RESEARCH
Testing of a GIS Model of *Eucalyptus largiflorens* Health on a Semiarid, Saline Floodplain

PETER J. TAYLOR*†
GLEN R. WALKER
CSIRO Division of Water Resources
PMB 2
Glen Osmond SA 5064, Australia

GEOFF HODGSON
THOMAS J. HATTON
CSIRO Division of Water Resources
GPO Box 1666
Canberra ACT 2601, Australia

RAY L. CORRELL
CSIRO Institute of Natural Resources & Environment
Biometrics Unit, PMB 2
Glen Osmond SA 5064, Australia

ABSTRACT / Irrigated agriculture has resulted in substantial changes in water flows to the lower reaches of the River Murray. These changes have led to large-scale occurrences of dieback in *Eucalyptus largiflorens* (black box) woodlands as well as increased inputs of salt to the river. Management options to address problems of this scale call for the use of spatial data sets via geographic information systems (GIS). A GIS exists for one floodplain of the River Murray at Chowilla, and a simple model predicted six health classes of *Eucalyptus largiflorens* based on groundwater salinity, flooding frequency, and groundwater depth.

To determine the usefulness of the model for vegetation management, the quality of both the model and the GIS data sets were tested. Success of the testing procedure was judged by the degree of spatial matching between the model's predictions of health and that assessed from aerial photographs and by field truthing. Analyses at 80 sites showed that tree health was significantly greater where groundwater salinity was less than 40 dS/m or flooding occurred more frequently than 1 in 10 years or depth to groundwater exceeded 4 m. Testing of the GIS data sets found that vegetation was misclassified at 15% of sites. Association was shown between GIS-predicted values and field-truthed values of groundwater salinity but not groundwater depth. The GIS model of health is a useful starting point for future vegetation management and can be further improved by increasing the quality of the data coverages and further refining of the model to optimize parameters and thresholds.

The Murray-Darling Basin is the largest catchment in Australia, draining about 1 million square kilometers (Figure 1). Over the last 70 years, following intensive development of the basin for irrigated agriculture, the rivers and tributaries within the catchment have become highly regulated through a series of locks. The full ecological and hydrological consequences of the changes in water flows are only now becoming apparent. The demand for water has increased and the basin now provides three quarters of all fresh water used in Australia (Margules and others 1990). As a result of this competition for water and the need for reliable year-round water supplies and flood mitigation schemes, substantial changes have occurred to the frequency, duration, and peak flow rates of river floods (Margules and others 1990). Inevitably, this has had wide-scale detrimental effects on the riparian vegetation. Dieback of trees due to water stress and the gradual replacement of some plant communities by others are the most visible signs of these changes.

Floodplain vegetation has an important role in aiding bank stability and providing habitat corridors for native fauna as well as improving the recreational and amenity value of the floodplain itself (Margules and others 1990). In addition, floodplain vegetation affects nutrient and salt flows in riverine environments by acting as a buffer zone. Therefore, reversal of the decline in the health of floodplain vegetation is vital.

River management requires an understanding of the processes and the spatial relationships that exist on the
whole floodplain. For example, the interaction of surface water and groundwater with floodplain vegetation and the associated movement of salt determine the environmental factors (such as salinity and flooding frequency and extent) that influence the distribution of species. The adoption of technologies that can handle large spatial data sets is required. A primary management tool for displaying and manipulating such spatial data and interpreting spatial patterns is a geographic information system (GIS). A GIS has been developed for the Chowilla floodplain anabranch system, one of the largest floodplains along this reach of the river. Along the western reaches of the River Murray, saline groundwater from the regional aquifers discharges to the river. This causes a large increase in the salinity of the water in the river, which is used downstream as a major water supply. In the vicinity of the river, the groundwater is both shallow and saline and this, coupled with irregular droughts and floods, means that high soil salinity is a widespread phenomenon on the floodplains (Jolly and others 1993).

The Chowilla region has high conservation value (Chowilla Working Group 1991). Apart from being the largest remaining area of natural riverine forest along the lower Murray, it also has high biodiversity of both flora and fauna, is an important nursery for native fish species, and provides extensive breeding areas for water birds (O’Malley and Sheldon 1990). Because of its significance to waterbirds, the area was listed as a Wetland of International Significance under the UNESCO Ramsar Convention in 1987. The chosen site of the current study is typical of salt-affected floodplains of the lower Murray system in terms of vegetation, soils, hydrogeology, and hydrology.

Vegetation health, in particular that of black box (*Eucalyptus largiflorens*), the dominant species on the floodplain, is greatly influenced by flooding frequency and groundwater depth and salinity (Jolly and others...