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r and k Selected Species

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Differences between r and k selected species:

In ecology, r/k selection theory relates to the selection of combinations of traits in an organism that trade off between quantity and quality of offspring. The focus on either an increased quantity of offspring at the expense of individual parental investment of r-strategists, or on a reduced quantity of offspring with a corresponding increased parental investment of k-strategists, varies widely, seemingly to promote success in particular environments. The concepts of quantity or quality

offspring are sometimes referred to as "cheap" or "expensive", a comment on the expendable nature of the offspring and parental commitment made. The stability of the environment can predict if many expendable offspring are made or if fewer offspring of higher quality would lead to higher reproductive success. An unstable environment would encourage the parent to make many offspring, because the likelihood of all of the majority of them surviving to adulthood is slim. In contrast, more stable environments allow parents to confidently invest in one offspring because they are more likely to survive to adulthood.

The terminology of r/K-selection was originally proposed by two ecologists Robert MacArthur and Edward O. Wilson in 1967 based on their work on island biogeography.

In r/K selection theory, selective pressures are hypothesised to drive evolution in one of two generalized directions: *r*- or *K*-selection. These terms, *r* and *K*, are drawn from standard ecological algebra as illustrated in the simplified Verhulst model of population dynamics:

$$\frac{dN}{dt} = rN\left(1 - \frac{N}{K}\right)$$

where N is the population, r is the maximum growth rate, K is the carrying capacity of the local environment, and dN/dt, the derivative of N with respect to time t, is the rate of change in population with time. Thus, the equation relates the growth rate of the population N to the current population size, incorporating the effect of the two constant parameters r and K.

R-selected species, also called r-strategist, species whose populations are governed by their biotic potential (maximum reproductive capacity, r). r-selected species are those that emphasize high growth rates, typically exploit less-crowded ecological niches, and produce many offspring, each of which has a relatively low probability of surviving to adulthood (i.e., high r, low K). A typical r species is the dandelion.

In unstable or unpredictable environments, r-selection predominates due to the ability to reproduce rapidly. There is little

advantage in adaptations that permit successful competition with other organisms, because the environment is likely to change again. Among the traits that are thought to characterize r-selection are high fecundity, small body size, early maturity onset, short generation time, and the ability to disperse offspring widely. Organisms whose life history is subject to r-selection are often referred to as r-strategists or r-selected. Organisms that exhibit r-selected traits can range from bacteria and diatoms, to insects and grasses, to various semelparous cephalopods, oysters, corals, Daphnia and small mammals, particularly rodents.

K-selected species—that is, species whose population sizes fluctuate at or near their carrying capacity (K)—make up the second strategy. K-selected species display traits associated with living at densities close to carrying capacity and typically are strong competitors in such crowded niches that invest more heavily in fewer offspring, each of which has a relatively high probability of surviving to adulthood (i.e., low r, high K). r-selected species are occasionally referred to as "opportunistic" whereas K-selected species are described as "equilibrium".

In stable or predictable environments, K-selection predominates as the ability to compete successfully for limited resources is crucial and populations of K-selected organisms typically are very constant in number and close to the maximum that the environment can bear (unlike r-selected populations, where population sizes can change much more rapidly).

Traits that are thought to be characteristic of K-selection include large body size, long life expectancy, and the production of fewer

offspring, which often require extensive parental care until they mature. Organisms whose life history is subject to K-selection are often referred to as K-strategists or K-selected. Organisms with K-selected traits include large organisms such as humans, elephants, bats, horses, lemurs, giraffes, and whales, birds, but also smaller long-lived organisms such as Arctic terns, parrots and eagles.

The production of numerous small offspring followed by exponential population growth is the defining characteristic of r-

selected species. They require short gestation periods, mature quickly (and thus require little or no parental care), and possess short life spans. Unlike K-selected species, members of this group are capable of reproduction at a relatively young age; however, many offspring die before they reach reproductive age.

