Plant Ecology, Examination 1
October 2, 2001 Name _____

Please restrict your response to the space available. Answer directly and fully - don't beat around the bush. The point values for each question are given in parentheses. Any notes you added to Wanda's notebook printout may be helpful in answering the exam. All page references refer to Wanda Weatherby's notebook.

1 (12). What kind of ecosystem occurs at **location 7230610**? Justify your answer based on the climate diagram (page 159).

(5) This climate diagram is from a region occupied by an eastern deciduous forest ecosystem.

(7) Based on the observation that there is a year-round excess of precipitation, we know that this is a forest ecosystem region. Based on the warm summer temperatures, we know that this is likely to be a region occupied by deciduous forests and not coniferous forests.

2 (12). Where is **location 7245000**? What kind of ecosystem would you expect to find in this location? Justify your answers based on the climate diagram (page 159).

(5) This climate diagram is from a region occupied by a tall-grass prairie ecosystem (Wichita, Kansas).

(7) Based on the observation that the precipitation and temperature curves are nearly identical to each other, we are seeing an ecosystem where precipitation inputs just about equal the evapotranspiration. This defines a semi-arid ecosystem, most likely a grassland We know that this would be a tall-grass prairie (as opposed to a short grass prairie), because the precipitation input always exceed evapotranspiration potential.. We know that this is a grassland and not a forest, because of the absence of sufficient wintertime precipitation.

3 (12). For each of the tree species on page 156, as one drives up Big Cottonwood Canyon the tree species first appears on the north-facing slope and later at higher elevations on the south-facing slope. Please provide a brief explanation of why this is to be expected.

(5) The lower distribution limits of trees in the Wasatch Mountains are determined by soil water availability.

(7) North and south facing slopes have different energy balances, with south facing slopes being warmer and drier than north facing slopes at similar altitudes. Thus, at lower elevations, we would expect trees to first appear on a north facing slopes because these sites have a more favorable water balance, are cooler, and impose less evaporative stress than the south facing slope at the same altitude.

4 (12). Briefly provide a succinct but complete quantitative description of the relationships between precipitation and elevation on the east and west sides of the Wasatch Mountains. Why are these patterns expected?

(6) Precipitation is positively related to elevation on both west and east sides of the Wasatch Mountains. The slope of this relationship os steeper for the west side.

(6) Since the majority of rainfall comes in the winter and storms come from out of the west, we expect a west-to-east rainshadow. The west side of the Wasatch should therefore be much wetter than the east side. If you graph the data, you will see that much more rain falls on the western slopes than on eastern slopes at similar altitudes.

5 (12). Provide a clear, complete and justified explanation for why total daily transpiration amounts in the experimental treatment *Lactuca* are greater than on the control plants (natural orientation) (page 162).

(6) The total daily transpiration is greater on the experimental plants, because these leaves receive much greater solar radiation loads, particularly during midday periods.

(6) Given that both sets of leaves have identical conductances, we would expect that water loss and solar radiation incident on the leaf surface would be positively related to each other.

6 (14). Why is the relationship between total seed yield (a measure of plant fitness) and total daily transpiration negative (page 162)? Please relate that pattern to the observations of the relative differences in control and treatment transpiration rates during the two time intervals.

(7) Seed yield and total daily transpiration are negatively related to each other, because although on any single day basis the horizontal leaf has more daily transpiration and greater daily photosynthesis than does the vertically oriented leaf (because of higher incident solar radiation loads) it is the long term patterns that matter most. The horizontal-leaf plant runs out of water earlier into the drought period. Thus, the natural vertically-inclined-leaf plant is able to continue to photosynthesis and produce more carbon for seed production for a longer time into the drought and to achieve a greater lifetime seed yield.

(7) Integrated over the entire growing season, the vertically oriented leaf is able to photosynthesize longer and obtain more carbon for reproduction, even though on any single day early in the drought period its daily photosynthesis may be less than that of a horizontal leaf. This is seen in the observation that the experimental plant runs out of water before the control. That is, the relative transpiration rate differences between experimental and control plants increase as the experiment progresses.

7 (14). Provide a succinct and complete explanation for why the slopes of the relationship between reproductive output (flower production) and plant size are different for control and treatment plants in page 163.

(5) At every plant size, the control plants have higher seed yields than do the experimental treatment plants and the slope of this seed yield versus size relationship is steeper for the control plants.

(9) The control plants always have a greater reproductive output because these plants are able to photosynthesize and accumulate carbon for reproduction over a longer period into the drought (i.e., more days). The experimental plants transpire water at a higher daily rate, running out of water earlier in the season. When this happens the experimental plants die and reproduction is terminated.

8 (12). Does the observation of identical leaf conductances for horizontal and vertically oriented *Lactuca* leaves mean that the transpiration rates are also identical (page 160)? Yes or no. Why or why not?

(5) No.

(7) The transpiration rate will be higher on the horizontal leaf, because its leaf temperature will be higher. Given identical leaf conductances for the two leaves, transpiration will be proportional to the difference in water vapor pressure between the leaf and air. Leaf water vapor pressure is a direct function of leaf temperature. The higher leaf temperature will occur in the horizontal leaf because it receives a higher energy load, particularly during midday conditions.

Other logical answers were also accepted that related to leaf coupling factors that could potentially influence leaf temperature.