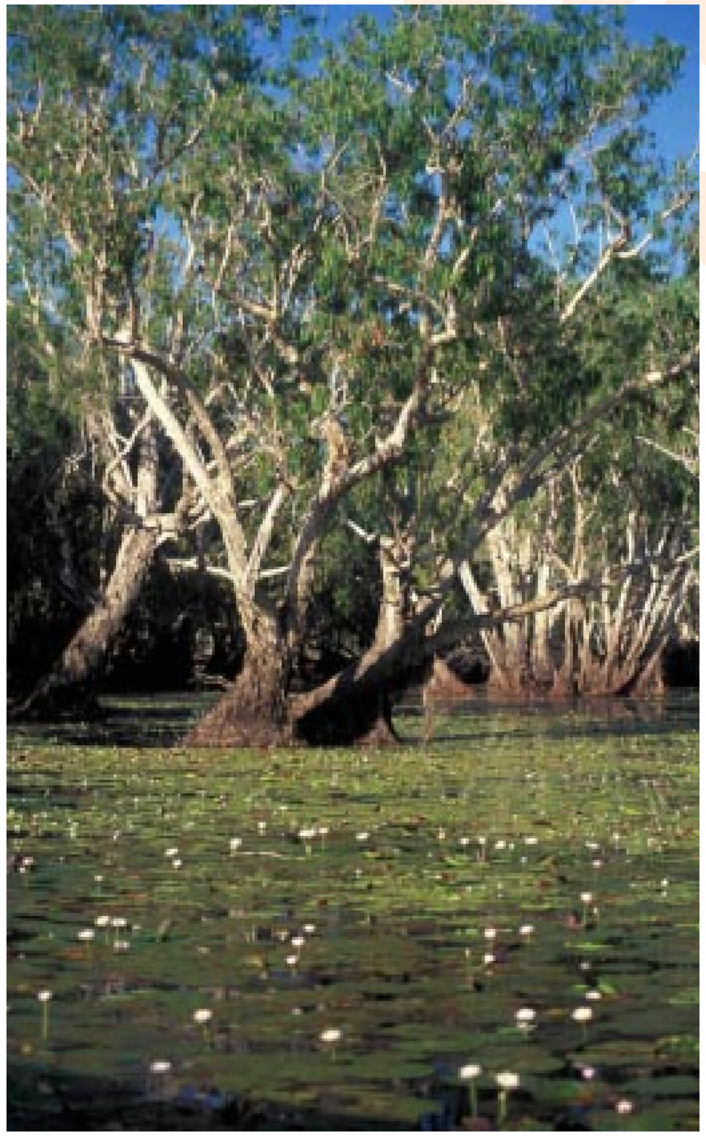
# Assessing density and distribution change in paperbark trees on the Magela floodplain in Kakadu using Geographic Information Systems (GIS)

As part of a wider study that will help distinguish between the causes of any environmental impacts in the Alligator Rivers Region, including Kakadu National Park, we investigated the biophysical characteristics of the Magela catchment downstream of the Ranger and Jabiluka uranium mines in the Northern Territory of Australia.

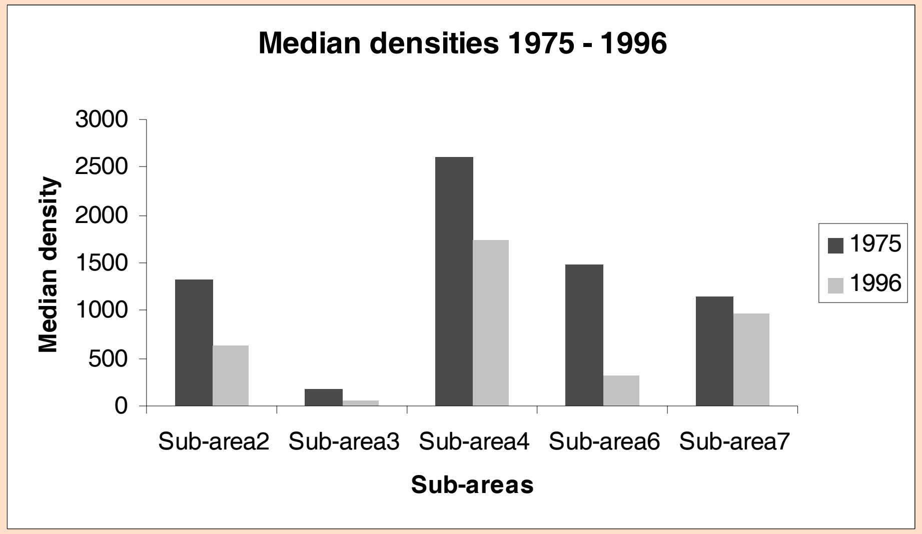
We used GIS technology to collate, integrate and analyse aerial photographs from 1975 and 1996, to determine if there has been a change in the density and distribution of paperbark trees on a section of the Magela floodplain. The application of GIS technology enabled the project to be undertaken as a desk top study over a short period.



