

The Danger of Small Populations

Have you ever stopped to wonder what criteria conservationists use to categorize species as endangered? Would it surprise you that the number of individuals living is not the only criteria? Many of the animals on the endangered species list are there due to small population size; either there is only one population known or many fragmented subpopulations that are separated by a geographic barrier.

So why is population size a criterion? If a species has 60 small populations around the world isn't that good enough? The answer to this question all depends on genetic diversity. When an animal is in a small population many trends start to emerge.

The first trend that is seen in small populations is increased inbreeding, which is defined as two individuals from the same family mating. Inbreeding can lead to an increase in frequency of certain alleles, especially recessive alleles that can cause rare recessive genetic diseases. In normal populations, many harmful recessive alleles are often kept in the population at very low frequencies because they are masked in "carriers" by the dominant allele. In normal populations recessive genetic diseases can occur, but they do so at a much lower frequency. An example of this trend can be seen in the Amish communities in Pennsylvania. As part of their culture, they believe in endogamy, which means that Amish children must marry within the Amish community. They also have a policy that an Amish person can leave the community but no newcomers can join. These two beliefs have the effect of the same sets of alleles being passed down through generations, and with no new comers to throw in different genes, the chance of a recessive gene being revealed increases because more and more people from the population are infected or are carriers. One example of a recessive allele that has increased in frequency is the gene that causes Ellis-van Creveld syndrome. In Amish communities this syndrome is characterized by dwarfism, polydactyly of the hands and the shortening of their limbs. An example of recessive alleles being unmasked due to inbreeding can also be seen in the royal family in England.

Another trend that is seen with shrinking population sizes is out breeding (when two different species mate often resulting in a sterile offspring). This usually occurs because no suitable mate can be found, so in the attempt of one animal to pass on their genes, another animal of a different species is impregnated. The offspring from closely related species usually survive but they are born sterile and thus is a dead end of its species. An example of this is when a lion and a tigress mate resulting in a baby liger. The liger is the largest cat in the world but it cannot reproduce.

Lastly when population size decreases, the gene pools' variation decreases and through genetic drift certain genes are often promoted to fixation, meaning that everyone in that population will have the same allele for a certain gene. The danger of fixating alleles is the process of natural selection. Natural selection works on phenotypes of individuals, and so there is a great advantage when there are different alleles (genotypes) that cause many phenotypes present with in a population. Since our environment is always changing, we need to be able to adapt. If every individual in a population inherits a gene and then natural selection selects against that gene, the entire population could be wiped out. Likewise if you have a population with many alleles and natural selection selects against any one of those genes, it may wipe out a portion of the population, but it will not destroy the entire population.

Sources:

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