RASH: the rapid assessment of soil health

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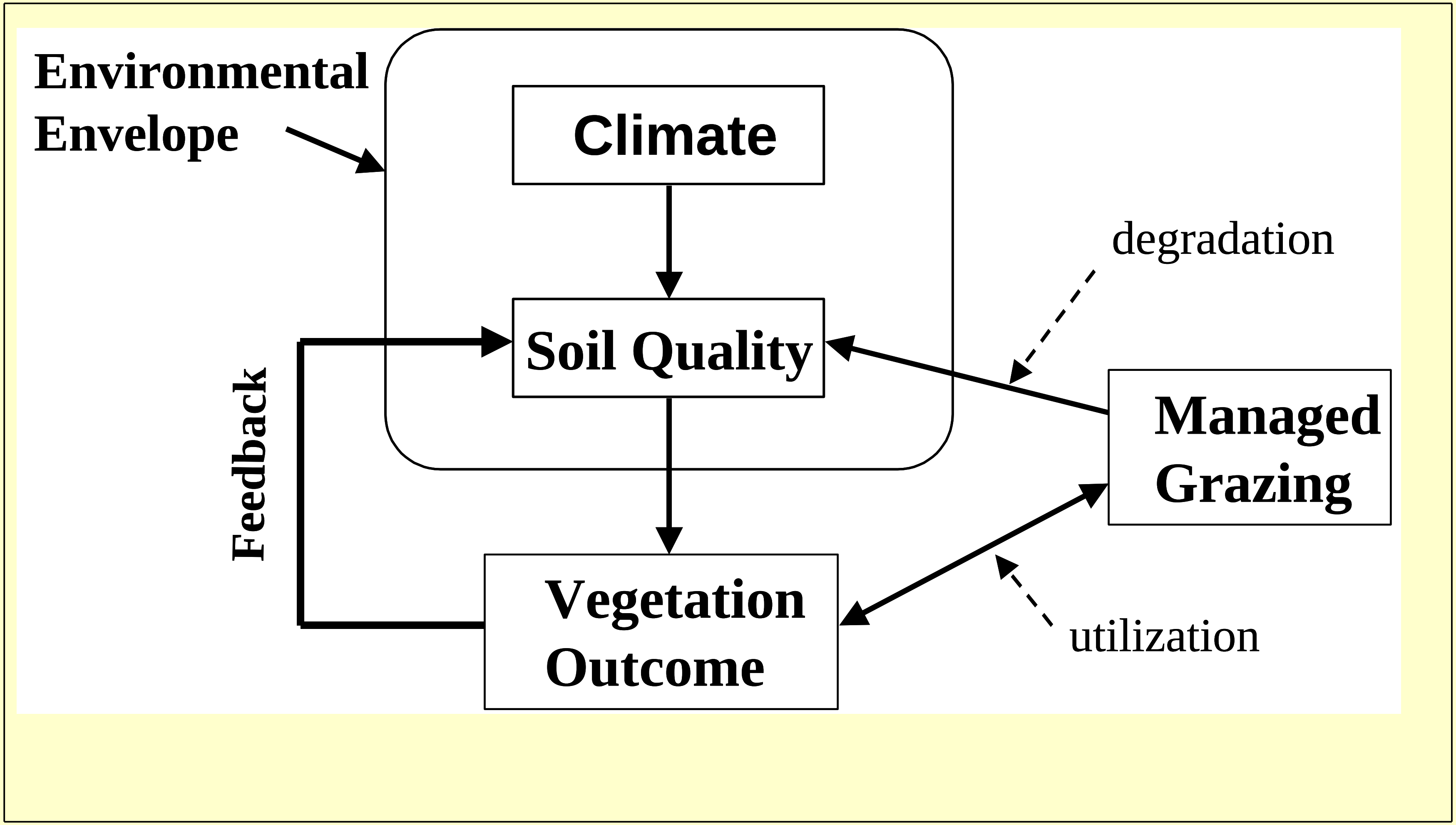
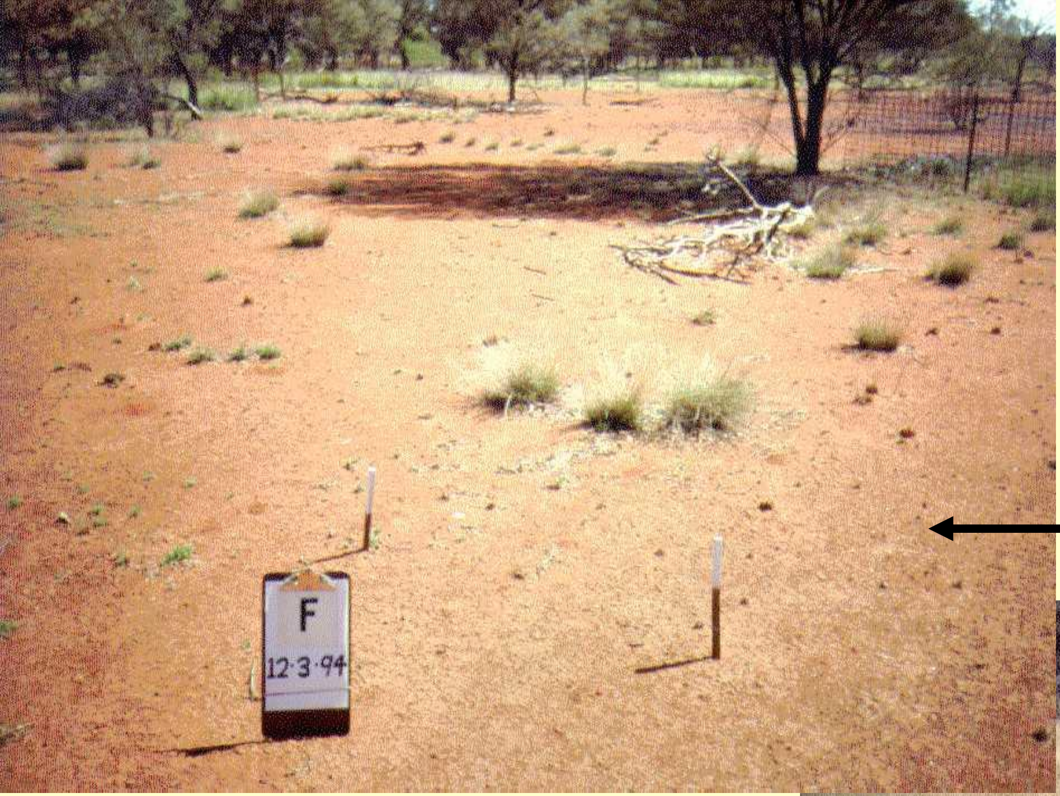
•LFA commenced development to add “changes to soil productive potential” to existing vegetation based monitoring procedures in the Australian rangelands.

