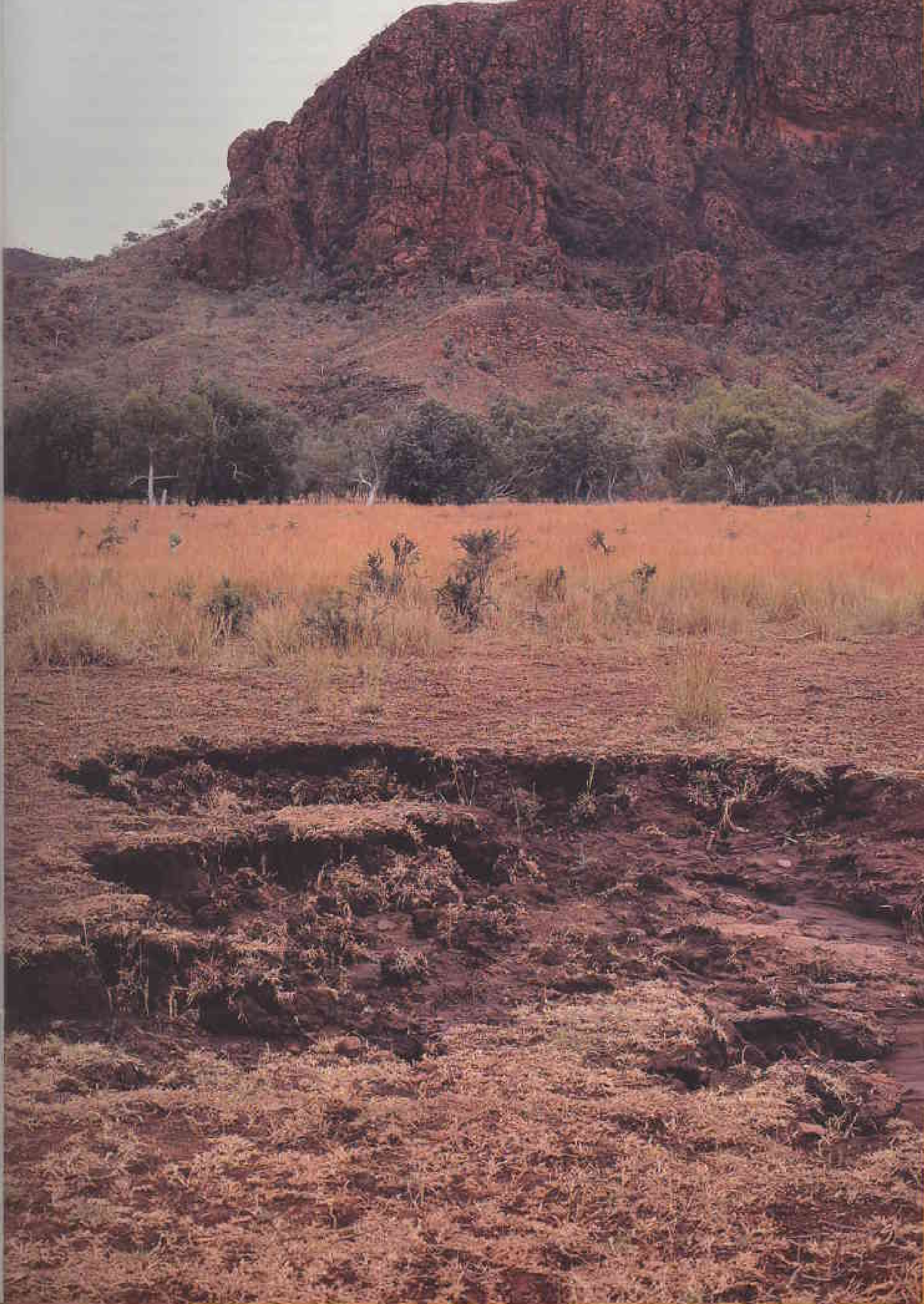
WATCHING THE GRASS GROW

BY GRAEME BEHN, CHRIS DONE AND ADRIAN ALLEN

The vegetation of Western Australia's north-west has suffered significant degradation since pastoralists sought the lush grasslands for stock grazing in the late 18th century. During the past 30 years people have begun to realise the extensive damage, grazing and wild cattle have had on the Kimberley's ecosystem and a number of steps have been taken to promote and foster grassland regeneration. Through the use of latest technology and satellite imagery the success of regeneration programs can now be measured.



