Landsat aids disease eradication

Mustering cattle with the help of satellites sounds an unlikely Orwellian mix of *Animal Farm* and *1984*. Yet Big Brother, alias the Landsat IV Satellite, is helping Australian agricultural experts pinpoint areas of the country hiding undetected diseased cattle.

Landsat imagery is one of the latest tools contributing to Australia's national bovine tuberculosis and brucellosis eradication campaign, which aims at ridding the country of both diseases by 1993.

Currently, one or other of these diseases infects 10% of our herds putting some 3·6 million cattle at risk of contamination. While this situation persists we may face trade embargoes being imposed by disease-free countries on imports of Australian beef. A testing and vaccination program is rapidly reducing the incidence of brucellosis, but bovine TB, which is largely restricted to the remote areas of northern Australia, will be harder to eradicate.

Current tests for TB require repeated monitoring of suspect herds; and, as no successful vaccine exists, infected animals have to be slaughtered.

The difficulty of mustering cattle for herd testing is the biggest obstacle facing the eradication program in northern Australia. In fact, the commercial viability and development potential of beef cattle properties in these areas depend largely on cattle-mustering costs.

In 1981, the Bureau of Animal Health, the Bureau of Agricultural Economics, and the then CSIRO Division of Land Use Research (now Water and Land Resources) initiated a project to determine the cost of completely eradicating bovine TB from northern Australia. Mr Leith Andrews of the BAH began by including questions about mustering in the BAE's annual grazing industry survey of pastoral areas of Western Australia, South Australia, Queensland, and the Northern Territory.

Mr Andrews asked graziers to grade the mustering difficulty of each area within their property boundaries into one of five categories — from 'easiest' to 'impossible' — and then estimate costs of mustering cattle within each category. Their estimates ranged from $2.20 per head in 'easy to muster' country, through $13.40 per head in 'moderately difficult' country, up to more than $180 per head for a complete muster of the most difficult.

The graziers reported that, because of the high cost of rounding up scattered individual animals there, they left unmustered about 25% of the stock in the most difficult areas. Using these data, Mr Andrews guessed the cost in 1981 of one complete muster of the 5 million cattle in northern Australia to be about $30 million; since eradication requires repeated testing and monitoring, many more musters need to be carried out.

Dr Peter Laut of CSIRO took on the job of estimating how much of the northern cattle country fits into each category of mustering difficulty. He examined the range of landscape types, and their extent and approximate distribution, so that the BAH could accurately estimate the costs involved in a clean (100%) muster.

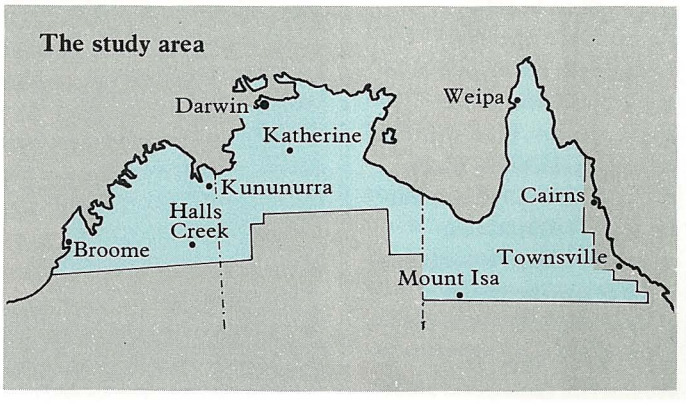
His study area extended to cattle stations in the rugged country further north than that surveyed by Mr Andrews. It included such places as the fortress-like Kimberleys of northern Western Australia and the tall grasslands of the Northern Territory inhabited by water buffalo (potential TB carriers).

