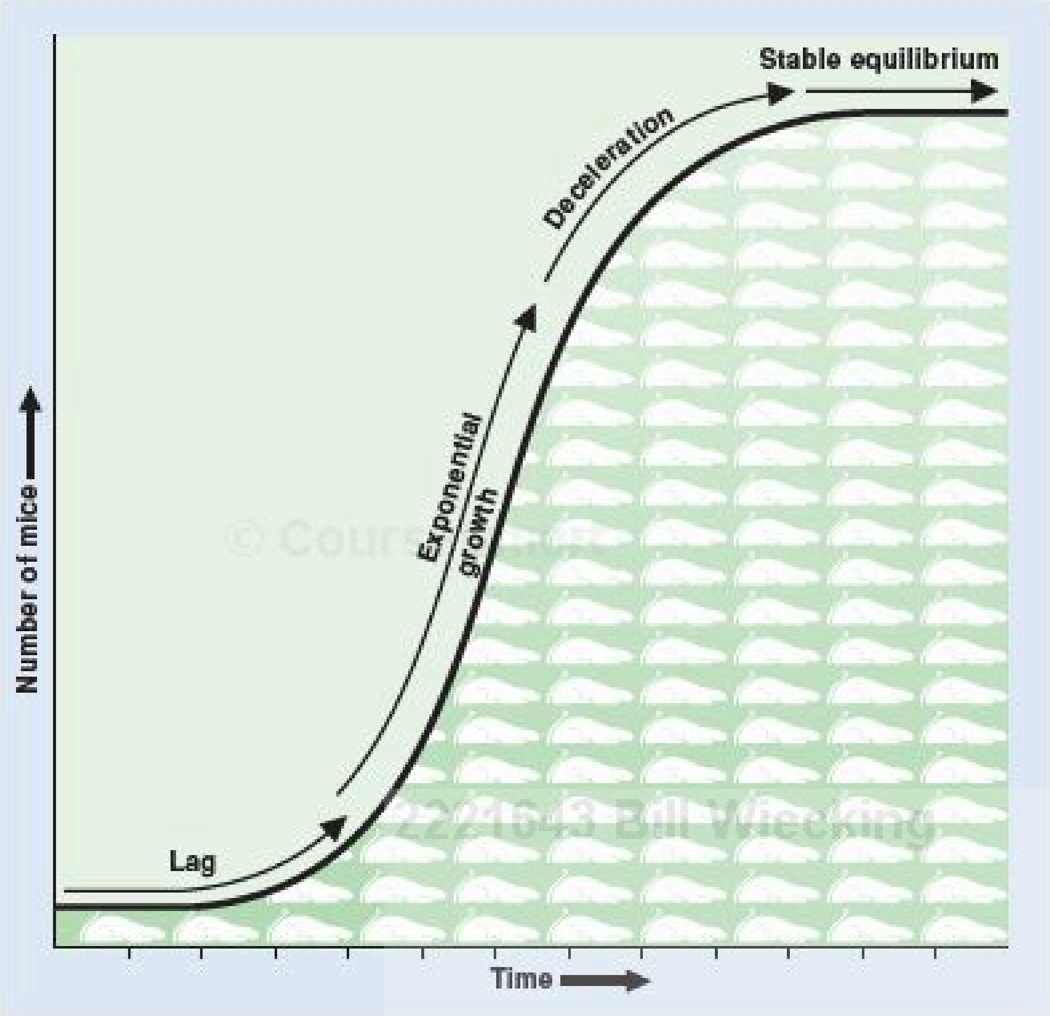

FIGURE 7.5 **A Typical Population Growth Curve** In this mouse population, there is little growth during the lag phase. During the exponential growth phase, the population rises rapidly as increasing numbers of individuals reach reproductive age. Eventually, the population growth rate begins to slow during the deceleration phase and the population reaches a stable equilibrium phase, during which the birthrate equals the death rate.

Under these conditions, the population will grow exponentially. Exponential growth results in a population increasing by the same percentage each year. For example, if the population were to double each year, we would have 2, 4, 8, 16, 32, etc. individuals in the population. While populations cannot grow exponentially forever, they often have an exponential period of growth.

Population growth often follows a particular pattern, consisting of a lag phase, an exponential growth phase, a deceleration phase, and a stable equilibrium phase. Figure 7.5 shows a typical population growth curve. During the first portion of the curve, known as the **lag phase**, the population grows very slowly because there are few births, since the process of reproduction and growth of offspring takes time. Organisms must mature into adults before they can reproduce. While the offspring begin to mate and have young, the parents may be producing a second set of offspring. Since more organisms now are reproducing, the population begins to increase at an accelerating rate. This stage is known as the **exponential growth phase (log phase)**. The population will continue to grow as long as the birthrate exceeds the death rate. Eventually, however, the population growth rate will begin to slow as the death rate and the birthrate come to equal one another. This is the **deceleration phase**. When the birthrate and death rate become equal, the population will stop growing and reach a relatively stable population size. This stage is known as the **stable equilibrium phase.**

It is important to recognize that although the size of the population may not be changing, the individuals are changing. As new individuals enter by birth or immigration, others leave by death or emigration. For most organisms, the first indication that a population is entering a stable equilibrium phase is an increase in the death rate. A decline in the birthrate may also contribute to the stabilizing of population size. Usually, this occurs after an increase in the death rate.

FACTORS THAT LIMIT POPULATION SIZE

Populations cannot continue to increase indefinitely. Eventually, some factor or set of factors acts to limit the size of a population. The factors that prevent unlimited population growth are known as **limiting factors.** All of the different limiting factors that act on a population are collectively known as **environmental resistance.**

Extrinsic and Intrinsic Limiting Factors

Some factors that control populations come from outside the population and are known as **extrinsic limiting factors.** Predators, loss of a food source, lack of sunlight, or accidents of nature are all extrinsic factors. However, the populations of many kinds of organisms appear to be regulated by factors from within the populations themselves. Such limiting factors are called **intrinsic limiting factors.** For example, a study of rats under crowded living conditions showed that as conditions became more crowded, abnormal social behavior became common. There was a decrease in litter size, fewer litters per year were produced, mothers were more likely to ignore their young, and adults killed many young. Thus changes in the behavior of the members of the rat population itself resulted in lower birthrates and higher death rates that limit population size. Among populations of white-tailed deer, it is well known that reproductive success is reduced when the deer experience a series of severe winters. When times are bad, the female deer are more likely to have single offspring than twins.

Density-Dependent and Density-Independent Limiting Factors

Density-dependent limiting factors are those that become more effective as the density of the population increases. For example, the larger a population becomes, the more likely it is that predators will have a chance to catch some of the individuals. A prolonged period