Pastoral patching

In Australia's arid and semi-arid rangelands, patchiness and healthy landscapes go hand in hand. Patches of trees, grasses and litter conserve scarce water and nutrients, preventing their escape to creeks. When patches fall apart, a 'leaky' system results: vital resources are not trapped, the landscape becomes dysfunctional, and livestock production declines.

The critical importance of landscape patchiness emerged during a 10-year study of grazing impacts at the pastoral property Lake Mere in western New South Wales. The study, by CSIRO's Division of Wildlife and Ecology, found that arid and semi-arid landscapes behave in predictable ways to conserve scarce resources. An explanation of this behaviour is presented in *Landscape Ecology Function and Management: Principles from Australian Rangelands*.

Dr David Freudenberger is a co-author of the book and a member of the CSIRO study team. He says a framework developed and tested during the study offers graziers a new way of judging how the land is responding to limited water and soil nutrients, and how it can be improved. Understanding these factors is central to sustainable pastoral management.

'It's a universal framework for rainfall-driven landscape systems,' Freudenberger says. 'We've applied it to grazing lands in north and central Australia, to eroded landscapes in south-west United States, to land grazed by elephants in southern Africa, and even in Iceland.'

The framework has four main parts: trigger, transfer, reserve and pulse.

Trigger: In arid and semi-arid landscapes, many plants, animals and microorganisms are simply waiting for the big event: the trigger of rainfall.

Transfer: Water and wind transfer materials horizontally across the landscape. Run-off can be a prime cause of degradation in the rangelands because most soils have low infiltration rates and sparse vegetation cover.

Reserve: Vegetation patches capture soil and litter materials carried by wind and water. In semi-arid landscapes every patch, from large tree groves to small grass tussocks, functions as a bank from which water and nutrient resources can be withdrawn by organisms of all kinds.

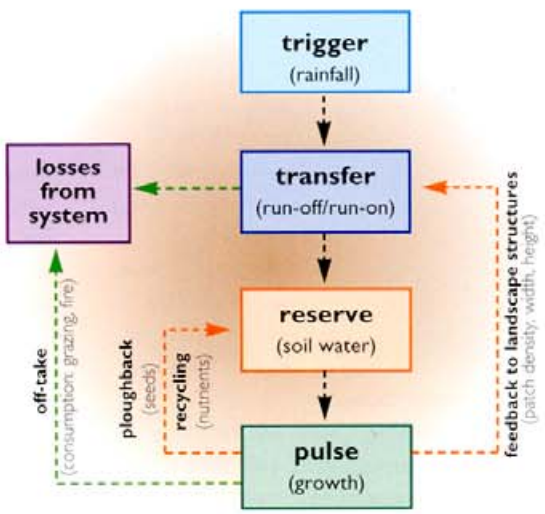
Pulse: To respond to rainfall and produce a pulse, plants and animals need adequate water and nutrients in landscape reserves. The size of the pulse depends on the size of the trigger and reserve.

The trigger, transfer, reserve and pulse processes are linked by ploughbacks and feedbacks. Production pulses plough back resources such as seed banks and plant litter, which is recycled into the soil organic carbon and nutrient pools. Litter breakdown is facilitated by a pulse in soil microorganisms. Plants established after a production pulse feed back to the patch itself by influencing how water and nutrients are transferred. For example, a higher density of grass tussocks in a patch enhances its ability to trap resources.

Out-flows and off-takes – the processes by which resources are lost from the system – form the final part of the landscape function framework. Outflows occur when the rate of run-off exceeds the trapping and storage capacity of landscape patches. This run-off is lost to creeks, rivers or lakes. Off-take occurs when consumers, such as livestock, are harvested.

The fundamental ecological cost of pastoralism is the breakdown in self-maintenance of rangeland landscapes caused by excessive total grazing pressure

The trigger-transfer-reserve-pulse framework



at the wrong times and places. In fully functional landscapes, water from a rainfall trigger is transferred to a variety of landscape reserves or patches. If this store of soil-water exceeds a threshold, a production pulse occurs, resulting in feedbacks and ploughbacks and, in grazing lands, cumulative off-takes. Dysfunctional or 'leaky' landscapes are less productive, and potentially less biologically diverse.

Obvious signs of dysfunctional landscapes are extensive bare soil, severe erosion and dead or dying trees. A procedure enabling rangeland managers to recognise less obvious signs of dysfunction is outlined in *Landscape Ecology*. It involves recording the size and location of vegetation patches along a sloping transect and comparing the measurements with those for more functional landscapes of the same type. Monitoring the transect over time can suggest a trend.

Maintaining landscape function requires balancing two competing processes: off-take and feedbacks. If most of the pulse is grazed away, little is left for feedbacks to

Smart moves planned for clean commuters

BUSES that are summoned to a bus stop on demand, take detours to avoid traffic snarls, get preferential treatment at traffic lights and deliver you to your door late at night sound like a commuter's dream. But current research will make this a reality within a decade, according to Dr John Smith who heads the Intelligent Transport Systems Project at CSIRO Mathematical and Information Sciences at Canberra.

It's part of a plan to get city people out of polluting cars and onto public transport. 'Only by making public transport more accessible and flexible will it start to be an attractive alternative to the private car,' Smith says.

The scheme will make available a range of new demand-responsive services, including buses, car pools and multiple-hire taxi fleets, to complement existing bus, rail and taxi services. The entire public transport system will be designed as an integrated network of readily accessible links, 24 hours a day.

'People think in terms of a daily schedule,' Smith says. 'And if there's one link in that schedule that can't be readily serviced by public transport, the immediate fall-back is to use the car for the whole day. I see this as a nexus that I aim to break.'