•Prior to this, vague comments were made about “soil erosion”



Has management or weather sequences resulted in soil degradation, or has the vegetation resource merely been heavily utilised?

The Challenge….



What sort of data collected from here…..

Can predict this response to good rainfall?

Clearly, the productive potential of the soil was substantial.

Functional: highly resource retentive

Dysfunctional: resources flow out of system

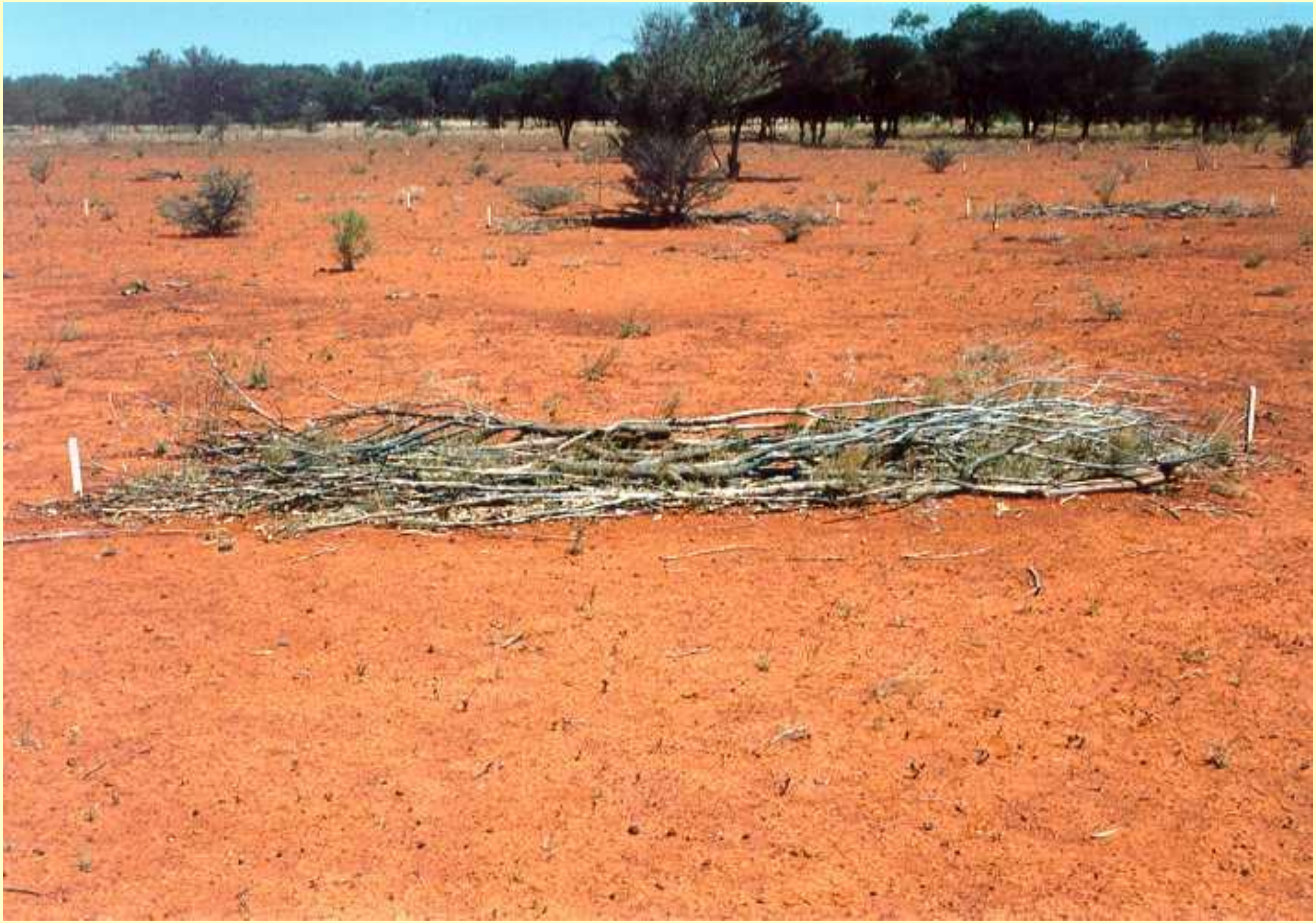
- Pattern→ Properties→ Processes→ Function

- We were able to resolve "function" the understanding of how landscapes work into the "economy of vital resources"

- Vital resources are water, topsoil/nutrients, organic matter and seeds.

- This enabled us to make the concepts applicable to a wide variety of landscapes and land uses

A rehabilitation Experiment



Vegetation response after 7 years

Golden rule for rehabilitation:

Restore or improve landscape processes that enable vital resources to be retained and used