In addition, r-selected species thrive in disturbed habitats, such as freshly burned grasslands or forests characterized by canopies that open abruptly, such as when a forest's tallest trees have been

knocked down by a windstorm. Temporary environments, such as vernal ponds and carrion, also harbour r-selected species. Under such conditions those organisms respond opportunistically, becoming the first ones to stake their claims to unused resources, such as nutrients, sunlight, and living space. Although their numbers may soar initially after an unpredictable event disturbed a habitat in which they reside or can easily colonize, this effect is often temporary. When other, more-competitive species move in or when the effects of overcrowding set in, the population will often decline rapidly.

Because of their reproductive strategy and parental care most k-selected species tend to survive for the majority of their maximum possible lifespan. Most r-selected species only tend to live for a very short time, the vast majority dying after a short period of time. However, those few who do survive to a reproductive age can live for very long periods of time. For instance trees may produce many thousands of seeds that develop into tiny seedlings. Only a very few of these will survive and grow into an adult tree, but those that do can live for a very long time.

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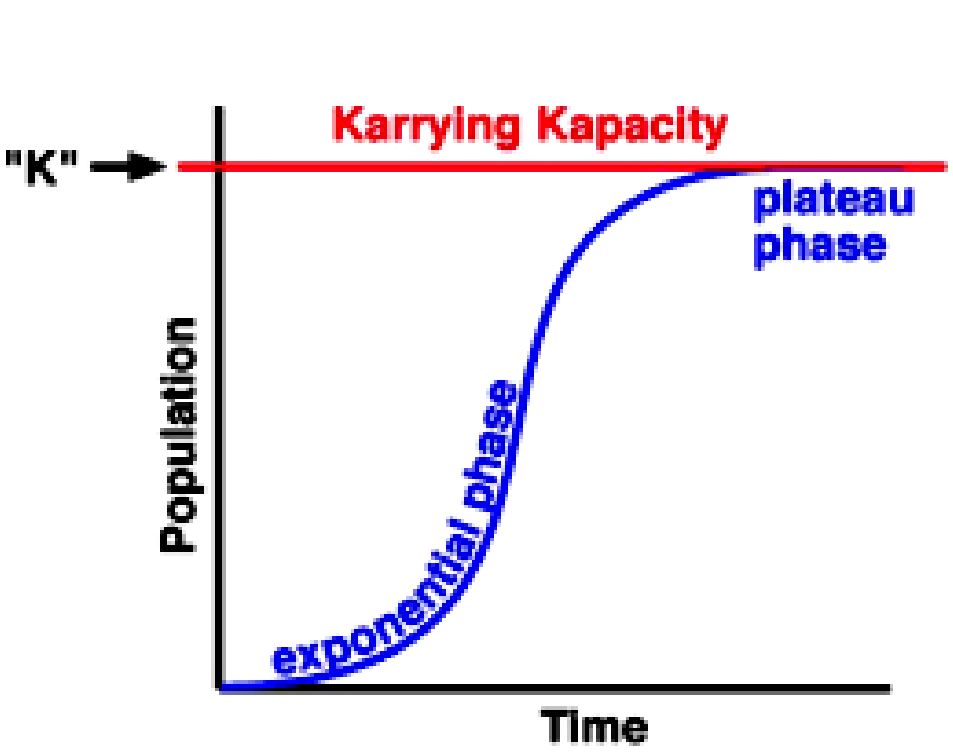
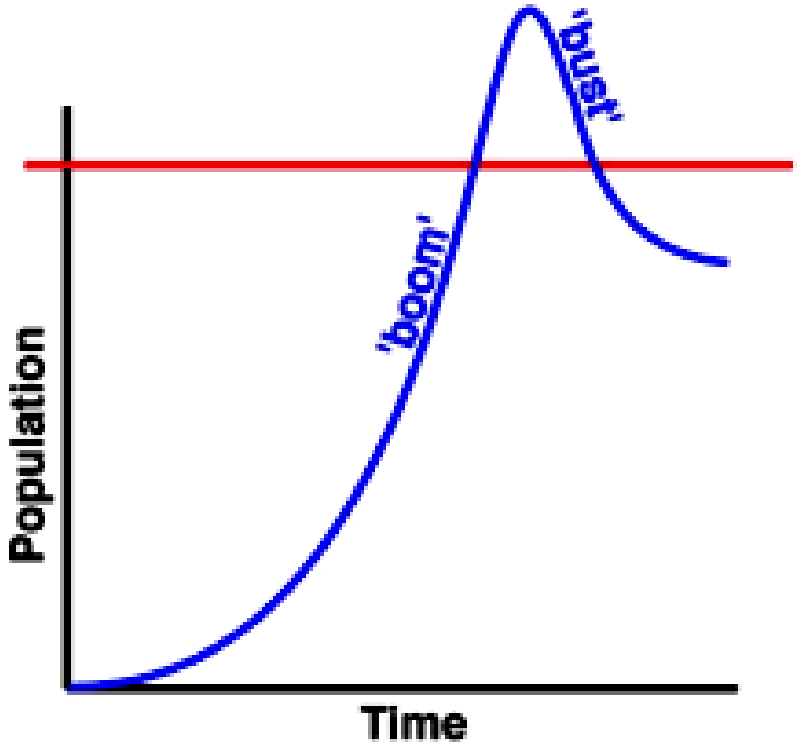


