Understanding Land Degradation Processes in a Nutshell

Dr Ted Christie, 26 June 2017

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Disturbance to natural ecosystems that lead to land degradation and habitat loss can arise from human use activities *e.g. agriculture, forestry, grazing and mining* or natural causes, e.g. *drought, fire, floods, insects and pathogens* – or the interaction between these activities and natural causes.

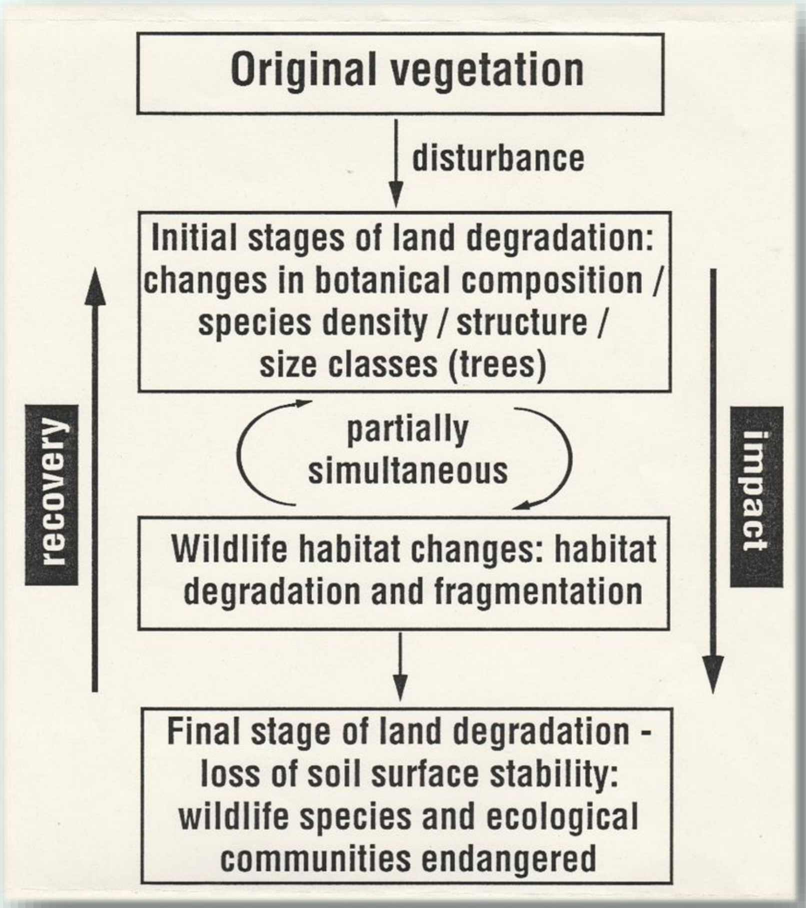
The impacts on habitat and biodiversity following disturbance are dependent on the time the disturbance persists, the intensity of the disturbance and the spatial extent of the disturbance.

- Impacts may arise as an **"acute disturbance"**, i.e. a catastrophic event over a short time-scale, such as clear felling of a natural forest.
- Alternatively, impacts may arise as a **"pulse disturbance"**, i.e. low intensity or intermittent impacts over a long time-scale, such as selective logging over large areas of land.

Pulse disturbance events are much more difficult to study experimentally, relative to acute disturbance events, and so pose a special problem for scientific proof of causation.

The processes of land degradation have been described as "*involving a continuum of change from slight to severe deterioration of the biological and soil resource*".

The generalised relationships between the processes of land degradation, biodiversity and wildlife conservation are shown in the following Figure.



i. The early warning signs of land degradation are primarily changes in species diversity of the plant community. It is at this stage that plant species most sensitive to disturbance, or "indicator species", are affected.

ii. As the disturbance continues, other plant species are lost, so that the impacts result in a loss in both plant species diversity and ground cover.

iii. Wildlife populations are affected at the stage when their habitats commence to degrade, or fragment, because of the disturbance.

iv. Depending on the time of and the extent of disturbance, fragmentation of habitats can lead to the loss of species from habitat remnants, *e.g. when the remnants are too small to support a viable population or when the remnant supports a plant population but not its pollinator.*

v. Should the disturbance continue to persist over time, the end-point of land degradation will eventually be reached; i.e. the loss of most, if not all the plant cover and loss of the stability of the soil surface.

vi. At this stage, regeneration becomes a very slow, difficult process.

vii. *The central question then becomes whether the natural ecosystem will return to, or near to, its pre-existing biological state prior to the disturbance?*

CASE STUDY: The Mulga Lands Bioregion (*Acacia aneura)* of Semiarid Australia

The Mulga Lands Bioregion is used for livestock grazing. It occupies an area of 251,640 km²; 74% of this area is found in south-west Queensland and 24% in New South Wales.

Two key issues for sustainable livestock production in the Mulga Lands Bioregion are the balance between mulga tree density and ground-storey biomass production; and seasonal grazing pressure - given annual rainfall is low and highly variable, with droughts frequent.

The top photo illustrates the woodlands structure of the Mulga Lands; the remaining photos, the ground storey component of the Mulga Lands - in various land condition classes arising from past disturbance(s) over time.

One of the measures for land condition of the ground-storey is the "Basal Area" of the perennial grasses (as a percentage of the ground area).

The first of the two middle photos illustrate "Excellent" land condition; the next photo, "Medium" land condition as evident from the initial stages of land degradation – loss of plant cover and changes in botanical composition.

The bottom photo illustrates degraded ("Poor") land condition.

The consequences of land degradation for biosequestration are clear.

Conclusion

"Resilience" is an accepted ecological concept that is central to understanding whether ecological impacts, following disturbance, are either reversible or irreversible following the end of the disturbance(s).

Resilience is dependent on the pattern of response by an ecosystem to disturbance, as well as the capacity of the ecosystem to recover when the disturbance is removed.

Natural ecosystems vary in their resilience. Recovery of degraded ground storey of Mulga Lands is limited by very low soil phosphorus levels: Seedling growth is very slow. Where soil water is limiting, seedling survival is affected. Both factors are key to understanding resilience of Mulga Lands.

This article is extracted from the Author's book, *"Finding Solutions for Environmental Conflicts: Power and Negotiation"*. To read more on a cross-disciplinary approach for finding sustainable solutions for "Biodiversity and Threatened Species" (Chapter 9, pp. 235-262), click on the following LINK.

TAGS: Land degradation processes; acute disturbance; pulse disturbance; pastoral land condition; resilience; biodiversity; habitat loss; Case Study: Mulga Lands Bioregion; biosequestration