Acclimation versus Adaptation

Acclimation: --generally divides into two types: Long- and short-term responses

1. Short term acclimation involves responses occurring within minutes of environmental change and typically involve preexisting components within a biochemical pathway; these responses are easily reversible, eg: increases in enzyme activity (ie Calvin cycle) in response to increases in temperature
2. Long term acclimation may begin within minutes but is pronounced within days or weeks following an environmental change. These responses typically involve altered patterns of gene expression, reallocation of resources between the component processes of photosynthesis, and morphological change. The responses are not immediately reversible and often lead to the development of a visually different phenotype. Long-term responses represent acclimation if they improve performance in the altered environment. Good example: plants growing in shade develop larger leaves and an enhanced photosynthetic apparatus for improved light capture; root growth may increase in environments with reduced moisture levels; increase in RBC count in mammals inhabiting high elevation environments

It is important to understand that acclimation occurs at the organismal level.

Adaptive responses occur over time scales covering multiple generations of a population. Evolutionary changes in genotypes may occur (ie. natural selection) adapting a population to a modified environment. In essence evolutionary adaptation reflects the close correspondence between organisms and their environment. Example: Ecotypes of *Amaranthus retroflexus* (Pigweed) at different latitudinal gradients exhibit different spectra of thermal tolerance: in hot climates such as North Carolina, populations of these plants are very heat tolerant unlike their counterparts in northern Canada or those at higher elevations.
Adaptive responses may involve phenology, growth and development, morphology, biochemistry etc.. Another good example is the freezing tolerance of the oaks in southeastern unites states: the warmer their indigenous environment, the less cold tolerant they are even though they may be the same species. Which brings us to the next issue….

What's the difference between varieties, hybrids and subspecies? Are they all essentially ecotypes?
I agree with Jim in that it all depends on whether you choose to be a lumper or a splitter. But because I'm a splitter, I'll start off with a few definitions:

The species concept: it is generally accepted that a species is a group of organisms that is able to produce viable (not sterile!) offspring. The union of a horse and donkey (two species) to produce a mule (sterile) precludes the latter from ever having the distinction of being a species. By virtue of hybridization and peculiar genetics, plants more often then not violate the species concept.

Ecotypes: populations optimized for certain ecological circumstances such as soil conditions, temperature and light availability. Different ecotypes have different genotypes, or at least unique genotypic *expression* designed to maximize fitness in a particular environment. Now, the lumping and splitting is up to you….

Speciation can be defined as the permanent severing of population systems so that migrants from one system would be at a disadvantage when entering another. A good example of this is **geographic speciation**. Imagine a large population of prickly pears suddenly separated by the creation of a river. The environment on one side is moist, on the other it's dry. Whether you choose to call the resulting specialized populations subspecies or ecotypes or varieties or subspecies is up to you, and the amount of detail you want to pursue… (these days, you better substantiate your decision by DNA analysis!)

Hybrids: Hybridization in plants means the combination of two different genotypic lines (ie: male pollen of species1 + female ovule of species2) upon fertilization. Hybridization frequently produces new plant species that may or may not persist. In the case of 'hybrid vigour', the new genotype is much more successful at acquiring resources (light, nutrients, water etc) than either one of its parents, and may outcompete them in a number of generations. The hybrid plant may or may not be called an ecotype. If it succeeds better in a different enviroment than either one of its progenitors, it may be lumped under the heading of 'ecotype or hybrid of plants X and Y'. If it is drastically different in morphology, or does not cross-pollinate with closely related plant species, it may be classified as a species in its own right.

Varieties: varieties represent a level of morphological (or genetic if using DNA) divergence that is lower than that among species. Different plant varieties may also be called microspecies. Varieties may be the result of natural selection (ie: adaptation) of a particular genotype best suited for a unique environment. But maybe not. Mutations are frequently responsible for causing changes in flower colour, leaf pattern etc. that seem to bring no obvious increase in fitness to that new plant variety.

Subspecies: Subspecies represent a level of morphological (or genetic) divergence that is lower than that among species, but greater than that among varieties. For example, venation patterns on a leaf may differentiate two different populations of a species that are otherwise exactly the same. Because venation may require a substantially larger suite of genotypic expression than leaf colour, the new plant type may earn the title of subspecies rather than variety.

This is all somewhat complicated, and to repeat Jim, dependent on your 'lump/split', state of mind. Here's an example. The desert to the west of you (the great basin) is rampant with shrubs and plants of the Chenopodiaceae and Asteraceae families. Because these plants hybridize and speciate like mad, a chaste botanist was prompted to call the region the 'basin or promiscuity'! There are many examples where species hybridized or through natural selection, formed new subspecies. However, not all of these plant types can be called ecotypes because the hybrids, varieties and subspecies do not always inhabit environments with unique microclimates (ie: local changes in temperature regimes, water availability and soil type).

The basic tenet here is that all ecotypes may be hybrids, varieties or subspecies, but not all of these plant groups may be ecotypes.