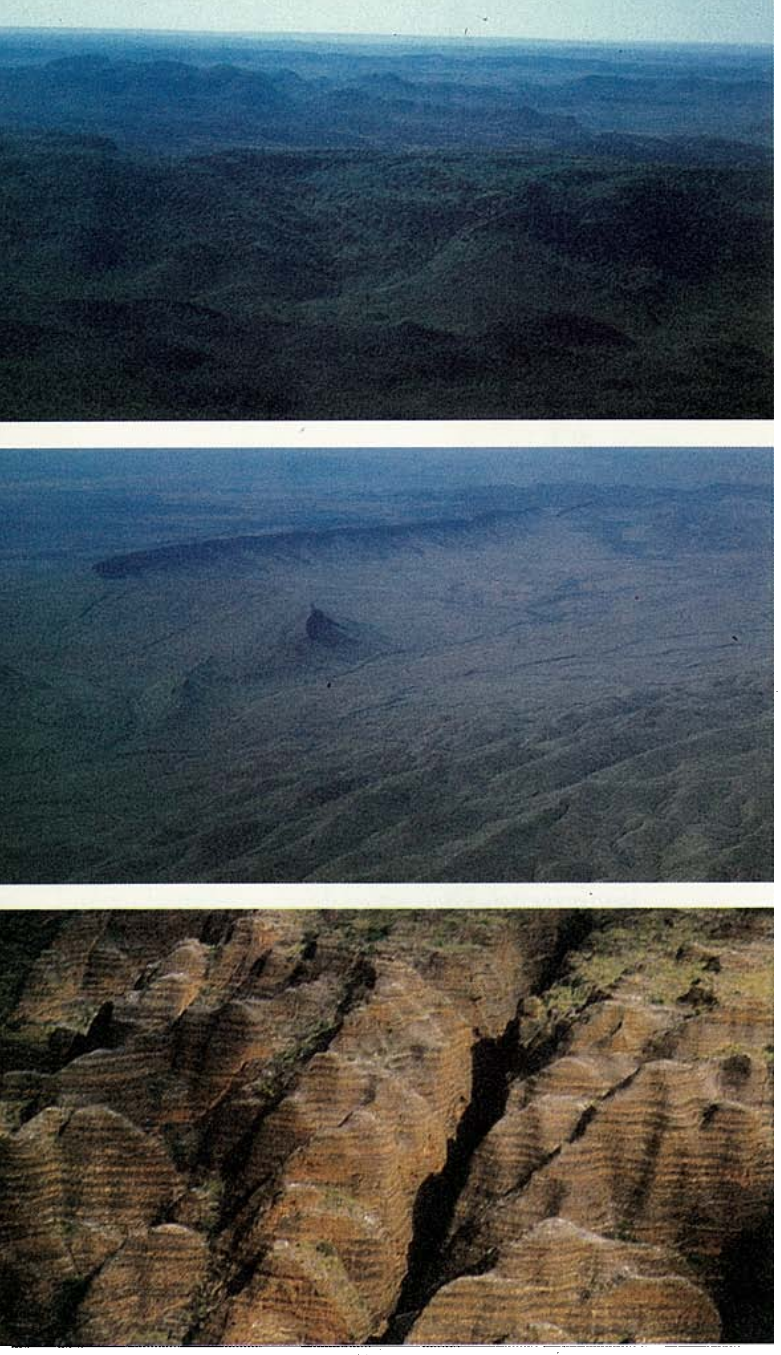
Moreover, it fell entirely within Australia's 'Big Wet' region. Here, summer floods hinder vehicle and stock movement. The rugged landscape also makes movement difficult in some areas, and can make cattle hard to find. As well as the Kimberleys and the grasslands and flood-plains of the Northern Territory, particularly difficult regions are the plateaux and ranges of the Victoria River basin and western Arnhem Land, N.T., and the northern portions of the Eastern Highlands, Qld.

Obviously, some tropical vegetation types, such as woodland shrubs and trees and tall grasses, will restrict movement and provide hiding places for stock.

