Biology 217: Ecology Second Exam Fall 2021   *Name:_____*

There should be 9 pages in this exam - take a moment and check that. Put your name on the first page, and on each page with written questions.

Please fill in the front of the Bubble sheet, including Student ID Number, name, test form, and course information (3100-217-001).

On the answer (bubble) sheet, please fill in: Student ID (<u>All 9 spaces</u> (use leading zeros as needed) , Last Name and First Initial, Course info (3100-217-001) and TEST FORM

. <u>**This is TEST FORM A**</u>

<u>**READ THE ESSAY AND SHORT ANSWER QUESTIONS CAREFULLY!**</u>

The following equations and constants may be helpful:

$\lambda = N_{t+1} / N_t$

$R_o = \sum l_x m_x = \sum l_x b_x$

$N_t = N_o \lambda^t$

$N_t = N_o e^{rt}$

$T = \sum(x\, l_x m_x) / R_o = \sum(x\, l_x b_x) / R_o$

$dN/dt = rN$

$dN/dt = rN(1-N/K)$

$dN/dt = rN(1-N_{1-\tau}/K)$

$dN_1/dt = r_1 N_1(1-N_1/K_1 - \alpha N_2/K_1)$

$dN_2/dt = r_2 N_2(1-N_2/K_2 - \beta N_1/K_2)$

$dN/dt = rn - cNP$

$dP/dt = acNP - mP$

$R_p = S\beta L$

$S_t = 1/\beta L$

$M/N = R/C$

$PV = nRT$

$e = 2.72, \quad \pi = 3.14159$

$\ln(2) = 0.69, \quad \ln(1) = 0$

$E = mc^2$

xkcd.com

Scoring:

Multiple choice (21, @ 2 pts each): _____ x 2 = _____/ 42 points

29) Short Answer _____/ 2 points

30) Short Answer _____/ 6 points

31) Short Answer _____/ 8 points

32) Short Answer _____/ 12 points

33) Essay (Pre-prepared) _____/ 24 points

TOTAL: _____/ **94 points=** _____%

Multiple Choice questions: 2 points each. Please put your answers to this section on the Bubble Sheet. Feel free to use the question sheet for scratch work. Each question has only one correct answer. You will not be penalized for guessing on this section. Fill in your Bubble Sheet carefully. Make sure that the number of the question matches the number whose bubble you're filling in!
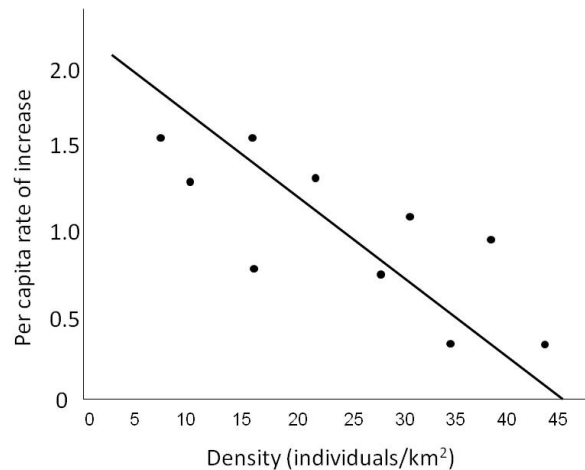
1) The graph below shows the number of Measles cases in Britain over 50 years. In the mid-1960s vaccination began, and by the 1990s over 90% of the population was vaccinated against Measles. Over that time, the number of cases declined to very low levels. In class we learned that the decline in Measles cases was because of:
   a) Herd immunity
   b) Natural cycles
   c) Natural Selection
   d) Superior medical care for the infected individuals
   e) Quarantine of infected individuals
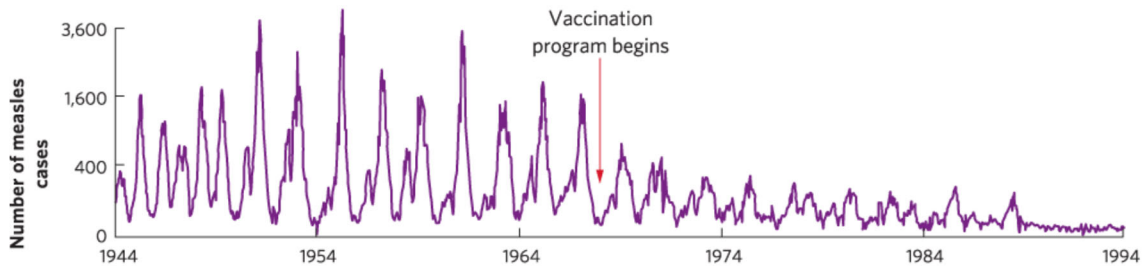
2) Yellow Jewelweed (*Impatiens pallida*) is an annual plant common in our area. Jewelweed seeds germinate in the spring, grows through late summer, and produces new seeds in the fall, after which all of the plants die. Based on this information, which model of population growth would be most appropriate for this species?
   a) Type II survivorship
   b) Geometric
   c) Exponential
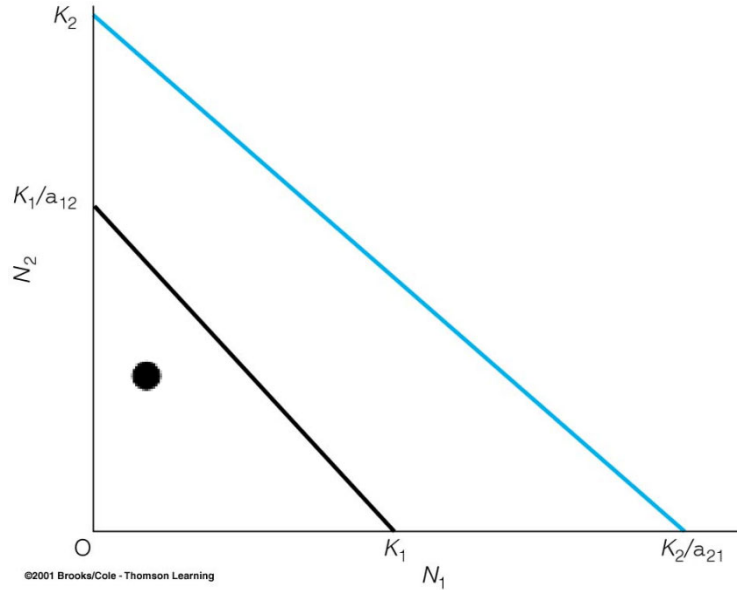   d) Demographic transition

3) Which of the following is a description of a trade-off between life-history traits?
   a) Female beetles that lay the most eggs have a lower survival rate than those laying fewer eggs.
   b) Oak trees with the highest growth rate in a particular year are also the ones that produce the most acorns that year.
   c) Male wasps that mate with many females have a higher growth rate than those that mate with fewer females
   d) Fruit flies that are forced to fly almost all the time are able to produce more offspring than those that are not forced to fly.

4) Ecologists studied lava heron population dynamics in the Galapagos Islands. This graph shows the per capita rate of increase for ten different sites. The lava heron population density varied among the sites, but the availability of resources was about the same. Based on these data, what is the best estimate of the current carrying capacity of the lava heron population on the Galapagos Islands?
   a. 5 individuals/km^2
   b. 15 individuals/km^2
   c. 25 individuals/km^2
   d. 35 individuals/km^2
   e. 45 individuals/km^2

5) A mature female sockeye salmon swims up to 5,000 km from her Pacific Ocean feeding ground to the mouth of a coastal river in British Columbia and then another 1,000 km upstream to her spawning ground. Once there, she lays thousands of eggs in her single reproductive event and promptly dies. The salmon's reproductive life history is
   a) annual
   b) perennial
   c) semelparous
   d) iteroparous

6) When two species provide fitness benefits to each other but do not require each other to persist, they are
   a) competitors
   b) parasites.
   c) predators and prey.
   d) obligate mutualists.
   e) facultative mutualists.