*Changes in water levels in the paperbark swamps at Yellow Water during the early and late Dry season*

## Paperbarks as environmental indicators

This project began after concern was raised that woody vegetation communities, in this case paperbark trees from the genus Melaleuca, may displace herbaceous vegetation on the tropical wetlands of northern Australia. As wetland habitats are recognised as being integral to the ecological and socio-economic health of a region, changes to the health or condition of a wetland area may be used to indicate broader changes underway in the environment. Such changes include impacts due to mining, grazing, invasive species or sea level rise and climate change. Kakadu contains wetlands that are recognised as being of international significance, as demonstrated by their inclusion on the Ramsar list of Wetlands of International Importance, and the inclusion of the Park in its entirety as a World Heritage Area.




*Variations in median densities of paperbark in component sub-areas of the study area 1975–1996*

experiencing a greater decrease than others, and in one instance, an increase.

Though there was a decrease in tree density across the study area, the extent and distribution of this decrease was variable. Conversely, there was an increase in the distribution of paperbark across the floodplain in the intervening period.

## The bigger picture

Whilst the results have demonstrated that changes have occurred in the section of the Magela floodplain investigated, it is not possible to extrapolate these results to other parts of the floodplain. We have shown, however, that it is possible to rapidly assess changes in paperbark distribution on the floodplain. Further analysis incorporating GIS and remote sensing is required to determine the extent of the change across the remainder of the floodplain, or indeed, other floodplains.

The current results are being used as part of a broader study into environmental change in the region and how these relate to mining and other activities, and the relative importance of each separately and cumulatively. This approach is in line with current international approaches to environmental assessment and management. In doing this work, we have also demonstrated that remote sensing and GIS techniques can be used for quick and cost-effective assessment of change on floodplain environments.

