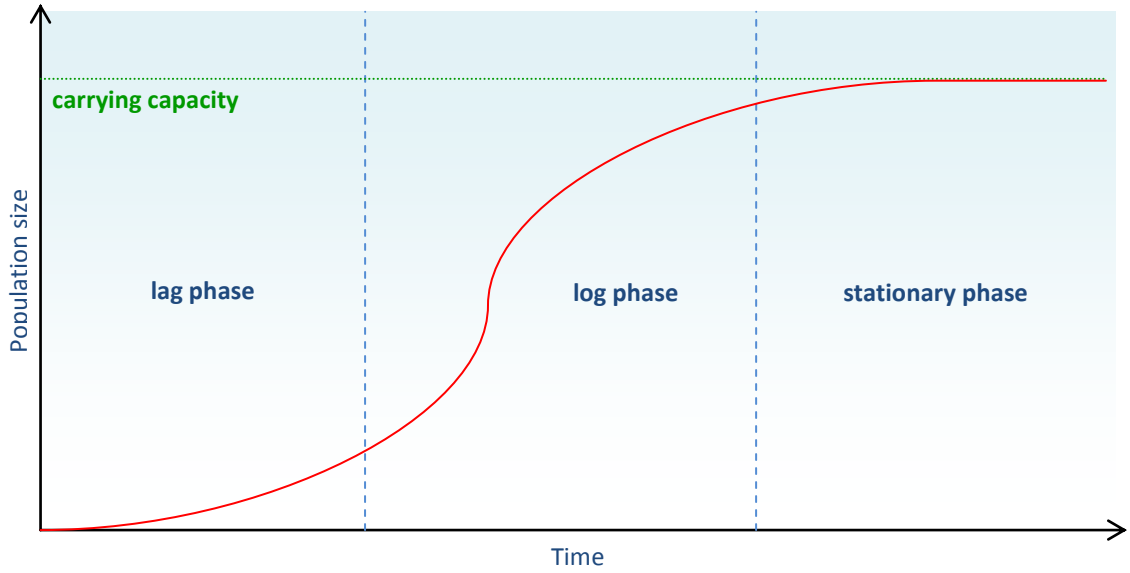
7.5 Populations

Carrying capacity and factors affecting population sizes within communities/ecosystems

Population growth and carrying capacity

In most ecosystems, the number of individuals of a species (its *population*) will fluctuate over time, but this is not a strict rule. Sometimes, population sizes can remain fairly constant over a long period, and in other cases, a sudden event can cause a dramatic increase or decrease in the number of individuals. The size of a population boils down to the difference between the **mortality rate** (death rate) and **reproduction rate** (birth rate).



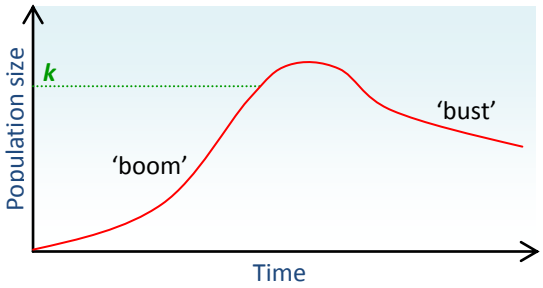
- During the **lag phase** there may only be a few individuals, still acclimatising to their habitat, and at this point the **reproduction rate** (***r***) is low and the growth rate of the population is slow
- During the **log phase** (exponential phase), resources are plentiful and conditions are good, and the reproduction rate increases significantly, exceeding mortality rate, and as a result, population size increases rapidly during this phase
- During the **stationary phase** the habitat itself cannot support a larger population size, which has levelled out to the point where the habitat is said to have reached its **carrying capacity** (***k***), so the rates of reproduction and mortality are equal, so the population size stays about the same, with very small fluctuations

When a species within a habitat reaches its carrying capacity, the habitat cannot support a larger population because of any combination of **limiting factors**, such as: the availability of food/prey, suitable space, weather and abiotic factors, predation, competition, disease and parasites, etc. The carrying capacity is the upper limit that these factors place upon the population size.

k- and *r*-strategists

Species whose population size is determined by the carrying capacity are often called ***k*-strategists**. For these populations, the limiting factors exert a more and more significant effect the closer the population approaches its carrying capacity, causing the population size to gradually level out.

However, some species adopt a different type of population growth. In these cases, the population size increases so quickly that it can exceed the carrying capacity of the habitat before the limiting factors have time to come into effect. Unfortunately for the species, once the carrying capacity has been exceeded, this clearly means there will not be enough resources to allow many members to reproduce (or even survive), and an excessive build up of waste products may begin to poison them, entering the species into the *death phase*. This is a **boom and bust** type of population growth, and the species which adopt this are called ***r*-strategists**.



For *r*-strategists the most important factor affecting growth rate within the population is the rate at which they can reproduce (*r*). This is a characteristic attribute for species with short generation times, such as bacteria, and also of **pioneer species** (see 7.3 Succession). Quick population growth means a pioneer *r*-strategist species can occupy a disturbed habitat before a species of *k*-strategists, dispersing to other habitats once limiting factors start to take effect.

Predator and prey relationships

Predators hunt prey. Therefore it only makes sense that **predation** is one of the limiting factors on the population size of prey, and in turn, any change in population size of the prey will have an effect on population size for the predator. Obviously, as more prey are eaten, this reduces the number of individuals of that species (hence the limiting factor), but the decrease in number of available prey acts as a limiting factor (lack of food) for the predator species. The graph shows how the numbers fluctuate in an otherwise controlled ecosystem.