UNDERSTANDING SUSTAINABLE YIELDS OF FISH AND WILDLIFE

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Under natural conditions, populations of animals and fish tend to vary in size from one year to the next. Population changes are affected by reproduction, harvest, natural mortality, and a variety of environmental conditions. Even after its size has been reduced by multiple circumstances, a sustained population can meet the needs of the next generation.

The abundance of a population, often described as the population density, can be affected by both *density-dependent responses* and *density-independent factors*. As a population increases within a given habitat, the death rate increases, and the birth rate decreases as the population responds to the available food and resources to survive. In contrast, natural events like fires, ocean currents, and storms often reduce the density of a population, independent of the availability of food, space, and resources.

Favorable conditions for most animals and plants can result in temporary overpopulation, which the available habitat cannot support for an extended length of time. In these instances, populations respond through lower birth rates and higher death rates. When numbers are reduced or increased as a result of density-independent influences, these phenomena tend to direct the population back to what is called the *carrying capacity*, where birth rates and death rates balance out to maintain numbers at the maximum level the environment can support.

Population numbers are generally not permanently reduced when a natural disaster strikes. All species have the capacity to increase their numbers in response to these events. When a cold front kills large numbers of speckled trout in coastal marshes, the following year there are fewer trout but more food and space per individual fish. As a result, reproductive success increases and over the next several generations the population moves back toward the numbers present before the freeze.

Unfortunately, most environments which support animals and fish are never constant long enough to allow very stable populations. Population numbers are always shifting up or down in density-dependent response to the increases or decreases brought on by density-independent conditions such as adverse weather or changes in available habitat.

This principle is easy for sportsmen to observe: when fish or deer are thinned out, their rate of productivity increases. Animals tend to eat better, have more offspring, and live longer. When the degree to which they are cropped back can be monitored and controlled, the natural response to increase in numbers can be used to produce a sustainable surplus without endangering the long-term survival of the population. Although throughout the world, populations of fish and wildlife support subsistence, commercial and recreational harvest year after year utilize an understanding of the density-dependent responses and density-independent factors affecting a specific population in a given year.

Populations of game and fish can be manipulated to provide a surplus under most conditions. The key is in determining how much surplus is available without affecting future population numbers and harvests.

Some species are adapted to produce many thousands of offspring, grow rapidly, and mature at an early age. Under these circumstances, very high natural mortality rates are unavoidable, and these types of fish and animals are usually adapted to highly variable environments. These species are available for high rates of harvest or exploitation with a wide safety margin in terms of long-term survival.

Other species are less adapted to change, and rely on a stable environment to ensure the survival of relatively fewer offspring. These species may grow relatively slowly and mature much later in life. These populations are much less suited to sustain long-term exploitation without careful monitoring and control of the harvest.

When people harvest fish or other animals, they do so with the expectation that they can harvest again, in the future. Through study, reports, and monitoring, scientists and government regulators work together to control the harvest for future use by considering the *density-dependent responses* and *density-independent factors* of a fishery during a particular period. They calculate a maximum number of fish or animals in a population that can be removed without having a negative effect on its density, known as *maximum sustainable yield*. Two quantities are used to determine this — *production and yield*. *Production* is the combined weight of the species in the habitat over a given period of time. *Yield* is the amount of that production that is harvested and put to use. Although these two quantities, especially the production figure, are inexact, they do provide some measure of the fishery resource to be used as a guideline for sustaining it for future harvests.