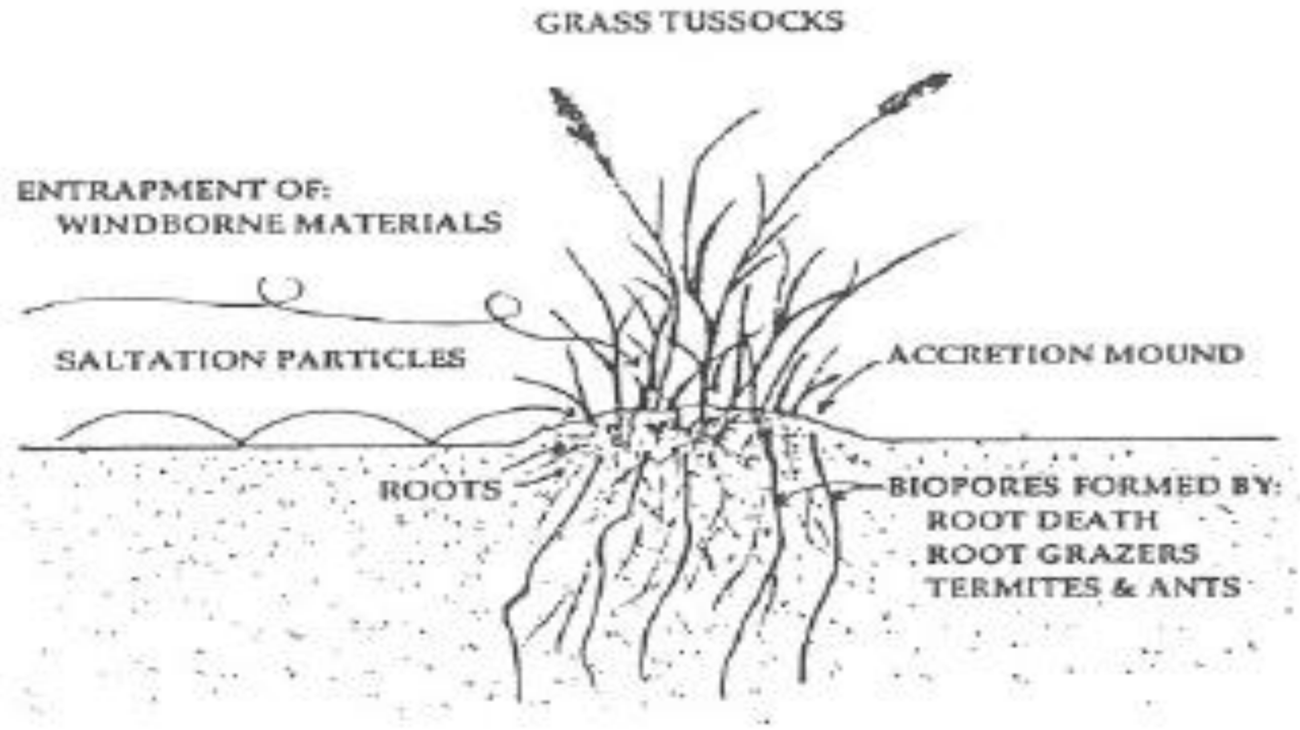
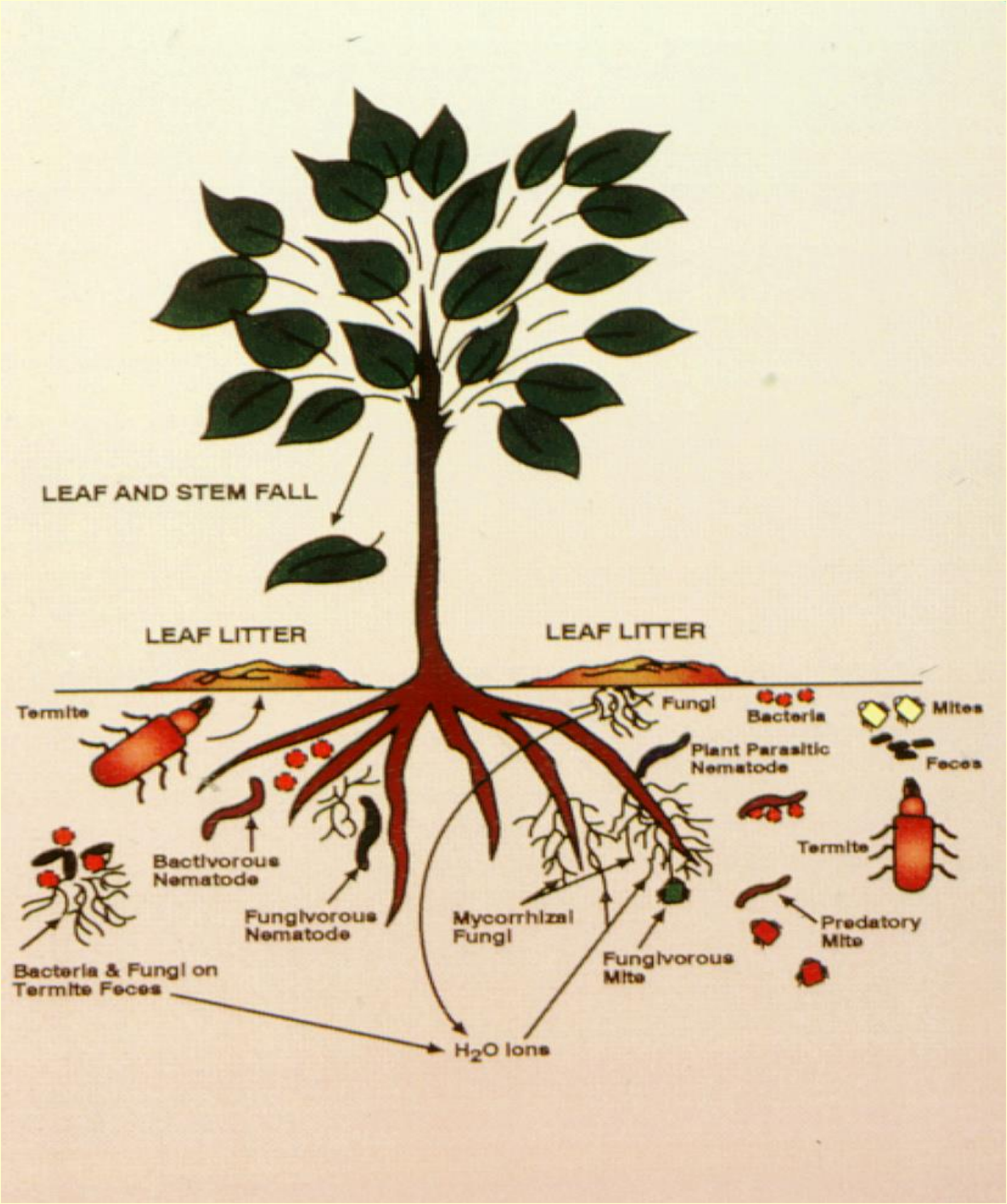


