (P. Waddell (2006)).

The reduction in palatable perennial understory species with high metabolisable energy reduces reproduction and growth rates in livestock (Brennan *et al.* 2006). The different pasture combinations and impacts on digestibility, pastoral resilience and management responses are shown in Table 1.

Scenario	Digestibility	Resilience	Preferred management response	Consequences of over stocking
1. Original vegetation. Mix of annual and perennial grasses plus palatable trees and shrubs	Good carbohydrate and protein balance throughout the year	Responsive to small rainfall events, with long-term forage from shrubs (a living haystack) in dry periods	Adjust stocking and total grazing pressure to forage availability and for recovery of palatable perennial species	Loss of palatable perennial species. Long-term decline in productivity
2. Transition to mix of annual and perennial grasses	Good digestibility when green, poor digestibility when dry	Perennial grasses have deep root systems, maintain green forage longer and respond to small rainfall events. Lack of perennial palatable shrubs to provide forage in extended dry periods	In addition to the above measures, destock in extended dry periods and include rest based management systems and conservative feed budgeting	Loss of perennial species. Long-term decline in productivity and resilience
3. Transition to annual grasses and weeds	Good digestibility when green. Poor digestibility when dry	Unresponsive to small rainfall events. Requires large rainfall events to germinate. Low palatability when dry. Lack of forage in extended dry periods	In addition to the measures above, destock annually and rest based management systems and conservative feed budgeting	Ongoing decline in any remaining palatable perennial species

Table 1. Impacts on pastoralism from transitions in Nullarbor ecosystems.

Each scenario in Table 1 has different stock management outcomes. Scenarios 1 and 2, which include perennial species, can maintain reasonable stock numbers across seasons, while adjustment of stock numbers for longer term seasonal patterns can maintain perennial species. Scenario 3 with annual pastures requires destocking in dry conditions.

Ecological recovery

Measures to address the loss of palatable perennial are illustrated in Figure 6 and include:

- Moving water points to more resilient land surfaces;
- Considering water point location and grazing radii to avoid overgrazing;
- Maintaining stocking rates within utilisable forage availability of the key perennial species;
- Reducing the spread and intensity of fires;
- Closing artificial water points when not required; and
- Where practical, with cattle, managing wild dog populations and other technologies to control kangaroos and goats.

However if a perennial seed source is not available and/or soil erosion has reduced seedling germination and survival capability, then perennial species are unlikely to return within decades.

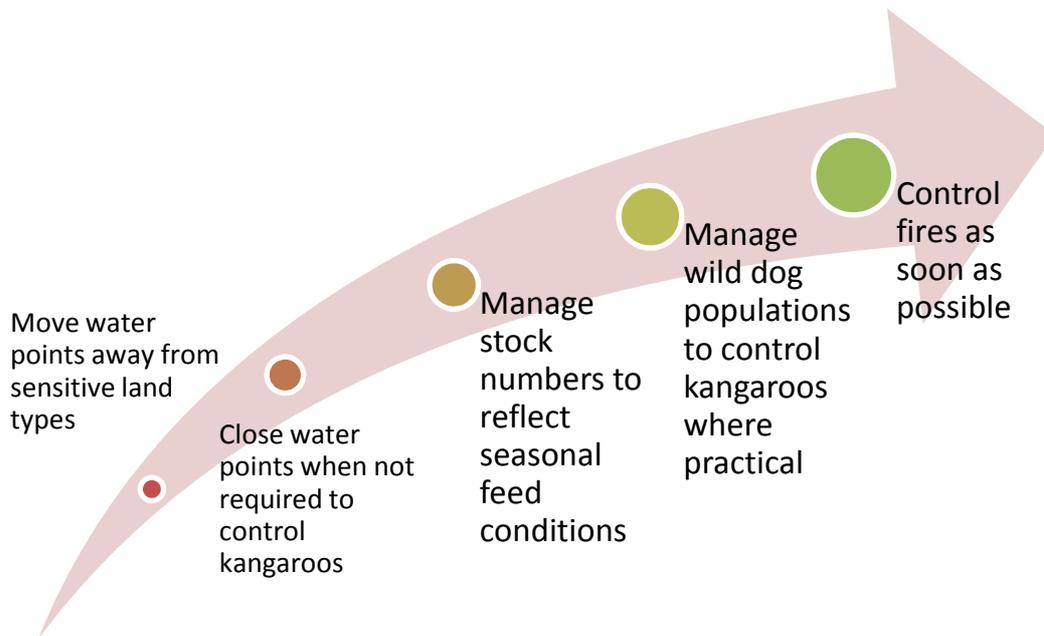


Figure 6. Steps taken by pastoralists to enhance perennial palatable species abundance and improve productivity.

A natural reaction to declining productivity is to increase stock numbers which may further degrade the natural capital of palatable perennial species. Foregoing short-term income to increase natural capital of palatable perennial species for long-term economic and environmental sustainability may not be achievable in times of economic stress. These sometimes opposing perspectives are shown in Figure 7.

There are currently limited economically attractive opportunities to improve pasture productivity by increasing the perennial species to support stock over dry seasons as:

- the measures require capital investment; or
- managing stock numbers to forage availability and paddock resting may mean forgoing short and medium term productivity; and
- there is unlikely to be a short-term return on investment.

