Topic III Population – Study Notes/Test Practice

1. Population Biology Concepts:

Population Ecology – The study of factors that cause populations to increase or decrease

Carrying capacity – the limit to how many individuals a food supply can sustain

Reproductive strategies – K-selected species and r-selected species

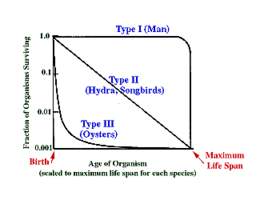
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| --- | --- | --- |
| Trait | K-selected species | r-selected species |
| Life span | Long | Short |
| Time to reproductive maturity | Long | Short |
| Number of reproductive events | Few | Many |
| Number of offspring | Few | Many |
| Size of offspring | Large | Small |
| Parental care | Present | Absent |
| Population growth rate | Slow | Fast |
| Population regulation | Density dependent | Density independent |
| Population dynamics | Stable near carrying capacity | Highly variable |

Density dependent – factors that influence an individual’s probability of survival and reproduction in a manner that depend on the size of the population (availability of food)

Density independent – factors that have the same effect on an individual’s probability of survival and amount of reproduction at any population (tornados, floods, fires etc.)

Limiting resource – a resource that a population cannot live without and which occurs in quantities lower that the population would require to increase in size (if this decreases so does the size of a population that depends on it)

Survivorship – patterns of survival over time (survivorship curves); 3 basic types (I, II, and III); K-selected species tend to exhibit Type I – show excellent survivorship until old age; r-selected species tend to exhibit Type III – show very low rates of survivorship early in life; Type II represents a relatively constant decline in survivorship over time.



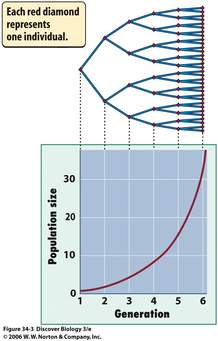
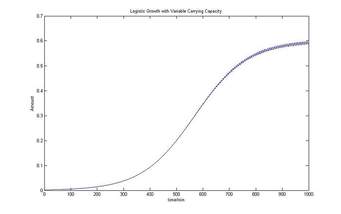
Growth rate – the number of offspring an individual can produce in a given time period, minus the deaths of the individual or its offspring during the same period

Corridor – a strip of natural habitat that connects separated populations

Metapopulation – a group of spatially distinct populations that are connected by occasional movements of individuals between them

Intrinsic growth rate – the maximum potential for growth in a population (in ideal conditions with unlimited resources available)

Exponential growth model – when populations are not limited by resources, their growth can be very rapid – more births occur with each step in time, creating a J-shaped growth curve

Logistic growth model - describes a population whose growth is initially exponential, but slows as the population approaches the carrying capacity of the environment; the pattern of this type of population growth follows an S-shaped curve

Competitive exclusion principle – this principle states that “two species competing for the same limiting resources cannot coexist”

Resource partitioning – when two species divide a resource based on differences in the species behavior or morphology (temporal – use the same resource, but at different times; spatial – two species reduce competition by using different habitats; and morphological –evolution of differences in body size or shape such as teeth or beaks)

Ecological succession – the predictable replacement of one group of species by another group of species over time

Primary succession – occurs on surfaces that are initially devoid of soil, such as an abandoned parking lot, newly exposed rock left behind after glacial retreat, or newly cooled lava

Secondary succession – occurs in areas that have been disturbed but have not lost their soil (follows an event, like a forest fire or hurricane that removes vegetation but leaves soil intact)

Pioneer species – a species that can colonize new areas rapidly

Theory of Island Biogeography - a theory that demonstrates the dual importance of habitat size and distance in determining species richness

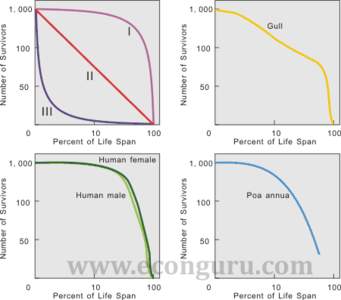
Species richness – the number of species in a given area

Species diversity – the variety of species within a given ecosystem

Species evenness – the relative proportion of different species in a given area

Test Practice: Preparing for the Exam…..Multiple Choice Questions

1. Which of the following is *not* an example of a density-independent factor?
2. Drought
3. Competition
4. Forest fire
5. Hurricane
6. Flood
7. As the size of a white-tailed deer population increases,
   1. the carrying capacity of the environment for white-tailed deer will be reduced.
   2. a volcanic eruption will have a greater proportional effect than it would on a smaller population.
   3. the effect of limiting resources will decrease
   4. the number of gray wolves, a natural predator of white-tailed deer, will increase,
   5. White-tailed deer are more likely to become extinct.
8. The following graph of the population growth of Canada geese in Ohio between 1955 and 2002 can best be described as
   1. An exponential growth curve.
   2. A logistic growth curve
   3. A stochastic growth curve
   4. Oscillation between overshoot and die-off
   5. Approaching the carrying capacity
9. Which of the following is *not* a statement of the logistic growth model?
   1. Population growth is limited by density-dependent factors.
   2. A population will initially increase exponentially and then level off as it approaches the carrying capacity of the environment.
   3. Future population growth cannot be predicted mathematically.
   4. Population growth slows as the number of individuals approaches the carrying capacity.
   5. A graph of population growth produces an S-shaped growth curve over time.
10. Which of the following characteristic are typical of r-selected species?
11. The produce many offspring in a short period of time
12. They have very low survivorship early in life
13. They take a long time to reach reproductive maturity
    1. I only
    2. II only
    3. III only
    4. I and II
    5. II and III
14. A high intrinsic growth rate would most likely be characteristic of
    1. a K-selected species such as elephants
    2. an r-selected species such as the American bullfrog
    3. a K-selected species that lives near its carrying capacity
    4. a species that is near extinction
    5. a species with a low reproductive rate that takes a long time to reach reproductive maturity
15. Which of the following descriptions *best* matches the survivorship curves presented below