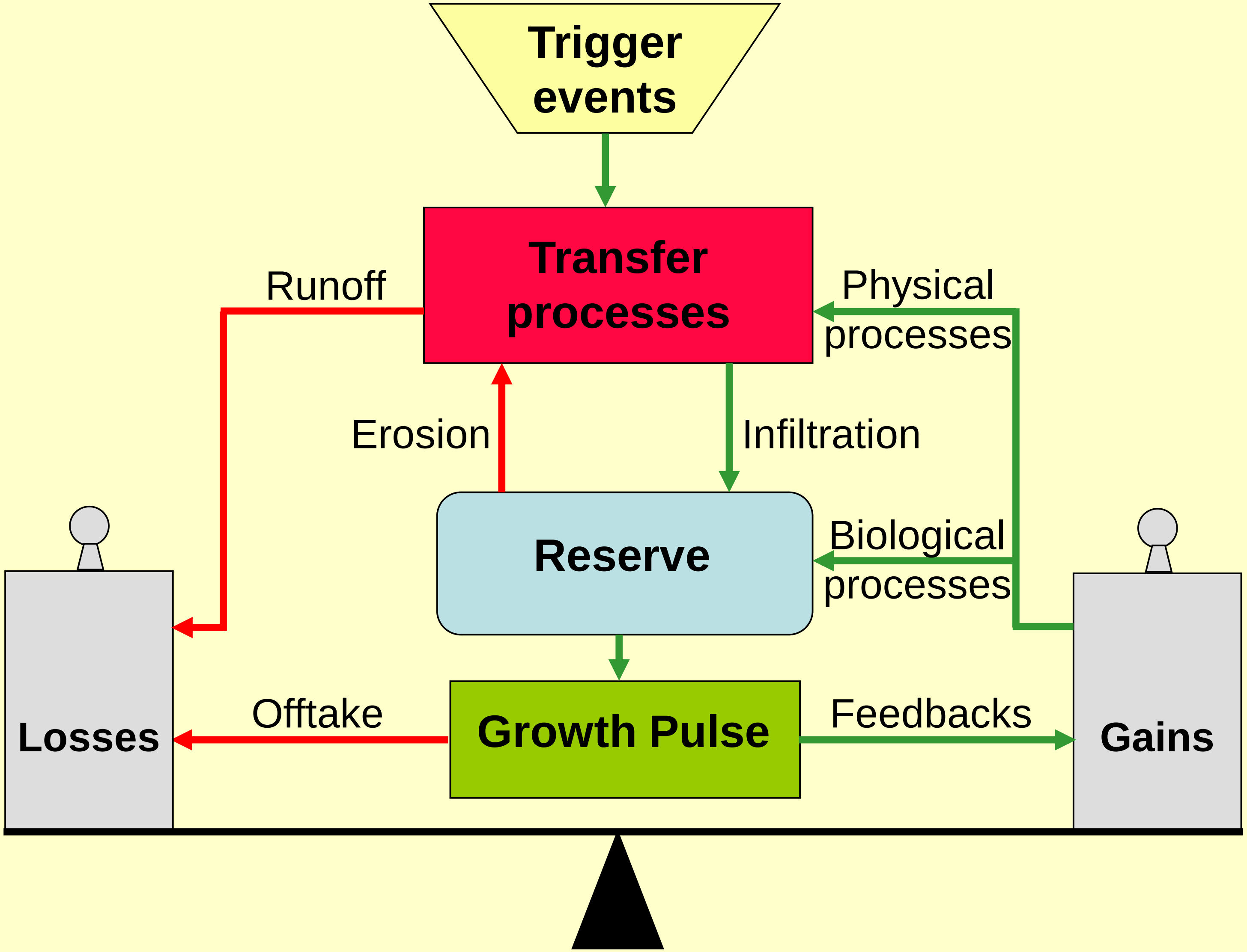
Fig. 2.2. Diagram illustrating the build-up of a mound by a perennial grass tussock with the accumulation of wind-blown materials, and the formation of biopore channels into the soil.



LEAF AND STEM FALL
LEAF LITTER
LEAF LITTER
Termite
Fungi
Bacteria
Mites
Plant Parasitic Nematode
Feces
Bactivorous Nematode
Termite
Fungivorous Nematode
Mycorrhizal Fungi
Predatory Mite
Fungivorous Mite
Bacteria & Fungi on Termite Feces
H_2O Ions

Landscape function: the economics of vital resources.

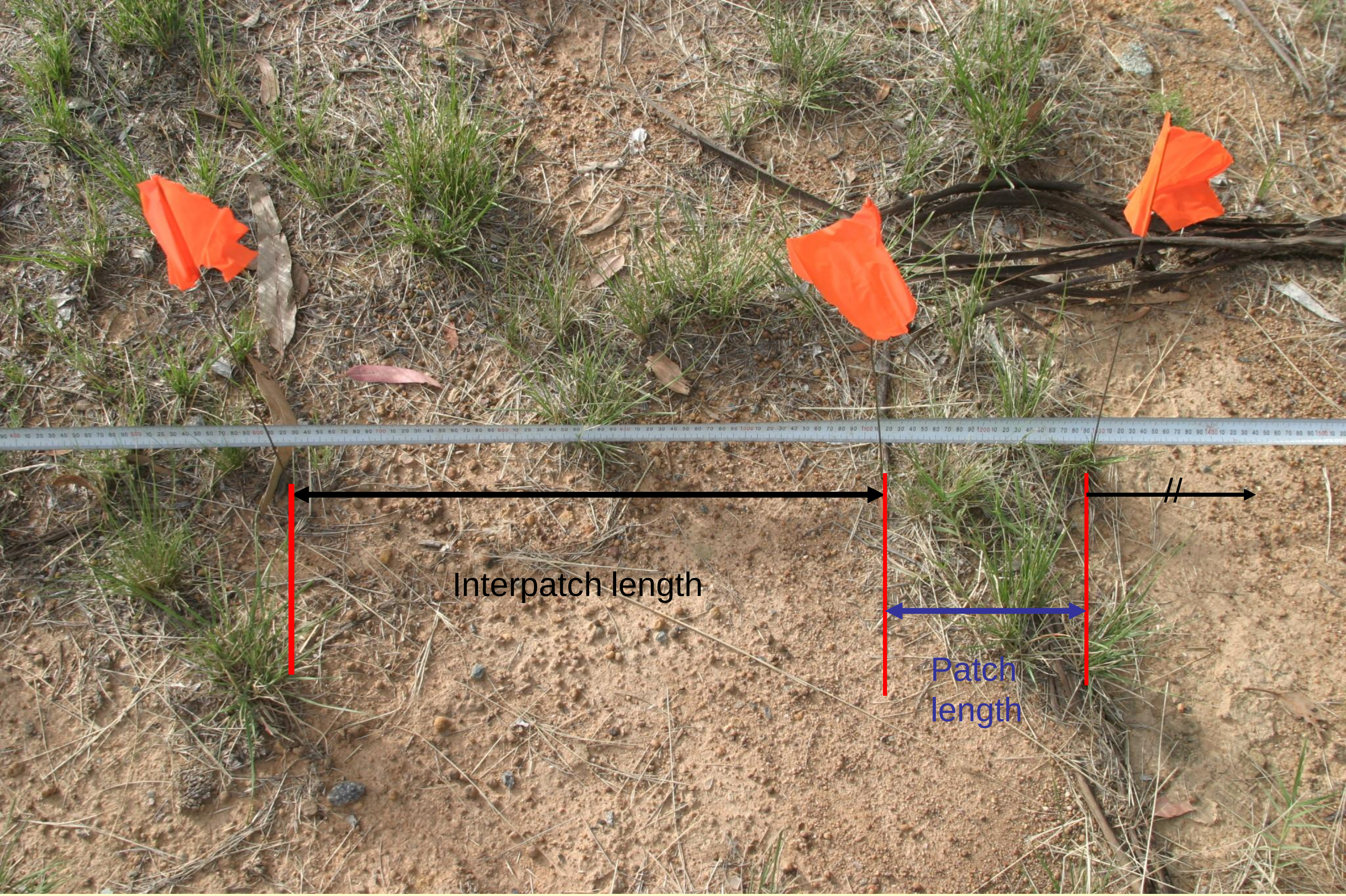
Landscape dynamics: a balancing of resource gains and losses