The system will be all high-tech with journeys planned and booked from home or the office via the Internet, or on touch screens at bus stops. Information accessed will include up-to-the-minute route choice advice, plus costs and travel times of services available. The commuter books the preferred option and pays by credit card, smart card or electronic purse.

The versatile, demand-responsive vehicles will have flexible routes, make detours to avoid traffic congestion, and pick up passengers when summoned from a remote stop. Late night passengers can request to be dropped off at their door.

These vehicles will be tracked by sophisticated communications, including satellite, so that a traveller can be collected by the nearest vehicle. Because the vehicles can be precisely located in the traffic network, traffic lights can be changed in their favour to minimise travel times.

'The patterns of the private car make it the most inefficient form of mechanised transport that has ever been invented,' Smith says. 'If urban problems of congestion and pollution are to be treated effectively, then these sorts of measures must be implemented.'

Prototypes of the service have been simulated for the NSW Road Transport Authority, the WA Department of Transport and on the Gold Coast. Field trials of new CSIRO technology for automatic vehicle location and dispatching will be conducted during 1998.

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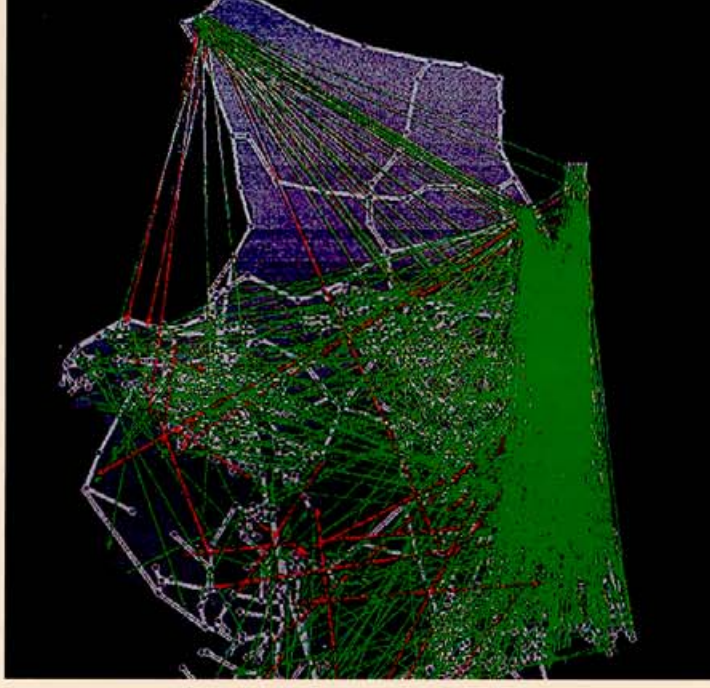
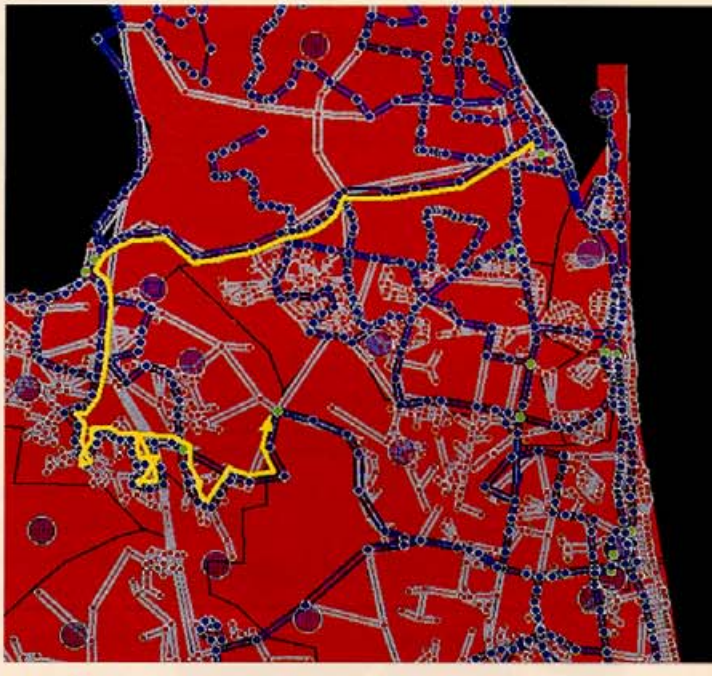


Travel requests received by the transport scheduler. Each request is shown as an arrow from origin to destination. The green ones are the successful requests, the red are unsuccessful. 'Successful' means a journey is planned that satisfies the travellers requirements.



The itinerary of a single public transport vehicle. The path traced already is shown in blue, the future path is ochre, and the current leg is shown in green. The vehicle itself is blue. Pickups and setdowns are coloured discs.

maintain landscape patch structures, or to rebuild reserves. This could lead to a decline in how well the landscape conserves water following the next rainfall trigger. Less off-take will tip the balance in the favour of the ploughback and recycling of nutrients to increase patch size and density. Consumption and off-take can be greater in landscapes in good condition (high degree of patchiness). In dysfunctional landscapes, consumption and off-take must be restricted.

Rangeland managers can influence the size of a production pulse resulting from a rainfall trigger by setting the number of animals consuming the pulse, and for how long they are allowed to do so. This includes managing the population sizes of feral and native grazing animals such as goats, rabbits and kangaroos.

Landscape Ecology Function and Management: Principles from Australian Rangelands *is for Aboriginal land holders, public land administrators and policy makers, pastoralists and Landcare groups, the military and the mining and tourist industries. It costs $59.95 and is available from CSIRO Publishing, free call 1800 626 420, fax (03) 9662 7555, email: sales@publish.csiro.au*