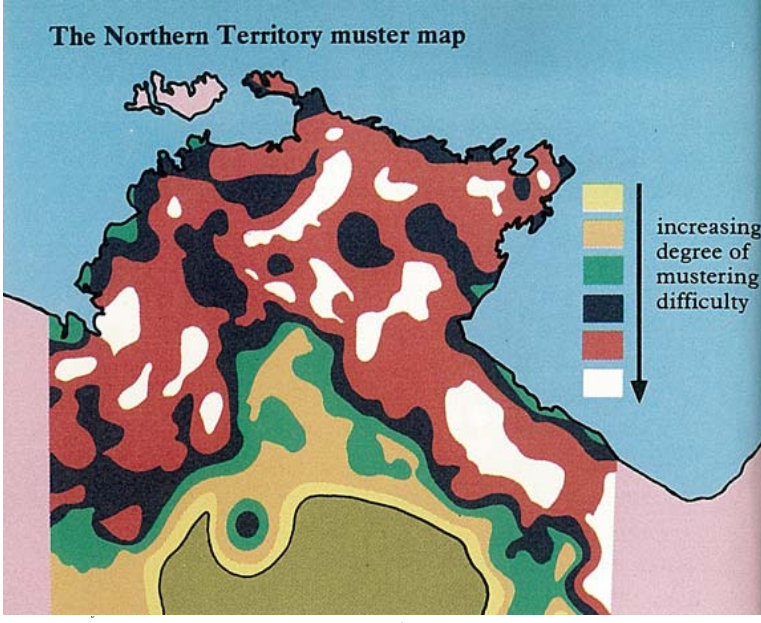
Dr Laut's discussions with graziers indicated that surface rockiness and the availability of plentiful watering points imposed added difficulties to mustering. In fact, the stock-watering situation emerged as the most important factor in determining mustering costs; then came land forms, vegetation cover, and rockiness.

Dr Laut gathered data on these four landscape components from previously published material. He obtained data on land forms and water features from a 1 : 100 000 topographic map series, and those on soil and rock types from a 1 : 250 000 map series. The vegetation information came from four sources — the 1 : 100 000 topographic map series, CSIRO *Land Systems Reports*, the *Atlas of Australian Resources*





Cattle country between Kununurra and Halls Creek: near Halls Creek (top), Maple Downs Cattle Station (middle), and the Bungles near Lake Argyle (bottom).



A simplified picture of the results of the study for the Northern Territory.

(containing maps on a scale of 1 : 6 million), and Landsat images.

Dr Laut used the 1 : 500 000 Landsat images to identify six types of vegetation in the study area. Deep red indicated closed-forest species; orange-red, eucalypts; blue- or purple-black, other forest species; blue-white to yellow, grasslands; black, burnt areas; and intermediate tones or mixtures, open and closed woodlands.

To relate the broad picture obtained from the maps and images to the ground reality, he selected 1805 sites for detailed examination, using a sampling technique that took account of the relative areas each of the major land types covered.

Each sample comprised a 4-sq.-km 'inner cell' and a 100-sq.-km 'context cell'. Examination of the larger cell showed whether the inner one, studied in detail, was typical of the surrounding area. As Dr Laut points out, a small grassed plain dominating a 4-sq.-km grid cell may be ignored in mustering if it is obscured from the ground by forested steep hills occurring in the surrounding 100 sq. km.

Linking the previously published map data with corresponding Landsat images, Dr Laut estimated what proportions of each 4-sq.-km and 100-sq.-km cell were 'easy to muster', 'difficult', etc. in terms of vegetative cover using eight classes of increasing 'weight'. He applied the ranking to each sample cell by multiplying the proportion of it under each form of cover by that ranking and totalling the subsequent values.

This ranking was also carried out for land forms, water features, and rockiness. The map shows the combined results for both inner and outer cells.

The Bureau of Animal Health will use Dr Laut's results to develop a more accurate estimate of the cost of the mustering required to complete the TB eradication program. In areas where mustering would be too costly, 'search and destroy' operations, using helicopter-borne marksmen, will probably have to be implemented.

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Landsat images as tools for livestock disease control in northern Australia. P. Laut. *Papers, Workshop on Use of Remote Sensing in Tropical Environments, Montreal, August 1983.*

Selected Papers, Australian Bureau of Animal Health, Working Party on the Brucellosis and Tuberculosis Eradication Campaign (BTEC) in Northern Areas, Canberra, December 1982.