5. BIOMASS AND CARBON ESTIMATES: HYPOTHETICAL NO-DISTURBANCE SCENARIO

Our analyses reveal that the vegetation over significant areas of the GWW has been highly disturbed by direct and indirect human impacts (Figure 3.18) and consequently is below its carbon carrying capacity. The disturbance factors of changed fire regimes (primarily due to increases in human ignition), timber cutting and mining appear to have altered the vegetation structures such that the extant vegetation cannot be correlated with, and predicted from, environmental factors alone, as would be expected for natural ecosystems. As we noted in Sections 2.4 and 3.22, the published maps of pre-disturbance condition (AUSLIG 1990 and NVIS 3.0, DEWHA 2005) do not adequately take into account the disturbance to the vegetation of the GWW that occurred before the initial vegetation mapping. We determined that the best means of estimating vegetation structure, and hence its carbon carrying capacity, in the absence of disturbance by human activities was to assume a vegetation cover of woodland in all areas with potentially suitable environmental conditions, as is shown in Figure 3.14. To estimate the AGB for this scenario, we applied the equations derived for undisturbed vegetation (Equations 3.8 and 3.11).

Fire and land use have, however, clearly impacted on $F_E$ (see Figure 4.2). Thus, before applying these equations, we needed a better estimate of $F_E$ for undisturbed vegetation. In a study of the relationship between $F_{PAR}$ and climate over the Australian continent, Berry and Roderick (2002) found that there was a linear relationship between $F_{PAR}$ and $W$—an index of water availability—along the aridity gradient (Equation 5.1).

**Equation 5.1**

$$W = P - R_s/L$$

In Equation 5.1, $P$ (mm yr$^{-1}$) is the average precipitation, $R_s$ is the sum of the global solar irradiance over the annual period (MJ m$^{-2}$ yr$^{-1}$) and $L$ is the amount of energy (joules) required to evaporate 1 kg of liquid water. (Note that 1 kg of water is equivalent to a 1 mm thick layer of water over a square metre of surface.) A map showing the distribution of $W$ over the GWW is given in Figure 5.1. As $W$ has negative values, we added a constant—3000—to create the variable $W_{3000}$ for subsequent analyses.

In order to relate $W_{3000}$ to $F_E$, we first identified those grid cells within the GIS layer of $F_E$ that represent long-undisturbed woodland vegetation ($F_{Eluv}$). We then plotted $F_{Eluv}$ against $W_{3000}$ and derived the equation of best fit (Equation 5.2).

**Equation 5.2**

$$F_{Eluv} = 0.03W_{3000} + 18$$

Following that, we created a spatial layer that comprised the maximum value of $F_{Eluv}$ predicted from Equation 5.2 and actual $F_{Eluv}$ (Figure 5.2). Finally, we calculated AGB for undisturbed vegetation using Equations 3.8 and 3.11. A summary of the biomass estimates for the GWW under the no human disturbance scenario is included in Table 4.1 and a histogram showing the frequency distribution of size classes of AGB ‘no-disturbance scenario’ is shown in Figure 4.1. Biomass carbon for this scenario was 915 Mt for the GWW—approximately three times the estimated present biomass. In Figure 4.1, the low values of AGB (that is, less than 15 t ha$^{-1}$) are associated with non-eucalypt dominated vegetation groups (MVGs 6, 7, 8, 17, 18, 20, 22). We have no
field measurements of biomass of undisturbed MVGs 6, 7 and 8 to test the veracity of these estimates. We speculate, however, that our modelled estimates understate the AGB of undisturbed *Acacia* (mulga, MVG 6), *Callitris* (MVG 7) and *Casuarina* (MVG 8) woodlands in the GWW.

Figure 5.1 Map showing spatial variability of a climatic index of water availability (W) over the GWW. The locations of the ANU field sites are indicated by the green circles.

For source of spatial data inputs for calculation of W, see Table A1—R_s and P.

Figure 5.2 Map showing estimated F_flw, F_v of vegetation if it were in the long-undisturbed condition, estimated from the water availability index, W (see Equation 5.1).