7) The phase plane in this graph shows the ZNGIs for two species competing according to Lotka-Volterra equations. What will be the outcome of this competition?
   a) One species will exclude the other
   b) These species will coexist indefinitely (stable)
   c) Species 1 and 2 will coexist briefly but then one will exclude the other (unstable)
   d) The two species will exhibit population cycles
   e) Type I survivorship

Graph labels: K_2, K_1/a_{12}, N_2, O, K_1, N_1, K_2/a_{21}

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8) Lab experiments of one-predator one-prey systems have demonstrated the importance of _____ and _____ in allowing coexistence.
   a) Resource partitioning and exploitation
   b) Dispersion and efficiency
   c) Prudent predation and functional response
   d) Refuges and immigration
   e) Search image and prey defense

9) How do reservoir species allow parasites to persist in nature?
   a) Reservoir species transmit the parasite more frequently than host species, so the parasite infects a larger number of individuals.
   b) Reservoir species are found near water, where mosquitos are common
   c) Without the reservoir species, the parasite could not disperse from one host to another.
   d) Reservoir species do not die of the parasite and can be a continuous source of the parasite.
   e) Reservoir species cause species to accumulate immunity to them

10) In class we learned that J Phillip Grime proposed that plant life histories can be categorized according to which of the following factors?
   a) Stability – Climate - Geography
   b) Senescence – Reproduction – Size
   c) Stress – Disturbance – Competition
   d) Fast - Slow – Variable
   e) Resource – Environment - Biotic factors

11) When a population grows according to the logistic model, at which of the following population sizes does dN/dt equal zero?
   a) $N = r$
   b) $N = K/2$
   c) $N = K$
   d) $N = N_o e^{rt}$
   e) dN/dt can never be 0

12) Which of the two human populations considered in this figure should have a <u>higher</u> value of r?
   a) I
   b) II
   c) Neither – both are growing at maximum speed
   d) Neither - both are shrinking
   e) Neither- they should have equal values of r
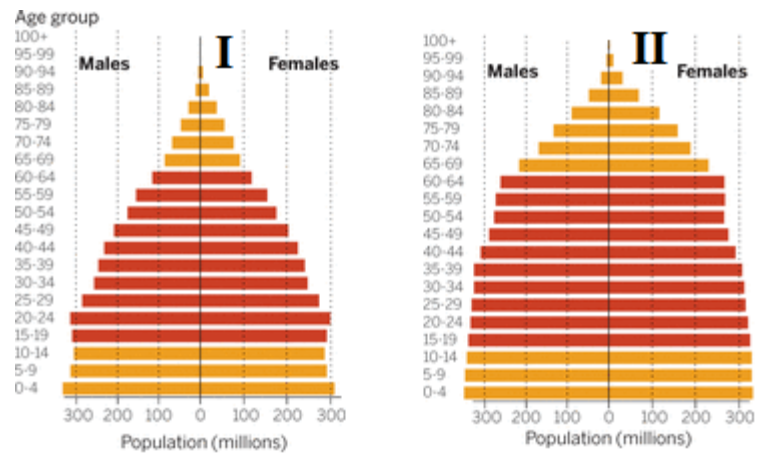
13) The association between bees and flowering plants is a well-known mutualism. What benefit do bees provide flowering plants?
   a) Bees disperse the plant's seeds.
   b) Bees allow plants to fix nitrogen.
   c) Bees lay eggs on the flowers.
   d) Bees spread pollen from one flower to the next.

14) Diseases often exhibit cyclic outbreaks. In class we considered the possibility that this is because:
   a) diseases have a circadian rhythm
   b) diseases have mutualistic interactions with disease vectors like mosquitoes
   c) disease-host-interactions are a form of competitive interaction
   d) disease-host interactions are a form of predator-prey interaction
   e) host susceptibility varies systematically over time

15) In Africa, the foraging activities of hippos stir silt and mud into the water column. As a result, these bodies of water are unsuitable for many species of fish and small invertebrates, although hippos are unaffected. This is an example of:
   a) Mutualism
   b) Predation
   c) Competition
   d) Commensalism
   e) Amensalism

16) Apparent competition
    a) occurs when two species compete without the same limiting resource.
    b) occurs when two species negatively affect each other through a shared enemy.
    c) occurs between two species with multiple limiting resources.
    d) occurs as a result of disturbances or abiotic conditions that favor one species.