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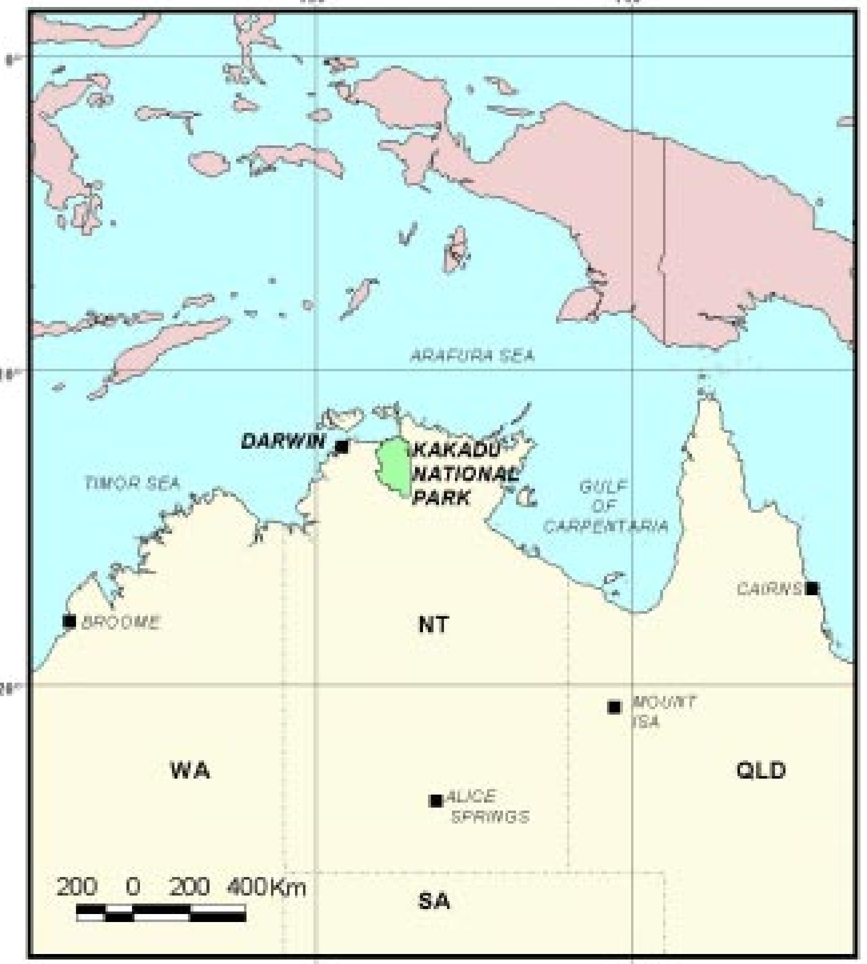
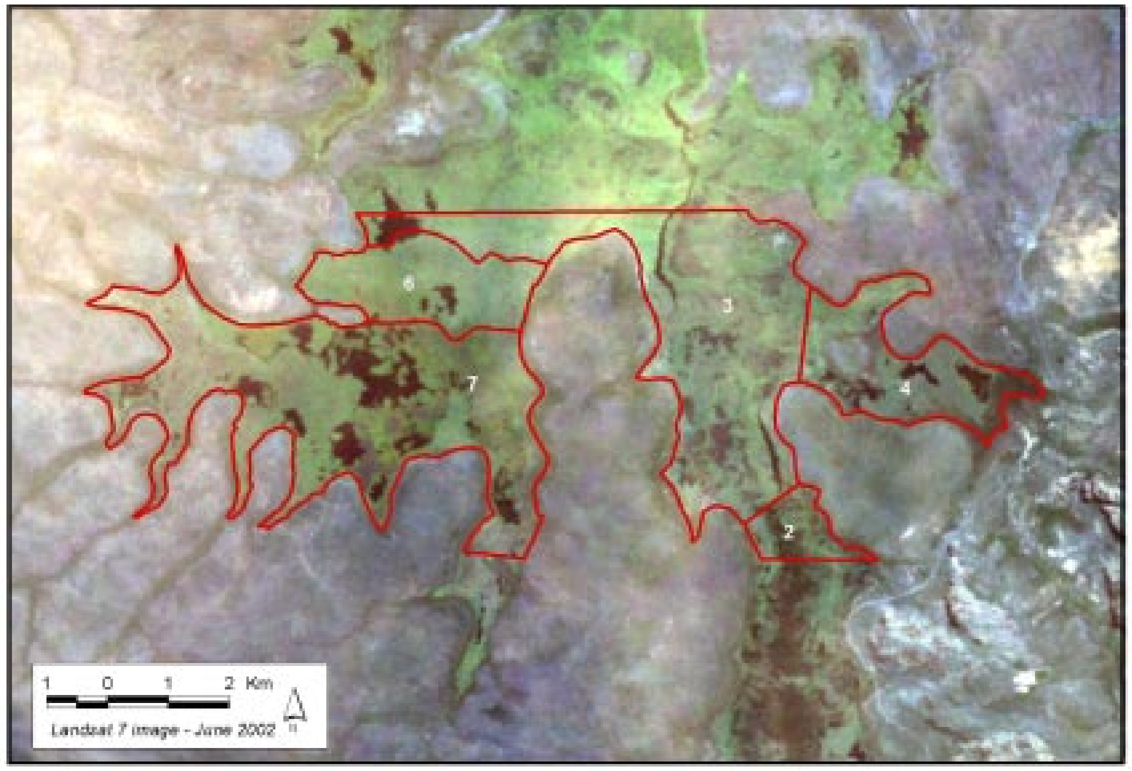







*Location of study area (top) and numbered component sub-areas (bottom)*

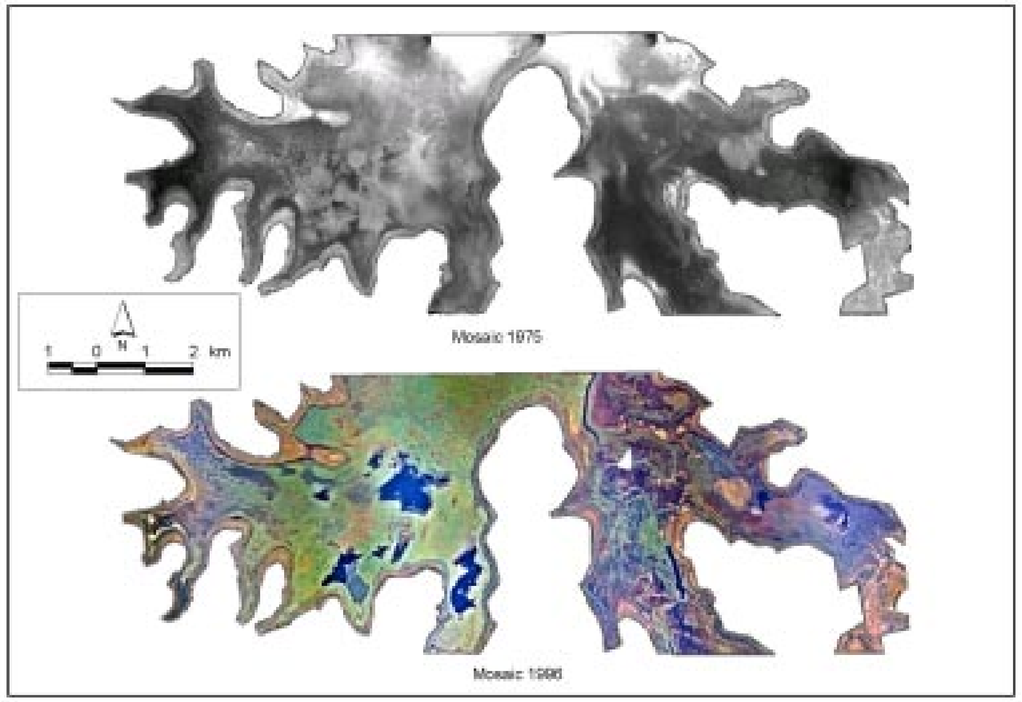
An earlier investigation used aerial photography to map the distribution and density of paperbark species on a section of the Magela floodplain within the Park boundary between 1950 and 1975. Using GIS and remote sensing software in conjunction with aerial photographs from 1975 and 1996, we assessed changes on the same portion of the floodplain (367 km$^2$). Aerial photography represented a cost-effective means of providing an updated initial assessment of paperbark distribution on the Magela. Integrating this information in the GIS enabled us to compare the results with changes described in earlier studies.