Data are collected in two linked spatial scales:-

1. The hillslope scale, looking at resource regulation by physical and biological features in the landscape

2. Patch/ interpatch scale, where 11 indicators of processes occurring at the soil surface are assessed.

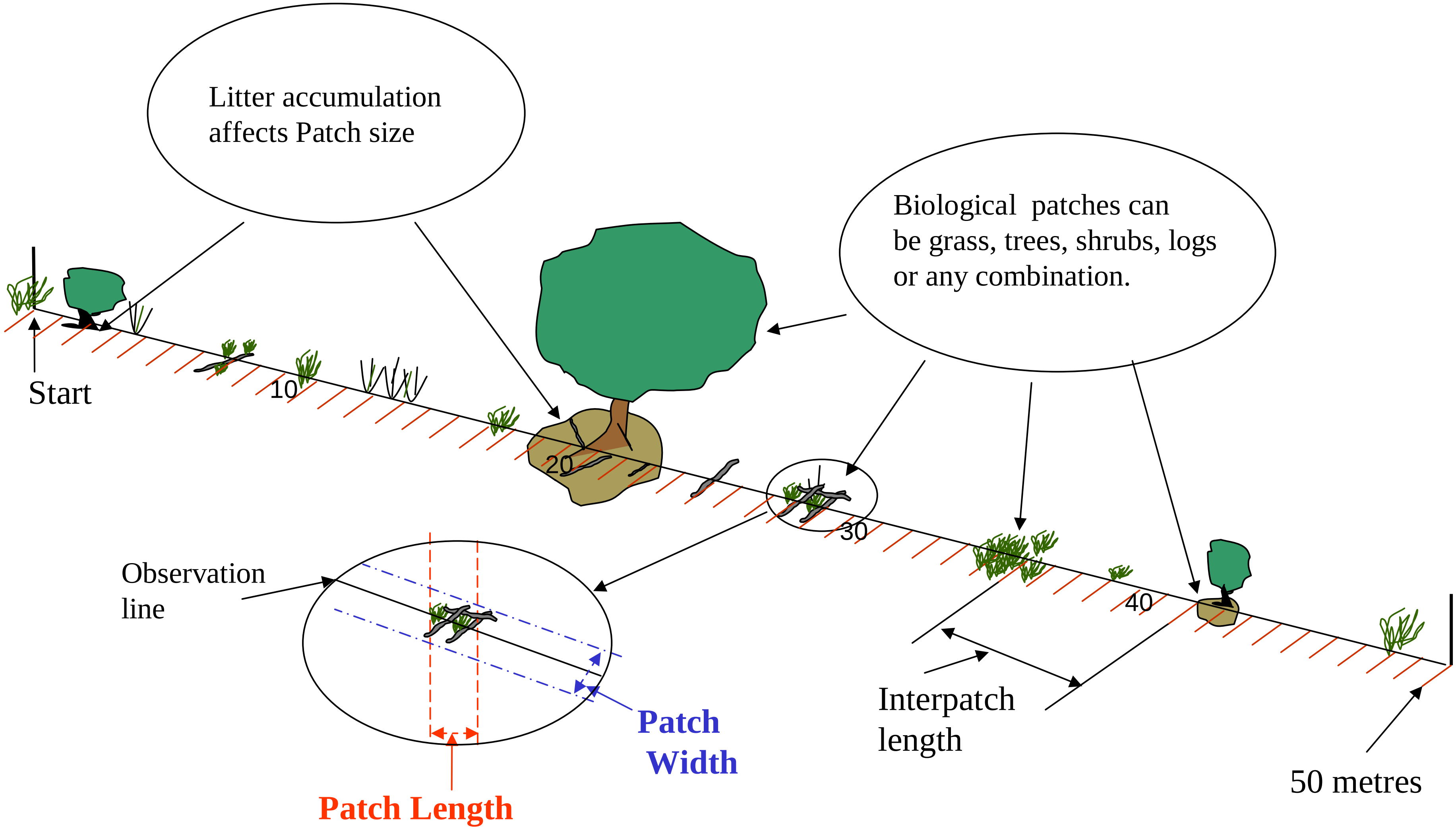


Measurement of patch and interpatch length in a slightly dysfunctional grassland

More traditional ripping to produce bank & trough structures showed good landform stability

Coarse woody debris is an effective resource flow regulator.

Acquiring data for "landscape organisation"



Geomorphic features such as flats, depressions and slopes are also evaluated

Indicator	Process Addressed
1. Soil cover	Rain-splash erosion/crust formation
2. Basal cover of perennial Grass and/or canopy cover of shrubs and trees	Below-ground biological activity
3. Litter cover, origin and degree of composition	Decomposition and nutrient cycling of surface organic matter
4. Cryptogam cover	Surface stability, resistance to wind and water erosion and nutrient availability
5. Crust broken-ness	Wind ablation or water erosion
6. Erosion type and severity	nature and severity of current soil erosion features.
7. Deposited materials	Upslope soil stability
8. Surface roughness	Water infiltration, flow disruption, seed capture
9. Surface resistance to disturbance	Effect of mechanical disturbance.
10. Slake test	Soil stability/dispersiveness when wet
11. Soil texture	Infiltration rate and water storage.