* 1. Type I could represent the house mouse, which is a typical r-selected species.
  2. Type II could be the average of r-selected and K-selected species in a specific area.
  3. Type III could represent elephants, which are typical K-selected species.
  4. Type I could represent an oak tree species that experiences very low survivorship early and late in life.
  5. Type II could represent a coral species that has a constant decline in survivorship throughout its life.

1. In the coniferous forests of Oregon, eight species of woodpeckers coexist. Four species select their nesting sites based on tree diameter. The fifth species nests only in fir trees that have been dead for at least 10 years. The sixth species also nests in fir trees, but only in live or recently dead trees. The two remaining species nest in pine trees, but each selects trees of different sizes. This pattern is an example of
   1. resource partitioning
   2. commensalism
   3. true predation
   4. predator-mediated competition
   5. a keystone species
2. Which of the following statements about ecological succession is correct?
   1. Secondary succession is followed by primary succession.
   2. Primary succession occurs over a shorter time span than secondary succession.
   3. Succession is influenced by competition for limiting resources such as available soil, moisture, and nutrients.
   4. In forest succession, less shade-tolerant trees replace more shade-tolerant trees.
   5. Forest fires and hurricanes lead to primary succession because a soil base still exists.
3. Which of the following sequences of secondary succession would be likely to occur in abandoned farmland in the eastern United States?
   1. Bare soil, lichens, mosses, grasses, deciduous trees
   2. Bare rock, lichens, mosses, grasses, shrubs, mixed shade- and sunlight-tolerant trees
   3. Bare soil, grasses and wildflowers, shrubs, shade-tolerant trees
   4. Bare soil, grasses and wildflowers, shrubs, sunlight-tolerant trees, shade-tolerant trees.
   5. Bare rock, grasses and wildflowers, lichens, mosses, shrubs, coniferous trees
4. The theory of island biogeography suggests that species richness is affected by which of the following:
5. Island distance from mainland
6. How the island is formed
7. Island size
   1. I only
   2. II only
   3. III only
   4. I and III
   5. II and III

Test Practice: Preparing for the Exam - Free Response Questions

1. The California Department of Fish and Game is developing a plan to connect mountain “habitat islands” that are separated by open areas of flat, arid land in the deserts of southeastern California. The mountain areas are habitats for desert bighorn sheep (*Ovis canadensis*), which move extensively among the islands through habitat corridors. The habitat corridors provide opportunities for recolonization, seasonal migration, and maintenance of genetic variation among the metapopulation of desert bighorn sheep.
   1. Explain what is meant by a metapopulation and how it relates to the desert bighorn sheep. (1 point)
   2. Identify *two* density-dependent factors and one density-independent factor that could affect the populations of desert bighorn sheep. (3 points)
   3. Explain the consequences to the desert bighorn sheep population if the plan to connect the mountain habitat islands is not implemented. (2 points)
   4. Explain how the theory of island biogeography applies to the mountainous are of southeastern California. (4 points)
2. Read the following information, which was posted in the great apes exhibit of the Freemont Zoo, and answer the questions that follow:

The Western lowland gorilla (*Gorilla gorilla*) lives in the moist tropical rainforests of western Africa. The gorillas’ diet consists of fruits, leaves, foliage, and sometimes ants and termites. Occasionally they venture onto farms and feed on crops. Their only natural enemy is the leopard, the only animal other than humans that can successfully kill an adult gorilla. Disease, particularly the Ebola virus, is threatening to decimate large populations of these gorillas in Congo.

The Western lowland gorilla has a life span of about 40 years and produces one offspring every 4 years. Males usually mate when they are 15 years old. Females reach sexual maturity at about 8 years of age, but rarely mate before they are 10 years old.

1. Based on the information above, is the Western lowland gorilla an r-selected or a K-selected species? Provide evidence to support your answer. (3 points)
2. Identify and explain *four* community interactions that involve the Western lowland gorilla. (4 points)
3. Explain what is meant by secondary succession and describe how it may be initiated in a tropical forest. (3 points)

Do the Math……..

*If we know the intrinsic growth rate of a population (r) and the number of reproducing individuals that are currently in the population (N0), we can estimate the population’s future size (Nt) after some period of time (t) has passed. To do this, we can use the exponential growth model Nt = N0ert - where e is the base of the natural logarithms (the ex key on a calculator or 2.72) and t is time.*

A population of deer has an initial population size of 15 individuals (N0 = 15). Assume that the intrinsic rate of growth for a deer is r = .25 or 25%, which means that each deer produces a net increase of .25 deer each year.

1. With this information, predict the size of the deer population 1 year from now. (Show your work.) [Formula: Nt = N0 ert]
2. How large will the deer population be 5 years from now?
3. How large will the deer population be 10 years from now?