K-species



r-species

R selected species exhibit very rapid growth into new, uncolonised areas. They reproduce and spread quickly but are less competitive and are dependant on invading new areas to survive. When conditions are right they produce huge numbers of offspring ("population boom"), often more than the environment can sustain (carrying capacity) and so this is often followed by a sharp decline in numbers ("population bust"). These species tend to spend most of their time in a reproductive 'r' phase.

K selected species exhibit slower growth but are more competitive in their environment. They tend to reproduce until the population reaches the environmental carrying capacity. Their numbers tend to fluctuate very little around the carrying capacity and are therefore fairly constant ('k' phase).

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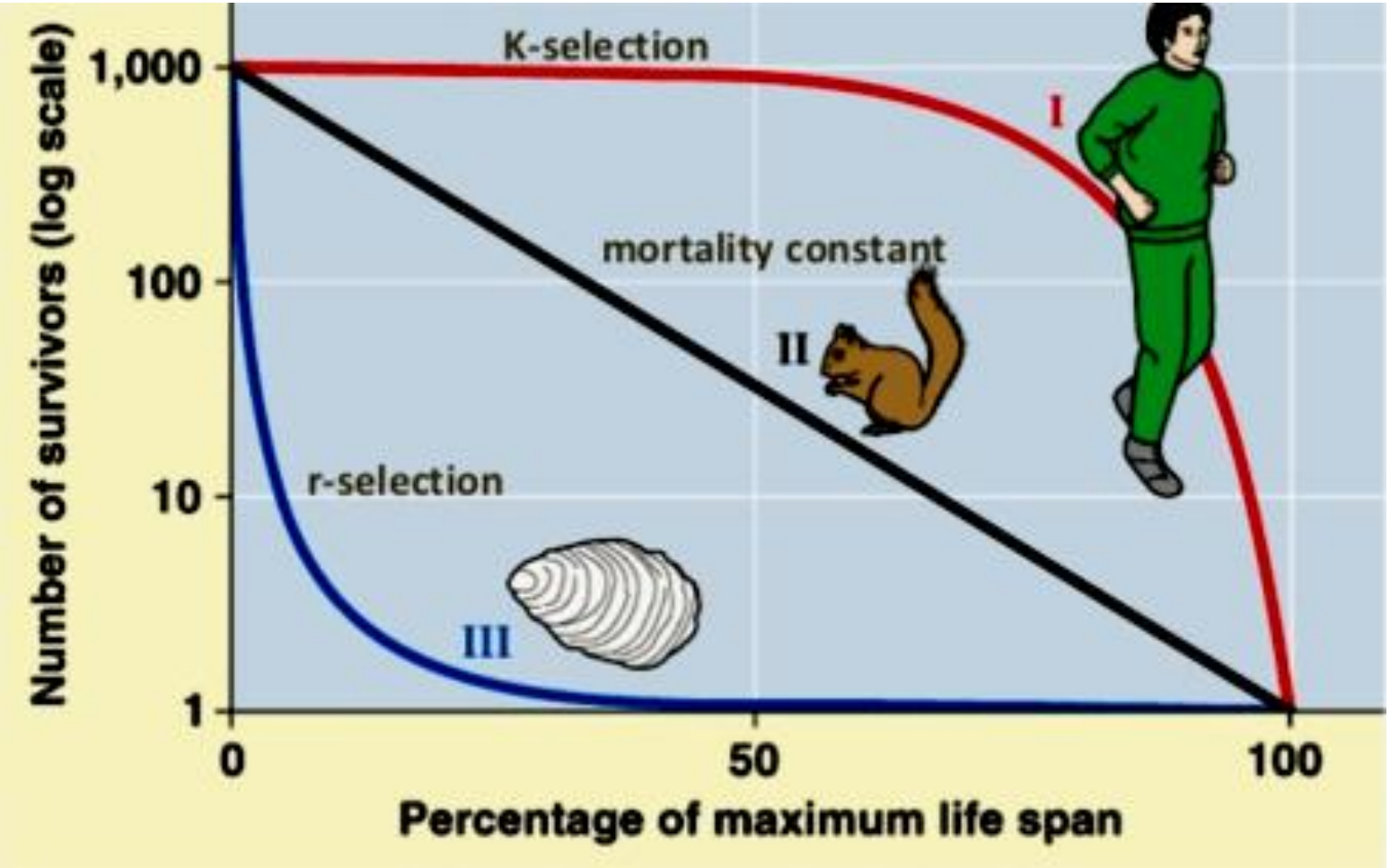
Survivorship Curve for r and k selected species:



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The table below summarizes some of the differences between r-organisms and K-organisms:

Characteristics of r- and K-selected organisms	
r-organisms	**K-organisms**
Unstable environment	Stable environment
Climate variable and unpredictable	Climate constant and predictable
Population size variable and well beyond carrying capacity (K)	Population size constant and at carrying capacity (K)
Exponential population growth	Sigmoid population growth
J-shaped growth curve	S-shaped growth curve
Life span short-lived/ Short life	Life span long-lived/ Long life

expectancy	expectancy
Small size of organism	Large size of organism
Weak	Strong or well-protected
Energy used to make individuals is low	Energy used to make individuals is high
Waste a lot of energy	Energy efficient is more
Many offsprings are produced	Less offsprings are produced
Population growth rate and development fast	Population growth rate and development slow
Less intelligent	More intelligent
Have large litters	Have small litters
Density-independent factors of population regulation/ Mortality density-independent	Density-dependent factors of population regulation/ Mortality density-dependent

Competition weak	Competition strong
Reproduce at an early age	Reproduce at a late age
Each individual reproduces only once	Each individual reproduce more than once in their lifetime
Reproductive effort high	Reproductive effort low
Early maturation	Late maturation
Death rate high	Death rate low
Parental care little or absent	Parental care present
Little care for offspring	Much care for offspring
Pioneer species	Climax species
Strong sex drive	Weak sex drive
Small size of offsprings at birth	Large size of offsprings at birth
Follow Type III Survivorship	Follow Type I or Type II

Curve in which most of the individuals die within a short time but a few live much longer	Survivorship Curve in which most individuals live to near the maximum life span

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THANK YOU