17) If you were trying to save an endangered species that lived in a metapopulation, which actions would be most helpful in trying to increase the proportion of occupied patches?
    a) Limit dispersal to only a few patches.
    b) Create barriers around the metapopulation.
    c) Decrease patch isolation.
    d) Increase the number of available patches.

18) Which of the following is most likely to lead to repeating and regular population cycles?
    a) Habitat fragmentation
    b) Delayed density dependence
    c) Demographic stochasticity
    d) Metapopulations
    e) Logistic growth

19) The whooping crane is an endangered species that has removed from near extinction in 1949. Below is a plot of its population size versus time. What type of growth best describes these observed dynamics?
    a) Density-dependent
    b) Exponential
    c) Logistic
    d) Linear
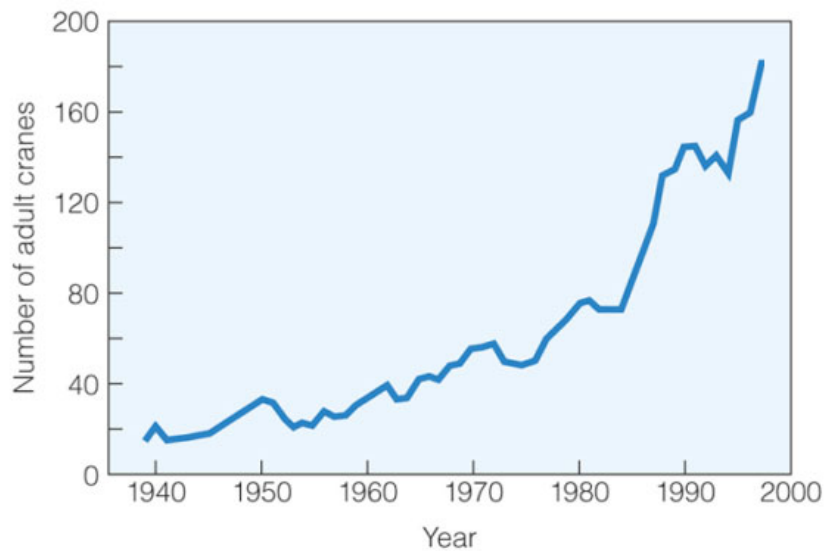
20) Which of the following is a symbiotic mutualism that involves a fungus?
    a) Coral- Zooxanthellae
    b) Ruminant – gut microbe
    c) Bee- Flower
    d) Plant-Mycorrhizae
    e) Legume-Rhizobium

21) During a survey of fish in a river you notice an interesting pattern. The temperature of this river increases gradually from 10C upstream to 15C downstream. One fish species is found in the cooler section upriver, while the other is found in the warmer section downriver. Their distributions do not overlap. Why do these two species have nonoverlapping distributions?
   a) Predation enforces this separation in the realized niche
   b) Each species competitively excludes the other from its section of the river.
   c) The two species have distinctive and nonoverlapping habitat requirements.
   d) It is impossible to answer this question without conducting further experimental studies.

SHORT ANSWER QUESTIONS

22) 2 points. What is the approximate size of the current human population on earth?

   _____

23) 6 points. List **three** of the five actions listed in class as being <u>effective and humane</u> policies for controlling human population growth.

   _____

   _____

   _____

24) 8 points). Draw a fully labeled graph depicting the abundances of a predator and its prey over time, based on what we covered in class. Explain your graph in a sentence or two.

25) 12 points) Modeling COVID:
   a) Briefly explain the main features of an SIR model of disease.
   b) List two of the major assumptions of the basic SIR model covered in class and in your book.
   c) Briefly explain whether and why any one of the assumptions may not apply for the COVID pandemic.

26) 24 points. YOUR REVIEW SHEET HAD 3 QUESTIONS YOU WERE TO PREPARE FOR. OF THOSE, THIS IS THE ONE YOU MUST ANSWER. *REMEMBER*: *your answer should be well reasoned and well written -- outline format is not acceptable (though you may outline the answer for your own benefit on the back of another page).*

Sheep, rabbits, eastern grey kangaroos, and red kangaroos are possible competitors for food in the rangelands of eastern Australia. Sketch out the major features of a research program that would test for competition among these herbivores. Explain how the expected outcomes of your research would relate to the possibility of competition.