

## Appendix A: Details of savanna model cover fractions $f_t$ , $f_g$ and $f_b$ .

Consider, for example, annual grasses growing between tree crowns. Throughout the year, a total of  $n_g$  grass individuals will sprout in the area  $A$ . Individual  $j$  will have some projected cover  $A_j(t)$  at time  $t$ , taken as zero before sprouting and after death. Neglecting overlap, the total projected grass crown area of the site at time  $t$  is  $\sum_{j=1}^{n_g} A_j(t)$  (overlap can be included by subtracting the obscured component from each  $A_j(t)$ ). Denoting the seasonal average (average over one annual cycle) with an overbar, the typical seasonally-averaged projected crown area of a single grass patch is then  $A_g = \frac{1}{n_g} \overline{\sum_{j=1}^{n_g} A_j} = \frac{1}{n_g} \sum_{j=1}^{n_g} \overline{A_j}$ . The value of  $A_g$  (and the analogous quantity for trees,  $A_t$ ) is assumed to be a constant independent of  $n_g$  and  $n_t$  (the number of trees), meaning that the dominant contribution to changes in seasonally-averaged grass cover in a given environment is the death or proliferation of new typical individuals rather than changes in the typical individual.

Consequently, the seasonally-averaged projected grass cover fraction  $f_g = \overline{\sum_{j=1}^{n_g} A_j}/A = A_g n_g/A$  changes in small fixed increments of  $A_g/A$  with changes in  $n_g$ , and likewise for  $f_t$ .