

ECOLOGY, LECTURE 8: HUMANS AND THE ENVIRONMENT (1245–1250)

Before our discussion of human population growth and the environment, we took care of some unfinished business concerning inclusive fitness.

Altruism refers to a behavior that reduces individual fitness but increases the fitness of other individuals in the population. On the surface, altruistic behavior appears to contradict the maxim that natural selection maximizes individual fitness. This apparent contradiction is resolved with the concept of **inclusive fitness**, defined as the total effect an individual has on proliferating its genes (i) by producing its own offspring and (ii) by providing aid that enables relatives to increase their reproductive output. Parents share 50% of their genes, on average, with their offspring, and it is not difficult to understand the investment that parents make toward the survival and ultimate reproductive success of their own offspring. But note that siblings also share ~50% of their genes, and more distant relatives share genes in relation to their degree of relatedness. The **coefficient of relatedness** (r) represents the fraction of genes that, on average, are shared between individuals.

Because genes are shared with relatives, natural selection can favor altruistic behavior that enhances the survival and reproductive success of relatives (**kin selection**). We looked at examples of altruistic behavior and kin selection in naked mole rats and Belding's ground squirrels. We also considered cases of altruistic behavior between non-relatives. This may occur among individuals in social groups that are sufficiently stable that individuals have numerous and ongoing opportunities to exchange aid. In these cases of **reciprocal altruism**, a donor provides aid because by doing so it makes it more likely that that individual will have the favor returned in the future. We looked at the example of blood-sharing in vampire bats in this context. In such systems, there is usually a mechanism for dealing with "cheaters" because cheating is expected to proliferate if unchecked. The **tit-for-tat** behavioral strategy refers to a tendency for individuals to treat others according to the way they were treated in past encounters. Scientists may rely on **game theory** to analyze these types of interaction.

Humans have undergone a remarkably long period of exponential population growth, and this trend is related to the complex suite of environmental problems that the world now faces. Although the human population continues to increase dramatically, the *rate* of growth has slowed since the 1960s. Some of this change is correlated with trends in modernization related to improved access to education, particularly for women. The **demographic transition** refers to the period of time during which a nation's population moves from high birth rate and high death rate to low birth rate and low death rate. This transition usually begins with declining death rates based on improvements in medical care. After a lag, birth rates also begin to decline. The duration of this transition is important, because if it is long, there may be an extended period of low death rates and high birth rates, leading to dramatic population growth.

The **age structure** of a population can be viewed as a histogram to help predict population growth trends and illuminate social conditions (e.g., Fig. 53.25). These graphical illustrations can show, at a glance, whether a population is likely to grow rapidly (a broad based pyramid), to grow slowly or to remain stable (a more uniform distribution from the youngest age classes through the reproductive age classes), or to remain stable or to contract (a top heavy distribution). The **ecological footprint** of a population is related not only to the density of the population, but also to per capita resource use patterns. The dense populations in some developing countries have an enormous impact on the planet, but so do the less dense populations in the developed world that have high rates of individual consumption. We concluded with a discussion of topics in conservation biology and environmental ethics that you will not be tested on...