**PROGRESS REPORT FOR AINGRA09075**

<table>
<thead>
<tr>
<th>PROJECT TITLE</th>
<th>Frequency of regeneration of Callitris glaucophylla in relation to rainfall gradients and disturbance regimes in NSW</th>
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<tbody>
<tr>
<td><strong>INVESTIGATOR(S)</strong></td>
<td><strong>Institution and Department</strong></td>
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<tr>
<td>Chief Investigator</td>
<td>A/Professor Ian Lunt</td>
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<td>Other Investigators</td>
<td>Professor Ross Bradstock, University of Wollongong</td>
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<td></td>
<td>Dr Karen Ross, Post-doctoral Fellow, Charles Sturt University</td>
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<tr>
<td>Students</td>
<td>Ms Janet Cohn, PhD student, Charles Sturt University</td>
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<td>ANSTO Investigators</td>
<td>Quan Hua</td>
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<td>Specialist Committee</td>
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**SCIENTIFIC OBJECTIVES**

*Callitris* glaucophylla is a widespread tree, but spatial patterns of stand dynamics are poorly documented; the species is classed as 'invasive noxious scrub' in some regions and as a declining species elsewhere. This project aims to identify effects of climate, soils and disturbances on *Callitris* regeneration from arid to semi-arid NSW. Cohorts will be counted along E-W transects receiving summer, uniform and winter rainfall (Fig. 1). Selected samples will be aged using C14 AMS analysis to verify discrete age classes. Results will document effects of abiotic and biotic factors on broad-scale recruitment patterns, and will provide a baseline for monitoring climate change impacts.

**PROGRESS REPORT and RESEARCH OUTCOMES**

**C¹⁴ AMS.** Radiocarbon dating was used to estimate age classes for representative samples of *Callitris* from 1950 to 2003 (Table 1). Cohort A was consistently dated from 1959-1964, although it is likely that these *Callitris* established earlier in the 1950s, if we allow for the sample removal 20 cm from ground. Cohort B was considered older than C in the field, however dating showed overlap. Cohort B dated from 1972 to 1996 and cohort C from 1988 to 2002. Where replicate samples were dated within a site, in five of the six cases both replicates were within the same recruitment year range. In the one case where this did not occur at Yantabulla, there was only a 1 year difference between the 2 replicates. The results indicate that whilst field recognition of the same age class between sites was difficult, within site differentiation of discrete cohorts was possible.

According to the dated samples of *Callitris* recruitment occurred at least in the 1950s (dated 1959-64), 1988-1993, 1990-94, 1992-96, 1995-99 in the west, largely coincident with above average rainfall or La Nina events (Fig. 2). By comparison, in the east, recruitment was almost continuous and included the 1950s (dated 1962-64), 1972-1973, 1976-78, 1982-2002 and 2007, not all of which were coincident with La Nina events.

**Trends in the numbers of Callitris cohorts.** There was an abrupt decline in cohort numbers west of 400 mm mean annual rainfall (MAR) in the uniform and winter rainfall zones (mean = 0.2 cohorts), which was associated with the occurrence of rabbits and sheep. In the summer, where there was no such decline in cohort numbers (mean = 1.9), rabbits and sheep were virtually absent (Fig. 3). Above 400 mm MAR, there were fewer cohorts on farms, which have historically higher grazing levels, than other tenures (mean = 2.1 vs 3.3 cohorts).

These trends in recruitment combined with a restricted but relatively frequent occurrence of *Callitris* above 400 mm MAR, and a scarcity below 400 mm MAR, suggests regions of expansion and contraction, respectively. Disentangling the interactions amongst MAR, seasonal rainfall and disturbance regimes, requires targeted smaller scale research, so that predictions on distribution of woody species can be made in the light of anthropogenically driven climate change.

**Value to the Australian community.** Woody species, like Callitris, make important contributions to ecosystems. They control soil water and salinity levels, soil structure and nutrient composition, understorey vegetation
composition and animal habitat. Where woody species have increased in density and are referred to as ‘woody weeds’, grazing productivity has declined. At the other extreme, where woody species are not regenerating and may become extinct as old seeder trees senesce, further increases in soil erosion and salinity can be expected. Our large scale survey has identified these areas of expansion and contraction of woody species and the suites of factors contributing to these patterns in SE Australia.

**DATA**

**Table 1.** Results of C$^{14}$ dating of *Callitris* samples at selected sites in each seasonal rainfall zone. *Callitris* which established after 2003 were dated using ring counts and are marked with an asterisk

<table>
<thead>
<tr>
<th>Site</th>
<th>East</th>
<th>West</th>
<th>Cohort</th>
<th>Replicate</th>
<th>Recruitment year (95% CI)</th>
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<tbody>
<tr>
<td><strong>(1) Summer rainfall</strong></td>
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<tr>
<td>Collarenebri</td>
<td>East</td>
<td></td>
<td>A</td>
<td>1</td>
<td>1963.78-1964.17</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td>1963.51-1963.91</td>
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<td></td>
<td>2</td>
<td></td>
<td>1983.11-1986.43</td>
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<tr>
<td></td>
<td>East</td>
<td></td>
<td>C</td>
<td>1</td>
<td>1990.36-1995.48</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td>1990.17-1993.94</td>
</tr>
<tr>
<td></td>
<td>East</td>
<td></td>
<td>D</td>
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<td>Yantabulla</td>
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<td>A</td>
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<td>1959.65-1961.81</td>
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<td>1959.68-1962.40</td>
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<td></td>
<td>West</td>
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<td>B</td>
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<td>1990.18-1994.34</td>
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<td></td>
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<td></td>
<td>2</td>
<td></td>
<td>1992.36-1996.31</td>
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<td>2</td>
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<td>1988.46-1993.94</td>
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<td><strong>(2) Uniform rainfall</strong></td>
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<td>Condoblin</td>
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<td>1976.57-1978.79</td>
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<td>East</td>
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<tr>
<td>Coombah</td>
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<td><strong>(3) Winter rainfall</strong></td>
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<td>Coolamon</td>
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<td>Narrandera</td>
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<td>B</td>
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</table>

**Figure 1.** The approximate location of transects where *Callitris* recruitment was sampled within New South Wales, Australia. Transects were placed to sample annual average rainfall from 200 mm-600 mm with mean average rainfall from west to east in seasonal rainfall zones from summer (S) in the north, uniform (U) in the middle to winter (W) in the south. The value of each isohyet is given at the top of the figure.
Figure 2. Establishment periods of Callitris, estimated from C\textsuperscript{14} dating (95% CI). Data are shown with mean annual rainfall in each seasonal rainfall zone and La Nina events. Replicate samples (R1, R2) were dated in the summer rainfall zone.

Figure 3. Curves of best fit for the number of Callitris cohorts since 1950 with mean annual rainfall in each seasonal rainfall zone.
PUBLICATIONS / REPORTS arising as a result of your work.

AINGRA09075: Journal manuscript in prep. (s): Cohn J. S., Lunt I. D., Bradstock R. A. & Hua Q. Spatio-temporal recruitment of a woodland dominant tree along rainfall gradients and disturbance regimes in the arid to semi-arid zone.

PhD STUDENTS