Population regulation is a density-dependent process, meaning that population growth rates are regulated by the density of a population.

**Learning Objectives**

- Differentiate between density-dependent and density-independent population regulation.

**Key Points**

- The density of a population can be regulated by various factors, including biotic and abiotic factors and population size.
- Density-dependent regulation can be affected by factors that affect birth and death rates such as competition and predation.
- Density-independent regulation can be affected by factors that affect birth and death rates such as abiotic factors and environmental factors, i.e. severe weather and conditions such as fire.
- New models of life history incorporate ecological concepts that are typically included in r- and K-selection theory in combination with population age structures and mortality factors.

**Key Terms**

- **interspecific**: existing or occurring between different species
- **intraspecific**: occurring among members of the same species
• **fecundity**: number, rate, or capacity of offspring production

## Density-dependent regulation

In population ecology, density-dependent processes occur when population growth rates are regulated by the density of a population. Most density-dependent factors, which are biological in nature (biotic), include predation, inter- and intraspecific competition, accumulation of waste, and diseases such as those caused by parasites. Usually, the denser a population is, the greater its mortality rate. For example, during intra- and interspecific competition, the reproductive rates of the individuals will usually be lower, reducing their population’s rate of growth. In addition, low prey density increases the mortality of its predator because it has more difficulty locating its food source.

An example of density-dependent regulation is shown with results from a study focusing on the giant intestinal roundworm (*Ascaris lumbricoides*), a parasite of humans and other mammals. The data shows that denser populations of the parasite exhibit lower fecundity: they contained fewer eggs. One possible explanation for this phenomenon was that females would be smaller in more dense populations due to limited resources so they would have fewer eggs. This hypothesis was tested and disproved in a 2009 study which showed that female weight had no influence. The actual cause of the density-dependence of fecundity in this organism is still unclear and awaiting further investigation.

![Fecundity as a Function of Population](https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_General_Biology_(Boundless)/45%3A_P…)

Figure \(\PageIndex{1}\): **Effect of population density on fecundity**: In this population of roundworms, fecundity (number of eggs) decreases with population density.

## Density-independent regulation and interaction with density-dependent factors

Many factors, typically physical or chemical in nature (abiotic), influence the mortality of a population regardless of its density. They include weather, natural disasters, and pollution. An individual deer may be killed in a forest fire regardless of how many deer happen to be in that area. Its chances of survival are the same whether the population density is high or low.

In real-life situations, population regulation is very complicated and density-dependent and independent factors can interact. A dense population that is reduced in a density-independent manner by some environmental factor(s) will be
able to recover differently than would a sparse population. For example, a population of deer affected by a harsh winter will recover faster if there are more deer remaining to reproduce.
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