Australia is an ancient continent. The entire history of the planet is encoded into its geological features—to the fascination of earth scientists and lay people the world over. Perhaps more than any other region, the Kimberley evokes a mood of mystery and timelessness, whispered secrets of patient evolving forces stretching for an eternity into the past. Yet barely more than a century ago, the merest drop in a bucket of geological time, the introduction of cattle onto its fragile grasslands was to wreak devastating damage, leading in the last ten years to intensive rehabilitation efforts. Now, in a still more ironic juxtaposition of the old and the new, the latest state-of-the-art technology—remote sensing using satellite images—is enabling land carers to monitor the progress of their work as never before.

THE EARLY STAMPEDE

Explorer Alexander Forrest's account of his journey from the De Grey River to Port Darwin, in 1879, inspired many pioneering pastoralists to take up vast areas of grasslands in the harsh dry climate of the south-east Kimberley. First to arrive was Nat Buchanan who staked his claim at the junction of Forrest Creek and the Ord River in 1884. With around 4 000 head of cattle owned by partners William Osmand, a mine owner from Stawell, Victoria, and Joseph Panton, a Melbourne magistrate, Nat Buchanan established the well known Ord River Station. Not far behind were the McDonalds, who bought Fossil Downs Station on the Fitzroy River and whose descendants still own and run the station today. The Durack family—well known for its long association with stations in the east Kimberley area—soon followed. As more and more pastoralists sought land, cattle numbers increased rapidly, particularly on the lush pastures of the Ord River. It took only 20 years for Ord River Station alone to reach around 80 000 to 100 000 cattle.

These pastures had previously evolved under much gentler pressure from typical Australian grazers such as kangaroos, wallabies and the grazing termites. The effects of the much harsher grazing cattle on the Ord frontage country were disastrous, as vast areas began to erode at an alarming rate. By 1967, the growing degradation had prompted the Western Australian Government to recover several grazing leases in the area. This enabled rehabilitation measures to begin so that the then new Ord River Irrigation Scheme would be less threatened by massive silting.

On the eastern side of the Ord, measures were taken to reduce stock numbers, and extensive fencing was constructed to control the remaining cattle. A great deal of work was also done to foster the re-establishment of grasses by ripping hardpan areas and seeding with pasture species. On the western side, however, no measures were undertaken to control cattle grazing until the mid-eighties, when commercial mustering and shooting from helicopters removed some 25 000 head of cattle and 4 000 feral donkeys. Some small areas of grass were ripped up to allow water penetration, but most of the eroded areas were allowed to regenerate without any ripping or seeding.

Since the area was declared the Purnululu National Park and Conservation Reserve in March 1987, the Department of Conservation and Land Management (CALM) has undertaken feral donkey and cattle control, keeping numbers to a minimum in the park. As a direct result of the removal of these hard-hoofed grazers, regeneration of grassland has been spectacular in some areas.

REMOTE SENSING

When the technology became available to them, scientists at CALM decided to use remote sensing to monitor the land management programs in Purnululu National Park.

Remote sensing is a means of collecting and interpreting information using a much broader range of the electromagnetic spectrum than that of visible light (black and white or colour photography). Using multi-spectral scanners (a particular type of remote sensing device that senses radiation in multiple wavelength regions of the visible, near infra-red, middle infra-red and thermal infra-red regions of the electromagnetic spectrum), scientists can obtain a more detailed picture of a land area, and the changes that occur to it over time, than could be provided by any conventional photograph.

Different land cover features reflect the sun's energy in varying, and often characteristic, non-visible wavelengths (such as the infra-red). Consequently, satellite sensors capable of detecting these wavelengths provide added information, beyond the visible light spectrum, which help to identify an object or land cover feature.