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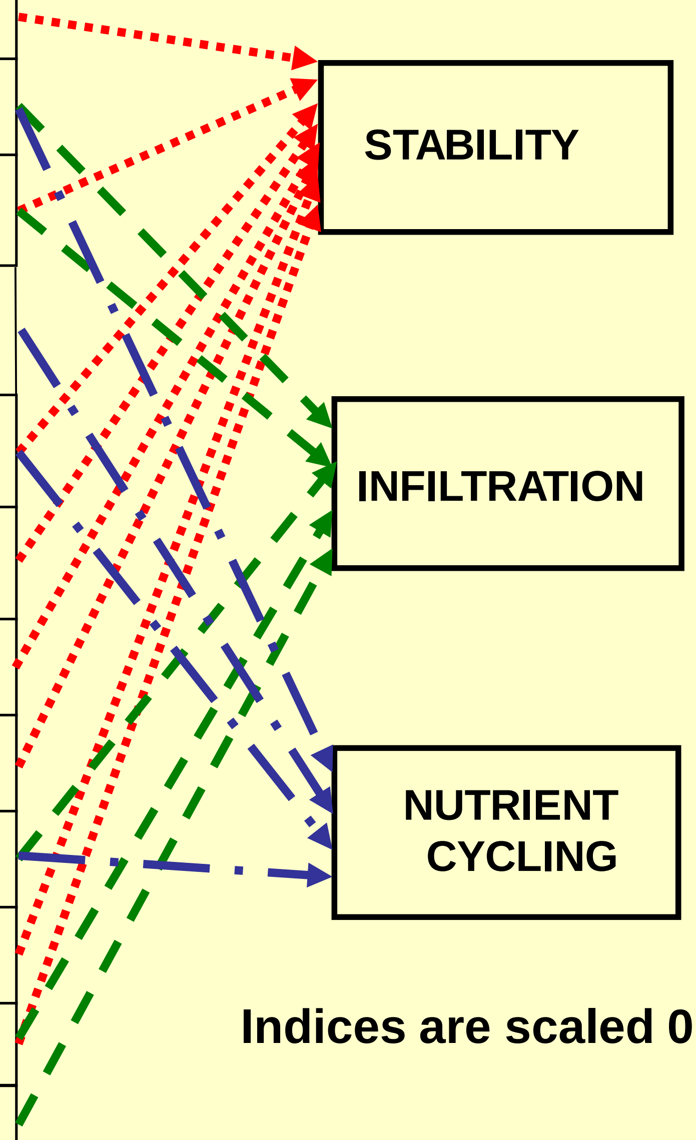
Each indicator is assigned a class value.

Indicator
1. Soil Cover
2. Basal cover of perennial grass
3a. Litter cover
3b. Litter cover, origin and degree of decomposition
4. Cryptogam cover
5. Crust broken-ness
6. Erosion type & Severity
7. Deposited materials
8. Microtopography
9. Surface resistance to disturb.
10. Slake test
11. Soil texture

Emergent soil surface Indices



Indices are scaled 0-100

Grassland with sufficient plant density to prevent overland flow from mobilising and transporting grassy litter.
Very little bare, crusted soil
No gravel lag
Litter is evenly spread

A ”critical spacing” could be devised to inform management decisions

Stab.= 69.1

Infil. = 39.8

N/C = 31.7

Friable, open-fabric soil a perennial grassland A horizon:

Patchy, short perennial grassland, beyond the critical threshold

Site values

Stab.=48.9

Infil.= 21.0

N/C = 14.7

Stab.= 43.3

Infil.= 24.0

N/C= 11.5

Bare, crusted, compacted A horizon: no visible biopores

Making practical use of the monitoring information

4 questions.

- What do the indicator numbers mean?
- In view of the "continuum" concept of landscape function, what is the shape of the response?
- Can critical thresholds or target values be discerned in the data?
- What are the consequences for management?

1.Function/dysfunction along a landscape use gradient.   Rangelands: 20 m from water

150 m from water

1 km from water

4 km from water

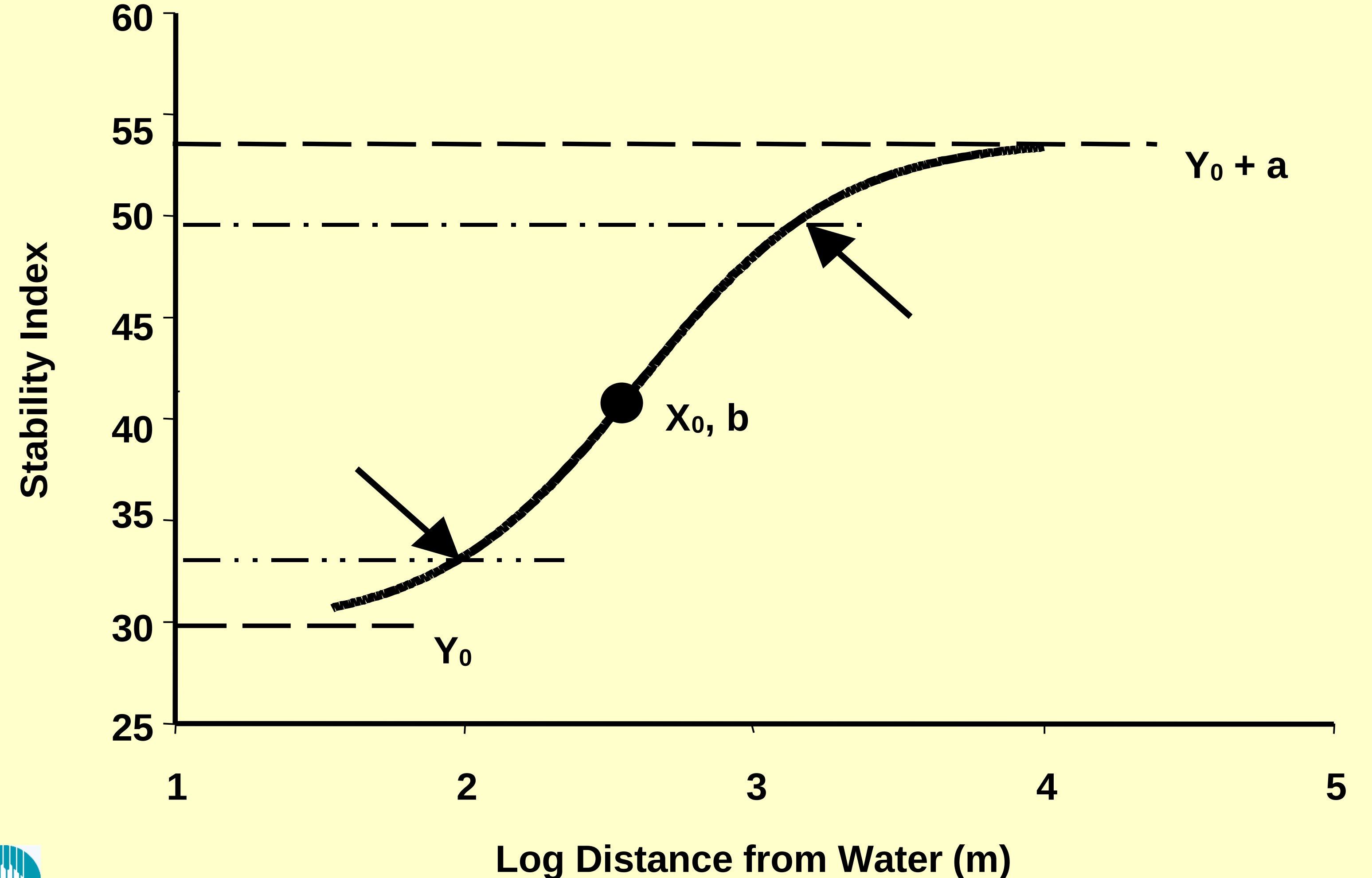
10 km from water

- **We propose an “S” shaped response curve to represent the function/dysfunction continuum.**

