where, δ_0 (m) is visual acuity or range, and *a* is attentional capacity, used in their model to impose limitations on perception and test the importance of cognitive constraints. This is not the purpose of the current model, so the equation was rearranged for δ_0, and f(θ) and *a* were set to their maximum values. Taking the midpoint between the two literature estimates for θ of 330^o and 360^o gives 345^o which, using the rearranged Equation 3.6, gives a visual range of ~400 m. This value for the animals' limit of perception was used in the model for animal assessment of their resource landscape. The effect of restricting visual range was compared with an equivalent simulation in which vision was unrestricted (see Fig. 3.11).

3.13.7 Assessment

With energy intake rate as fundamental, it was possible to incorporate visual range, the influence of prey species aggregation and nearest-neighbour selection into a vocabulary of animal assessment strategies for optimal landscape utilisation, across increasing scales, in fact, a Herbivore Assessment Lexicon (HAL) (see table 3.7).

To account for influences of patch density the spatial pointer grid was arbitrarily segmented into four directions of travel, such that each sector comprised D_d cells (where d = 1,2,3,4). Next, HAL calculated the mean e_{ij} that could be achieved by travel as far as the perceptual limits in each direction (*p* cells from current). These directional mean values do not acknowledge structural organisation of the landscape into a scale hierarchy of patches or super-patches (*sensu* Beecham & Farnsworth 1988). However, they do take into account the perceivable profitability for clumped resources at remote locations, beyond the scope of neighbouring cells, out to the limits of animal visual range. Taking the sum in these blocks would have given leverage to a larger collection of cells for non-central positions. Next, HAL compared the e_{ij} of the cells neighbouring the current position and having membership of the directional segment with maximum mean e_{ij}. If the search failed to find a profitable cell immediately proximate to the current location, then the search was expanded to the next nearest cells, and so on, until the limits of perception were reached.

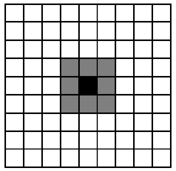
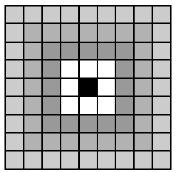
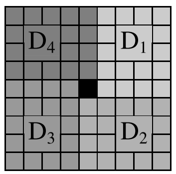
Range	Rule	Expression	Columns	Rows
Proximal 	Selection of the cell with maximum profitability from the 8 cells neighbouring the current cell location ■ (x,y)	Max e_{ij}	$i \in \{x-1,\ldots,x+1\}$	$j \in \{y-1,\ldots,y+1\}$
Remote 	Selection of the cell with maximum profitability from the range of cells at incremental offsets (α) from the current cell location ■ (x,y) out to the limit of perception (p cells from current).	Max e_{ij}	$i \in \{x-\alpha,\ldots,x+\alpha\}$ $\alpha \leq p$ $p \leq \mathrm{Max}(x, I-x)$	$j \in \{y-\alpha,\ldots,y+\alpha\}$ $\alpha \leq p$ $p \leq \mathrm{Max}(y, J-y)$
Directional 	Selection of the direction with maximum mean cell profitability, where each sector comprises D_d cells (where d=1,2,3,4) ranging from the current cell location ■ (x,y) out to the limits of perception (p cells from current).	$\mathrm{Max}\left[\sum_i \sum_j e_{ij} \Big/ D_d\right]$	$d \in \{1,\ldots,4\}$ $i \in \{x-p,\ldots,x+p\}$ $p \leq \mathrm{Max}(x, I-x)$	$d \in \{1,\ldots,4\}$ $j \in \{y-p,\ldots,y+p\}$ $p \leq \mathrm{Max}(y, J-y)$

Table 3.7: Herbivore Assessment Lexicon (HAL) for animal foraging behaviour. See text for details.

It was therefore possible that the first cell visited might not be adjacent to the starting position for the day. Subsequent destinations also may not neighbour previous locations. For depleted landscapes where few profitable cells remained, the constraints on perceptual limit (range and direction) were relaxed, leading to an exhaustive grid-wide search, ranging out in incrementing annuli, from the current location in all directions[2].

3.13.8 Global and local G*

Optimality of foraging strategies was tested by modification of the assumptions made for G*, the environmental mean E_{ij}^{R} . As mentioned above, global G* was the mean potential energy intake rate calculated for the whole grid. Local G* was calculated as the mean E_{ij}^{R} of only the cells scanned during assessment as described in Section 3.13.7, above. This also included the cells visited along the foraging path.

Local G* should provide a more accurate estimate of the mean energy intake rate offered by the most available resources at the beginning of each day. During the dry season, animals that assess their environment globally would be expected to travel further from water to reach resource levels in excess of G*. Because local G* is estimated only from previous encounters, for an established utilisation gradient, this estimate would be expected to be lower than global G*.

The grids were initialized with low variation for the spatial distribution of vegetation (CV of only 1%), making starting conditions near identical. Consequently there is little difference between the local and global estimates of G* until the onset of the wet season which introduces more variation via plant growth (Fig. 3.5). Here, the locally derived measure of G* showed erratic fluctuations reflecting a series of encounters with

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[2] An alternative algorithm would have been to invoke a random or correlated random walk for exhausted grids. However, this would not be in keeping with the deterministic algorithm employed, which was purposely based on a nearest-neighbour rule in contrast to random walk models. Random walk models have enjoyed some success, but it was patch density that went some way towards determining animal foraging paths in the model, and it should have been the relaxation of this rule in extreme conditions and not substitution of an unrelated rule.