The earlier investigation found that within the 25-year interval (1950–1975) there had been no increase in the area occupied by paperbarks; however, there had been a 38% decrease in tree density.

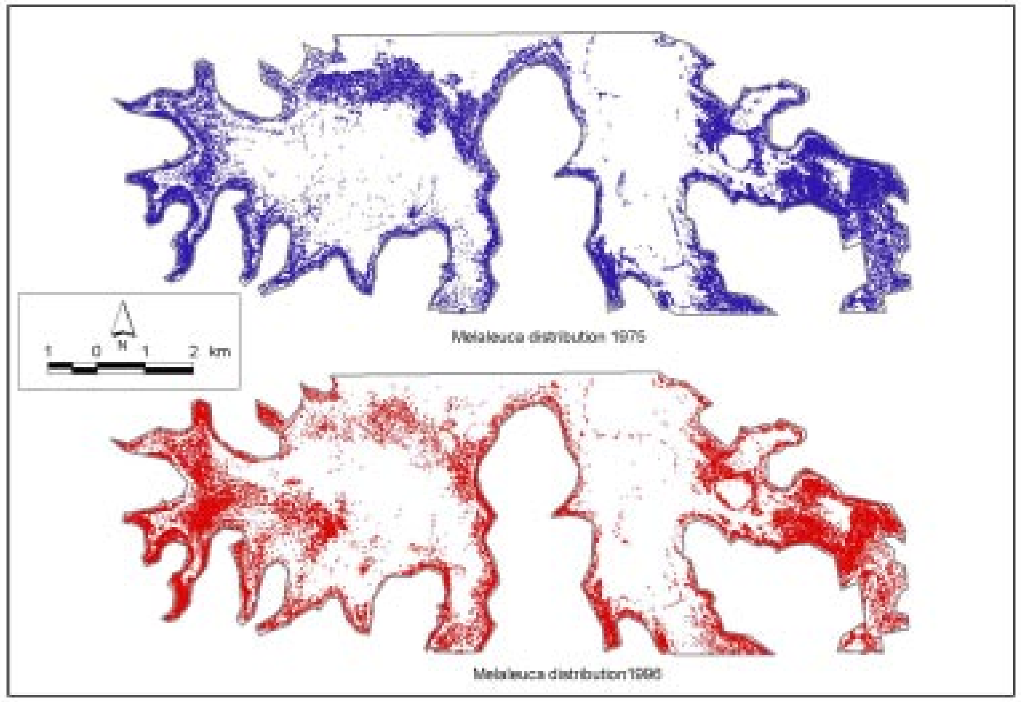
Our results indicate that there has been a further 21% decrease in the overall tree density between 1975 and 1996.

Remote sensing software was used to create mosaiced images of the study area from aerial photographs flown in 1975 and 1996. GIS software was then used to analyse the images to extract the density and distribution of paperbarks for 1975 and 1996. The resulting maps illustrate the distribution of paperbark in the different years.

The tabulated data show that between 1975 and 1996 there was an overall decrease in the number of trees observed in the study area. However, this decrease was not consistent, with some areas




*Top: Photographic mosaics compiled for 1975 and 1996 of study area on Magela floodplain. Bottom: Points representing distribution of Melaleuca 1975–1996*




**Total number of trees counted in sub-components of study area**

| Year | Sub-area 2 | Sub-area 3 | Sub-area 4 | Sub-area 6 | Sub-area 7 | Total |
|---|---|---|---|---|---|---|
| 1975 | 1886 | 2545 | 11238 | 5447 | 10317 | 31433 |
| 1996 | 819 | 1404 | 6989 | 1797 | 13695 | 24704 |
| Change | -1067 | -1141 | -4249 | -3650 | +3378 | -6729 |