- **This curve type recognises a “dysfunctional state” and a state representing the “biogeochemical ceiling” of a landscape type (limited by parent material and climate)**

- **The rate of change between these extremes is an important response to assess, whether degradation or rehabilitation is the aim.**

Interpretational framework



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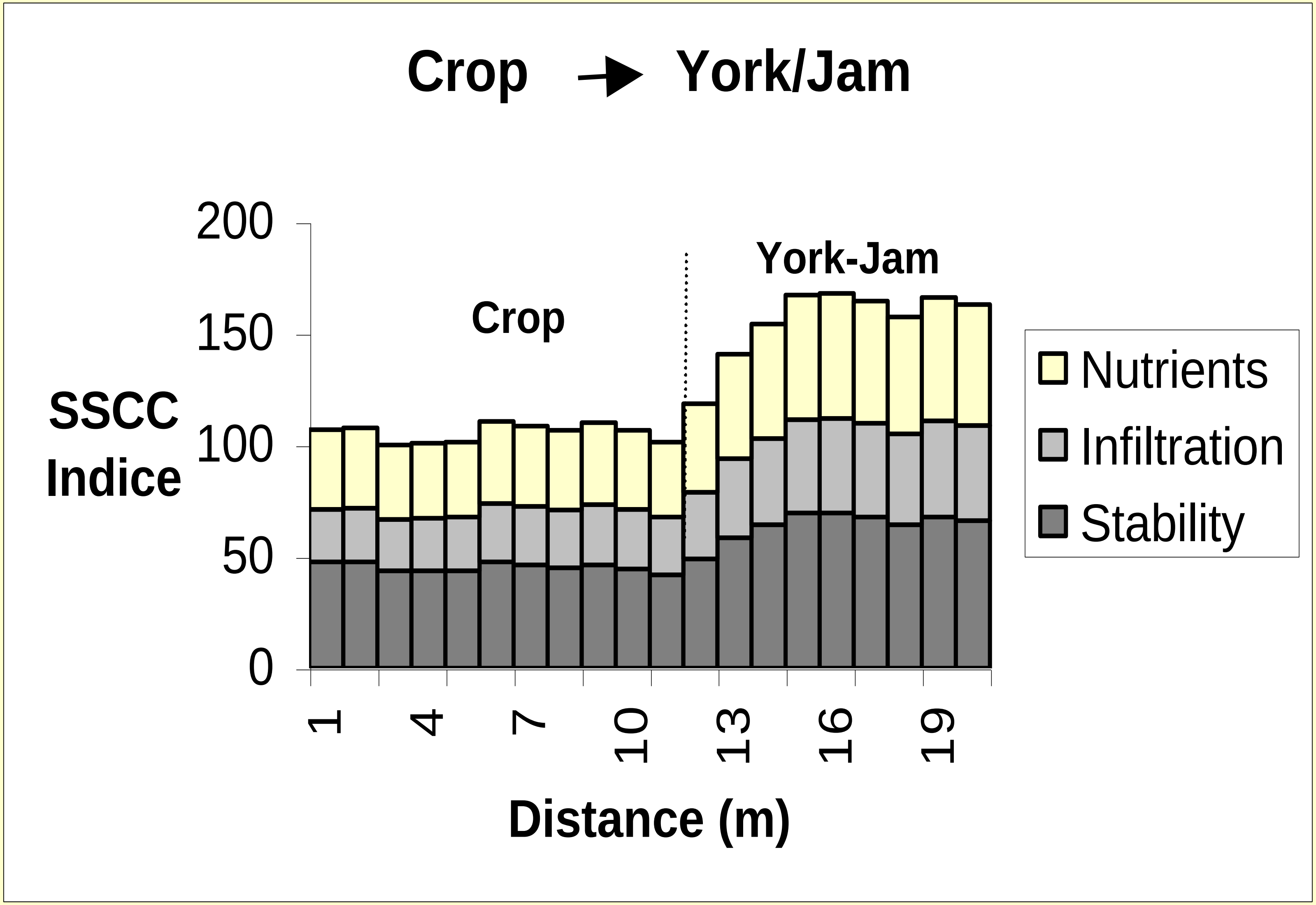
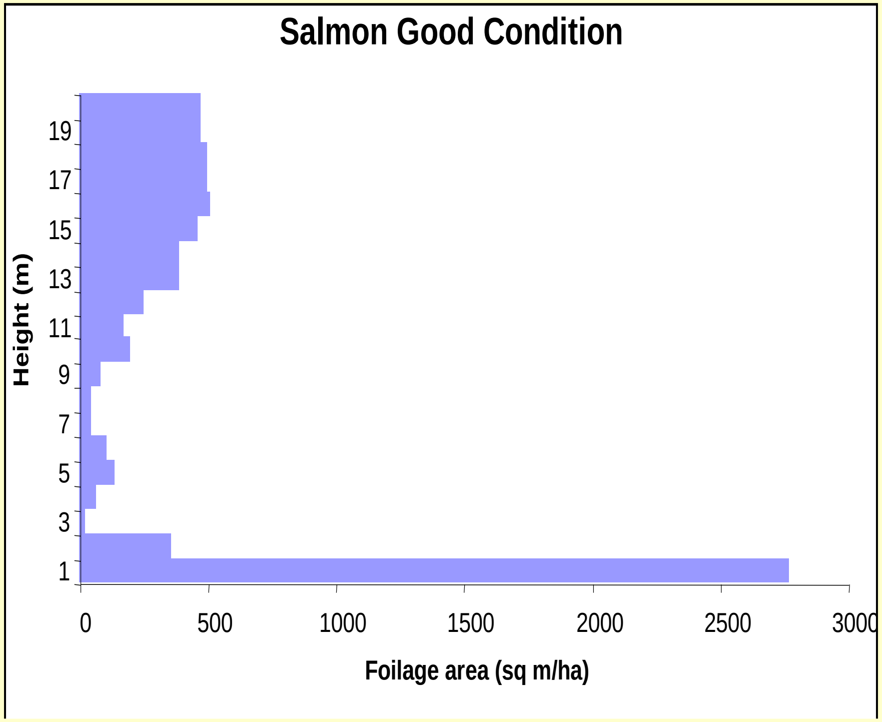
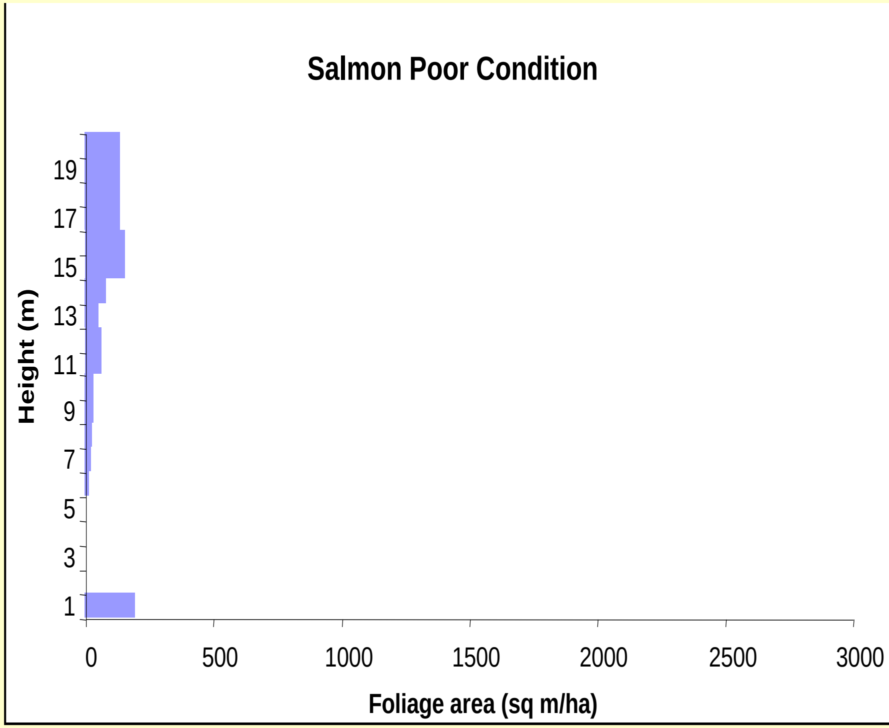
3. Assessing the effects of agricultural practices on woodland remnants: "crop to remnant" investigations; need for a "buffer".