Multi-spectral scanning devices digitally record the reflected energy in a number of defined wavelength 'channels' or 'bands'. The principle is the same as using filters on a camera to photograph limited parts of the visible spectrum.

The information representing a predetermined area of the ground is composed of discrete picture elements,

Previous page
Gully heads eating back into areas where vegetation was largely destroyed by overgrazing. Removal of the heavy grazing pressure has allowed regeneration to occur and stability to be restored to many areas.

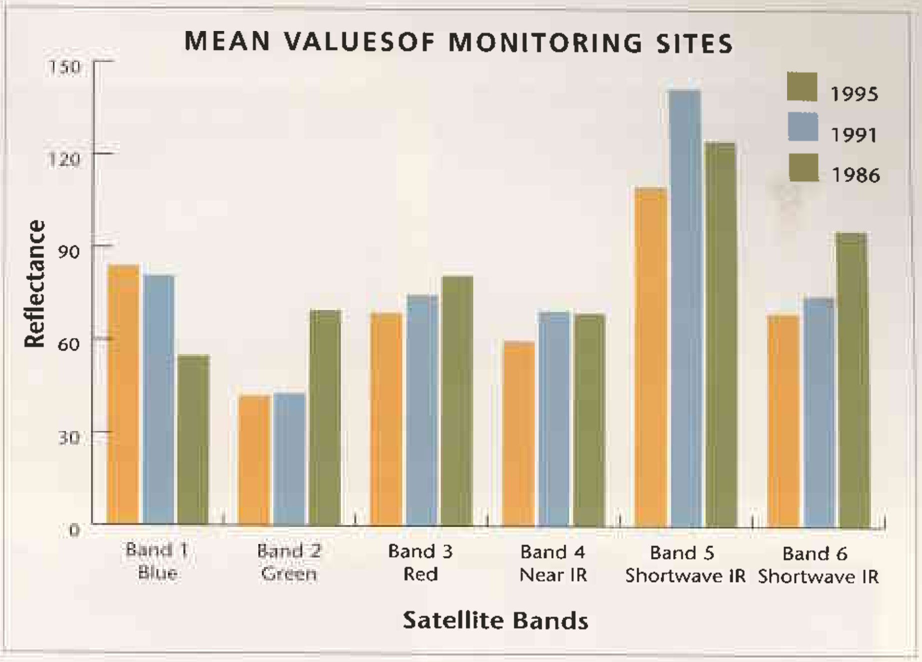
Below: Regeneration in this area near the Blue Holes cattle yards was aided by ripping the soil to allow easier penetration of water and lodgement of windblown seed.
Photos – Chris Done

or pixels. These are arranged into discrete brightness levels and are allocated a number between one and 255. Low numbers are associated with dark targets (for example, shadows) while high numbers are associated with bright targets (for example, white sands).

DETECTING THE CHANGES

In this way, remotely-sensed data can be used as a tool to detect, monitor and evaluate changes in ecosystems, and to develop future management strategies. Its big advantage over traditional ground-based monitoring is that it provides the time sequence, the required coverage and the ground resolution needed for accurate assessment of management programs such as grass regeneration. Because satellites pass over specific areas time after time, the land in those areas can be viewed regularly and images taken to assess changes in vegetation levels.

These 'change detection' techniques were used to detect grass regeneration in the park between 1986 and 1995. The use of carefully processed historical satellite imagery enabled grass areas to be identified, giving a clear idea where vegetation cover had changed or had stablised over time.



Above: About 25 000 head of cattle and 4 000 donkeys have been removed from the park since 1985.
Photo – Chris Done

ANALYSING THE IMAGES

The images from 1986, 1991 and 1995 (on page 26) were co-registered and calibrated to each other, and the information required to highlight the grass growth over time was extracted from them. The Purnululu National Park boundary was superimposed on the images to aid visual inspection and locational reference.

From the location of the monitoring sites, it was possible to extract the digital spectral information, which indicated the condition of each site at the time the image was captured. Information about these sites was then analysed for each of the spectral bands from the three-date image sequence, and was correlated to the site data to identify variations that might suggest that grass-regeneration had occurred. Individual bands from both the visible and infra-red portions of the spectrum showed specific spectral trends that could be used to identify grass regeneration within the national park. These spectral trends, from the three dates, could then be applied to the whole image sequence to determine the regeneration of similar grass types.