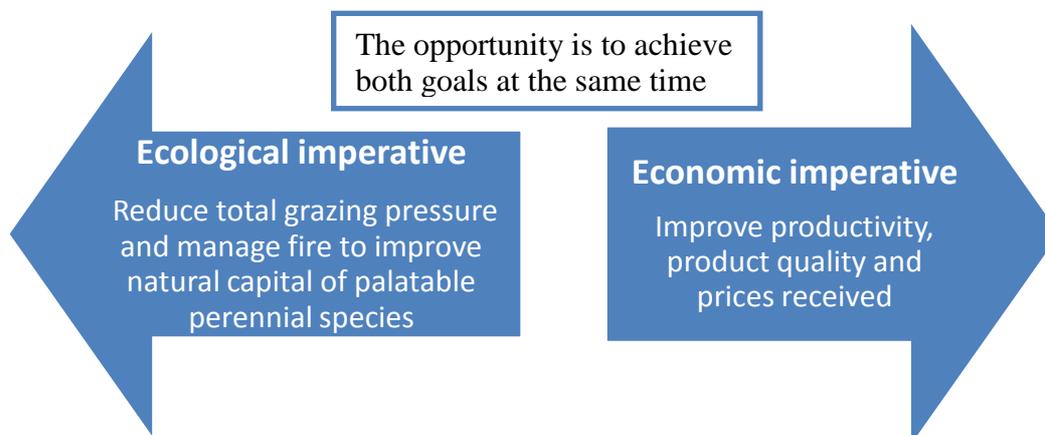


Figure 7. Ecological and economic imperatives can be opposing forces impacting on the natural capital of palatable perennial species

The governance opportunity

The government of Western Australia is responding to changing economic circumstances in the rangelands through rangeland reform. The proposed Rangeland Lease allows for a diverse range of permitted uses, including tourism and conservation. On the Nullarbor there are limited opportunities for tourism and diversification.

Governance systems may require a mix of enforcement, extension and incentives. For example:

- Ensuring that rangelands are managed in an ecologically sustainable manner as required under legislation;
- Providing incentives to encourage perennial vegetation recovery; and
- Lease or sale to government or private sector for vegetation recovery.

These measures may induce greater financial costs on the industry or require greater funding by government and not be achievable.

Innovation opportunities

There is a desire by the pastoral industry and governance systems for sustainable productive pastoral landscapes. Management pathways towards ecological recovery for sustainable production could include:

1. Stock and water management technological innovations that reduce management costs and better control grazing pressure;
2. Strategies to reduce kangaroo grazing pressure such as closing water points and use of managed wild dog populations;
3. Grazing only in good seasons with rapid destocking when conditions deteriorate.

Governance considerations for ecological recovery are illustrated in Figure 8.

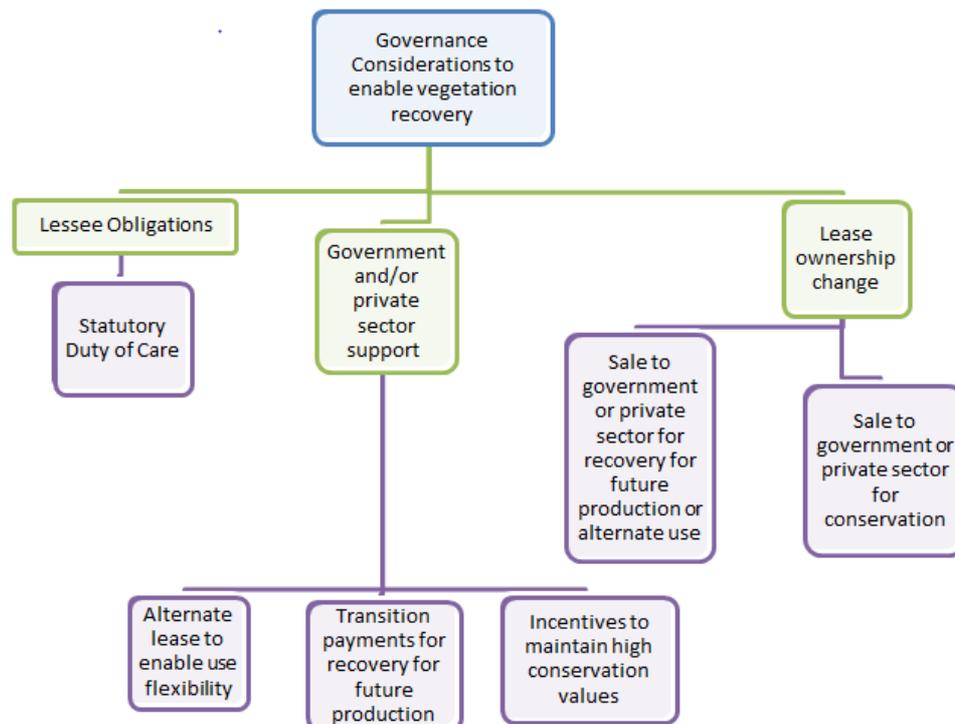


Figure 8. Considerations for ecological recovery

Incentives can be challenging for governments to fund and require consideration of property rights, statutory duty of care and incentive options. An innovation may be transition payments to assist producers adjust to sustainable practices. Transition payments are made available on an interim basis to send a clear signal that at some time in the future they will be withdrawn (Powell *et al.* 2003). When withdrawal occurs, the expectation is that the practices previously supported by transition payments will then be funded by producers as part of their duty of care.

The current generally poor and declining ecological condition of the rangelands of the Nullarbor region of Western Australia, due to loss of perennial species, has direct implications for pastoral productivity. Measures to address declining ecological condition are known but may not be economically feasible and proposed reforms may not assist. Technological innovations for stock management and changed management regimes to support perennial vegetation recovery require increased investment or may reduce short and medium term income. Transition payments may offer a way forward to enable vegetation recovery and future productivity. A last resort appears to be lease acquisition by government to support vegetation recovery.

There may be innovative pathways that have not been considered. A way to support these to emerge could be through developing relationships of trust and respect for effective collaboration between all stakeholders.

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