LFA index changed rapidly across the fenceline between a conventionally cropped paddock and a protected woodland remnant. In this case, no buffer is needed, and LFA provides the objective evidence.

4. Assessing the functional role of vegetation structure





Salmon Poor Condition
Height (m)
19
17
15
13
11
9
7
5
3
1
0
500
1000
1500
2000
2500
3000
Foliage area (sq m/ha)

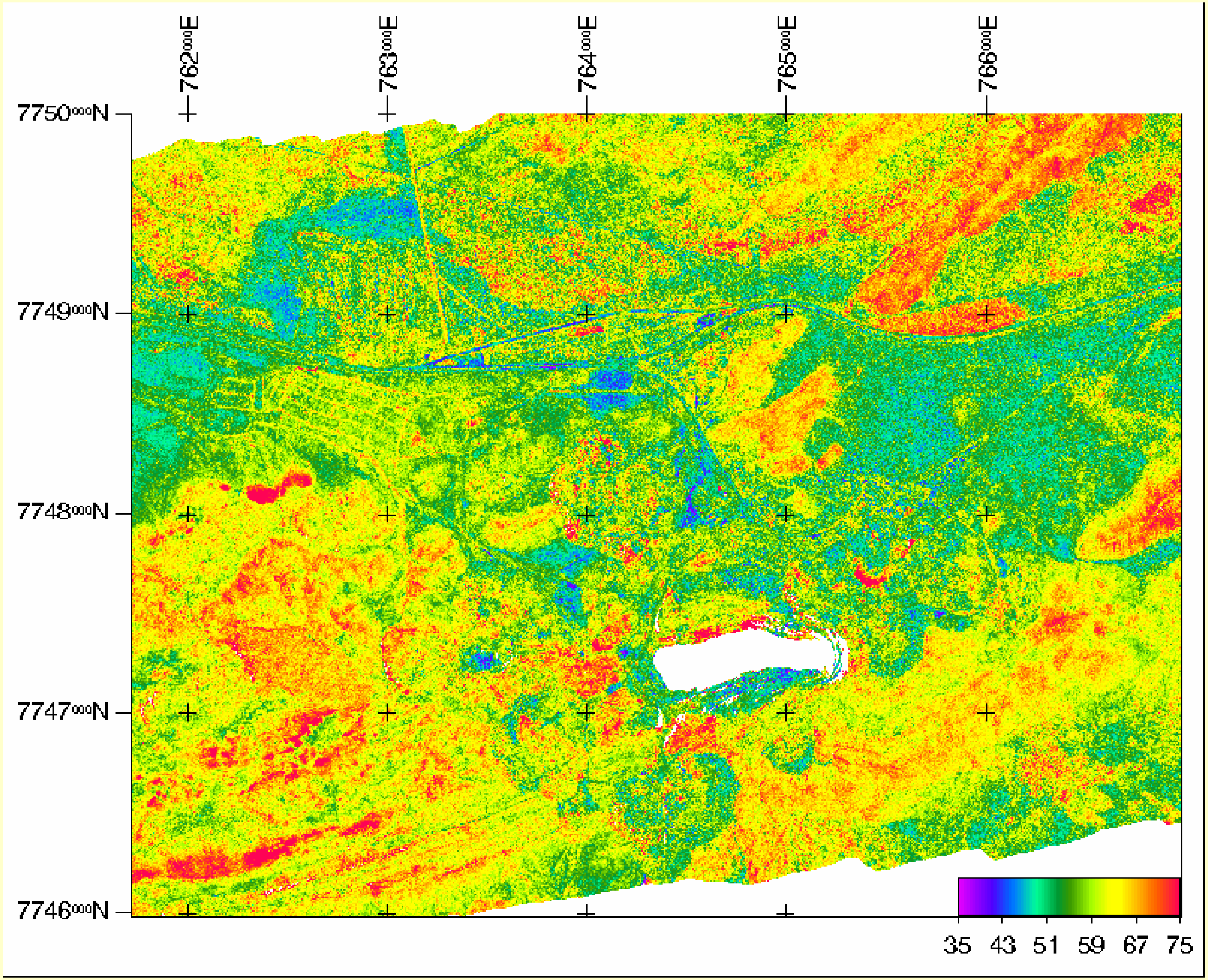


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Image is about 6 km by 4 km

5. Links to remote sensing. Distribution of the LFA stability index by calibrated hyperspectral remote sensing

Summary

- LFA treats landscapes as systems
- Assessment is based on many disciplines that have been integrated for the purpose of monitoring.
- Cross-scale issues directly addressed
- Can be used by a wide range of practitioners
- Contains an integral interpretational module.
- Identifies critical thresholds and targets
- Can trigger appropriate management action. eg suggest/provide appropriate restoration methods