Answers to Exercise 30
Landscape Ecology: Quantifying Landscape Patterns

1. Changing the definition of a patch (as in Figure 2) alters many of the patch level metrics computed for a given landscape. For instance, if you consider a patch to be a cell plus any adjacent and diagonal cells (such as Species 2 in Figure 2), the number of patches in the landscape will decrease. The definition of a patch should center on the species of interest, and how those species perceive changes in habitat. For example, as you move from class to class, subtle changes in patch composition (from grass to weeds to bare ground) might affect how you "disperse" between buildings. However, a beetle crossing the very same area is likely to perceive and react to these same habitats differently. Thus, for a given landscape structure and composition, the metrics will be quite different depending on the patch "rule" used in analysis.

2. The categories that define each pixel, as well as the grain size of each pixel, are critical in landscape quantification. For example, imagine you have an aerial photograph of your school and the surrounding areas, and are given the task of quantifying the landscape pattern. You would have to decide first what resolution should be evaluated (do you assign habitats based on a 50 m^2) or some other resolution. The resolution will critically impact how you classify each pixel's habitat type. For example, if you choose a 50 m^2 resolution, and a pixel in your photo consists of both forest and field habitat, how will you determine whether to call that pixel a "forest" or a "field"? As resolution increases so that more detail can be quantified (e.g., pixel size is 20 m^2), you might be able to classify the "forest" and "field" more accurately. However, there are trade-offs. If you have limited funding for analysis, it is unlikely that you can map in detail a very large area. Decisions on the appropriate scale will need to be considered in light of the study objectives.

3. As the extent changes, the presence and relative proportions of the two land cover types change. Many other metrics vary as well as a function of extent. For example, in Landscape *a*, the patch in the upper right-hand corner consists of 2 cells (using the restricted rule for patch identification). Increasing the extent of the landscape, we now see that the patch consists of 3 cells. The smaller the extent of a map, the more serious the problem of artificial truncation of patches by the map boundary, resulting in biased measurements of patch size, shape, and complexity (Turner et al. 2001).

Landscape *a*: Extent = 81 cells

1	0	0	0	1	0	1	1	0
0	0	0	1	0	0	0	1	0
1	0	0	0	1	0	1	0	1
0	1	1	0	0	0	1	1	1
1	0	0	1	1	1	0	1	0
0	0	1	0	1	0	0	0	0
1	0	1	1	1	0	0	0	1
1	0	1	1	1	0	0	1	0
0	0	1	1	1	1	0	0	1

Landscape *b*: Extent = 121 cells

0	0	0	1	0	0	0	1	1	1	1
1	1	0	0	0	1	0	1	1	0	0
1	0	0	0	1	0	0	0	1	0	1
0	1	0	0	0	1	0	1	0	1	1
1	0	1	1	0	0	0	1	1	1	1
0	1	0	0	1	1	1	0	1	0	0
0	0	0	1	0	1	0	0	0	0	0
1	1	0	1	1	1	0	0	0	1	0
0	1	0	1	1	1	0	0	1	0	1
1	0	0	1	1	1	1	0	0	1	0
1	1	1	1	0	0	0	1	0	1	1

4. One way to aggregate the smaller pixels "up" so that the landscape consists of only 9 units is to assign each block a habitat type based on the proportion of pixels that consist of each habitat type. For example, the upper-left cell of the right-hand landscape would be classified as a shaded habitat type because over 50% of the habitat is shaded. The bottom-left block of cells would be classified as the nonshaded habitat type because over 50% of its habitat is nonshaded. The re-sampled landscape is very different from the landscape on the left in terms of landscape metrics. Thus, grain size is a significant consideration in how landscapes are quantified.

n = 1

1	0	1	1	0
0	0	0	1	0
1	0	1	0	1
0	0	1	1	1
1	1	0	1	0
1	0	0	0	0
1	0	0	0	1
1	0	0	1	0
1	1	0	0	1

n = 9

1	0	0	0	1	0	1	1	0
0	0	0	1	0	0	0	1	0
1	0	0	0	1	0	1	0	1
0	1	1	0	0	0	1	1	1
1	0	0	1	1	1	0	1	0
0	0	1	0	1	0	0	0	0
1	0	1	1	1	0	0	0	1
1	0	1	1	1	0	0	1	0
0	0	1	1	1	1	0	0	1

Aggregated

0	0	0	0	0	0	1	1	1
0	0	0	0	0	0	1	1	1
0	0	0	0	0	0	1	1	1
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	0	0	0
1	1	1	1	1	1	0	0	0
1	1	1	1	1	1	0	0	0