

Why is Genetic Diversity Important?

Why We Care About Genetics Vol.1

Biological diversity is a commonly recognized value in natural resources management. This diversity is often represented as a hierarchy of discrete units such as species, ecosystems, and landscapes. There is a parallel hierarchy in taxonomy that orders diversity from species (e.g., *Populus trichocarpa*) to genera (*Populus*) to families (Salicaceae) and so on, up to kingdoms (Plantae). In both cases, it is understood that biological diversity is really more of a continuum — particularly with plant species that tend to hybridize more freely than do animals. The discrete units are helpful organizing tools but to truly understand biological diversity, the continuity should be considered.

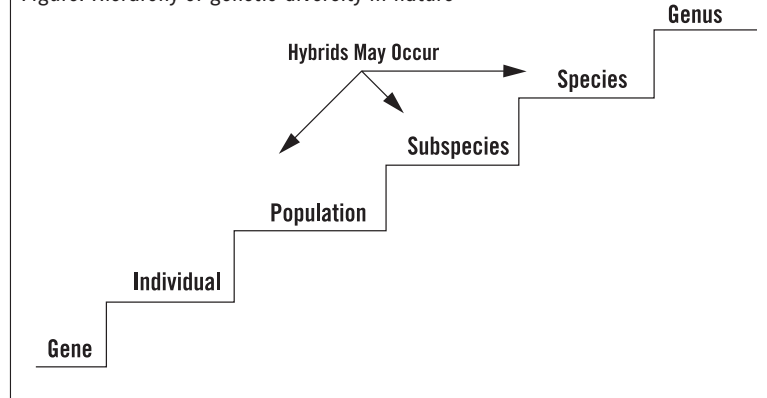
[biological diversity is really more of a continuum — particularly with plant species that tend to hybridize]

The species is a unit that is common to both the biological diversity and taxonomic classification systems. Typically, it is also the focus in management and regulation of natural resources. However, in nature, diversity does not stop at the species level. Within species, there is often considerable diversity related to environmental influences, genetic differences, or a combination of both. For example, a species may contain two or more subspecies that typically have some genetic differences from one another. Because plants

that are geographically close would be more likely to interbreed than those more distant, we recognize plant ‘populations’ as local breeding units. Across a species’ native range, these populations may differ genetically from one another — sometimes a reflection of local adaptations. Within populations, all the individuals can be genetically distinct from one another depending on their breeding system. Genetic diversity continues down the line (see Figure) at the gene level, with different variations of a gene, called alleles, potentially occurring within the same plant (as they have two or more copies of each gene). Genes themselves are constructed of a sequence of biological units, called nucleotides: variation in these nucleotides can (but doesn’t necessarily) create meaningful changes in the gene. So genetic diversity neither ends nor begins with the species: it continues in both directions.

As suggested above, plants, in particular, frequently blur the distinctions among units we recognize as species or populations. In part, this is a consequence of plants

Figure. Hierarchy of genetic diversity in nature



National Forest Genetics Laboratory (NFGEL)
Pacific Southwest Research Station
USDA Forest Service
2480 Carson Road
Placerville, CA USA 95667
<http://www.fs.fed.us/psw/programs/nfgel/>



Genetic Resources Conservation Program
University of California
One Shields Avenue
Davis, CA USA 95616
<http://www.grcp.ucdavis.edu>

More Information

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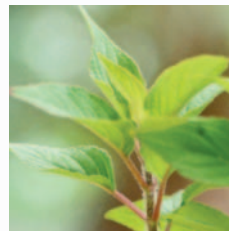
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sometimes having fewer reproductive barriers to crossing with other populations or species than do animals. Although technically a 'hybrid' could describe the progeny that results from a cross between any two dissimilar individuals, it is more conventionally applied to individuals that arise from mating between two different species, subspecies, or populations. So for species that do hybridize, this process contributes to more of a continuum in genetic diversity.

Focusing on diversity levels within species — such as regional units, populations, and hybrid zones (to the extent they occur) — is an important consideration in conserving biological diversity. Recognizing and managing the genetic diversity within a species is valuable because genetic diversity is:

- Important to the species' ability to adapt to changing environmental conditions over time, such as those related to climate change. It is not the entire species that adapts in concert, but particular populations over time. Some populations may become better adapted than others; some may become extinct. Similarly, when we find something of economic, social, or cultural value within a particular species (such as a component for a useful drug or an aesthetically pleasing flower color or plant shape), it is often a trait that is variably expressed within the species and often has a genetic basis. Breeding

[genetic diversity is important to the species' ability to adapt to changing environmental conditions over time]

and selection for the desirable trait can lead to an increase in the frequency of that trait. These processes are merely concentrating and repackaging existing genetic diversity.

- Important to the species' ability to colonize new areas and occupy new ecological niches. The upper-elevation populations of plant species (e.g., white fir (*Abies concolor*)) are often genetically differentiated from the lower-elevation populations. In these cases, genetic diversity allows the species to exist in substantially differing environments.
- Generally correlated with some measures of fitness. Although the cause-effect connections aren't all understood at present, there is substantial evidence that levels of genetic diversity are positively related to a species' ability to produce substantial and robust progeny and persist in the long term. ■