The graph (above) clearly shows that the bands in the visible light portion of the spectrum (bands 2 and 3) and the short-wave infra-red (band 6) correspond well with the grass regeneration. The green part of the spectrum (band 2) indicates a similar increase to that of the red part of the spectrum (band 3). In broad terms, these increases can infer an increase in leaf pigment cover, but the significant spectral band is band 6. This band shows similar increases over the three image dates and represents a general increase in ground cover with less exposed soils.

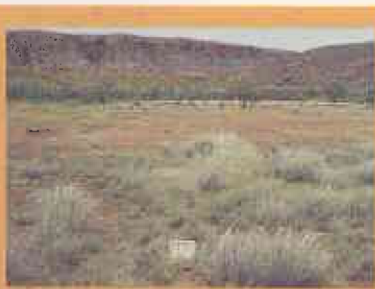
BACK ON THE GROUND

Several ground-based sites were also established within the grasslands to monitor the impact of grass regeneration after de-stocking. The program was principally based on the measurement of perennial vegetation on selected small sites that were visited each year. Although this ground-based site data is much more difficult to gather and monitor than the satellite information, it does provide tangible visible information with which to compare the satellite imagery.

WHERE NOW?

It will take more than a decade or two to mend the damage of more than a century of grazing. Regenerating grasses is not a finite project with a clear beginning and end. Like the slow evolution of a landscape itself, it is a continuous process. But this is a patient landscape. Satellite imaging and remote sensing enables us to watch the process unfold, moment by moment, and to marvel at both the technology of the toolkit and the awesome slow processes of nature to which it is being applied.

A) Bare ground from 1986

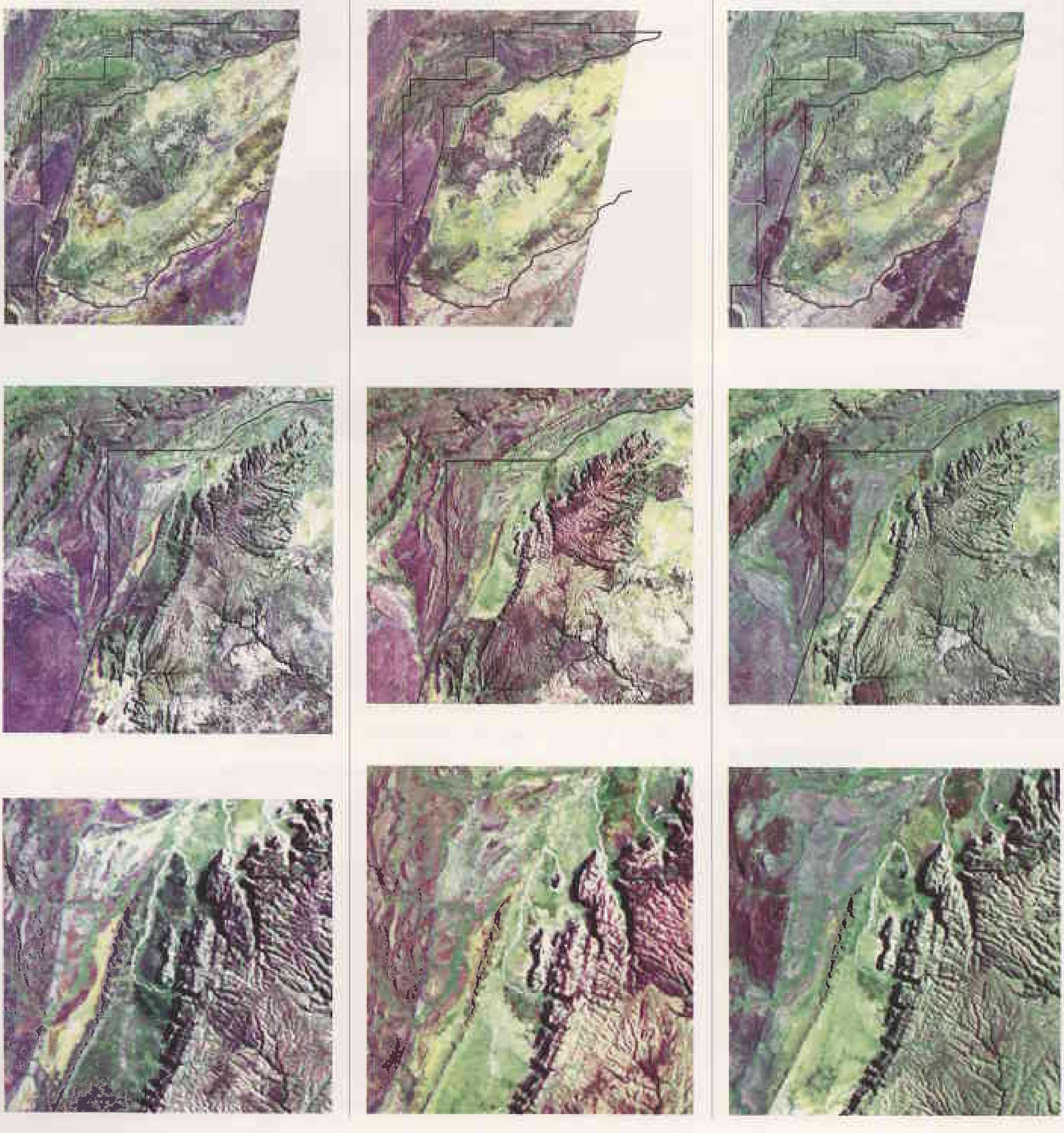


B) Partial grass regeneration 1990

C) Good grass recovery 1996

From the sequence of ground photography it is possible to show the grass regeneration achieved. Site data indicates the positive results of the de-stocking program within the park.

1986 | 1991 | 1995



Facing page: Imagery that covered the park was acquired during the dry seasons of 1986, 1991 and 1995. The imagery was co-registered and calibrated so that areas of change or modification to vegetation surface characteristics, over the nine-year time period, could be assessed.

Below: The final satellite image of the Purnululu National Park shows the application of the results. The increased grassland change (shown below in yellow) was overlaid onto the 1995 image to give the visual impact of the success of the regeneration program. The location and extent of grass regeneration along the river frontage is clearly evident. The area was then assessed for accuracy by field site inspection and from ground knowledge.

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LANDSCOPE

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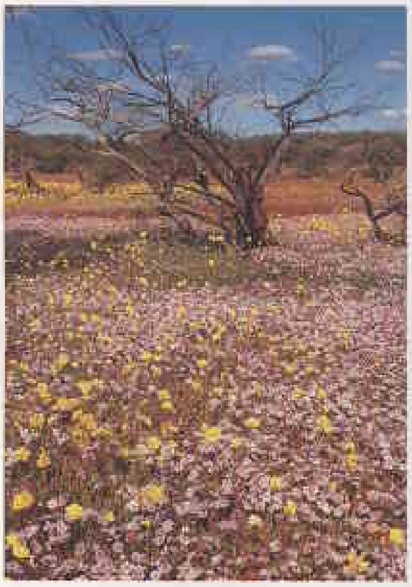
The waters off Western Australia's south coast are home to a rich diversity of marine plants and animals. Read about them on page 28.

Was it created by a meteorite crashing to Earth, or more slowly over time? Find about Curiosity Swamp on page 50.

Imagine a commercially-owned and managed sanctuary in the hills east of Perth and you have 'Karakamia Sanctuary'. Find out how it was created on page 17.



Burnerbinmah Station, in WA's Murchison Region, fills an important gap in the State's flora and fauna reserve system. See page 42.

The Western Blue Gum, a commercial variety of the Tasmanian bluegum, was developed for WA conditions, but tree breeders continue to improve the strain. See page 36.

F E A T U R E S

R E G U L A R S

C O V E R

Is the forest red-tailed black-cockatoo rare or just rarely seen? Find out the answer to these questions on page 10.

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