Biology 541: Ecology of Fishes & Fisheries Biology
Fall 2003

NAME: _____

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MIDTERM II

You will have up to 60 minutes (beginning at 1400) to complete the exam. The exam is worth 100 pts. and 15% of your final grade. Please budget your time accordingly.
Good luck!

MULTIPLE CHOICE (Questions 1-10) Choose the BEST answer (3 pts each).

1. What property of water allows persistent survival of lentic freshwater fish populations ?
   a. high heat capacity
   b. thermocline
   c. low evaporation rate
   d. density of water at freezing
   e. solvent properties

2. What is the correct order of water layers in lakes as a function of temperature, beginning from the lake bottom and decreasing in depth?
   a. hypolimnion, metalimnion, epilimnion
   b. metalimnion, epilimnion, hypolimnion
   c. epilimnion, hypolimnion, metalimnion
   d. hypolimnion, epilimnion, metalimnion
   e. epilimnion, metalimnion, hypolimnion

3. "Bottom-up" effects are those that are
   a. controlled by consumers
   b. controlled by detritus
   c. controlled by resources
   d. uncontrolled
   e. all of the above

4. A species that lives mainly in freshwater but spawns in the ocean would be termed
   a. oceanadromous
   b. catadromous
   c. diadromous
   d. anadromous
   e. oceanadromous

5. An otter trawl is a piece of fishing gear designed to catch
   a. pelagic fishes
   b. bottom fishes
   c. schooling fishes
   d. estuarine fishes
   e. intertidal fishes

6. You find yourself next to a stream. You follow the stream to higher elevations up a mountain, opposite the direction of water flow, and find that it branches into two streams. You follow one of these streams up the mountain further until you reach the beginning of a headwater stream. The stream in which you originally found yourself would be a
   a. 1st order stream
   b. 2nd order stream
   c. 3rd order stream
   d. 4th order stream
   e. You can't determine the answer, which also is probably why you are hopelessly lost

7. The lottery model is important in structuring reef fish communities if
   a. competition is weak and settlement is modified by post-settlement processes
   b. competition is weak and settlement is not modified by post-settlement processes
   c. competition is intense and settlement is modified by post-settlement processes
   d. competition is intense and settlement is not modified by post-settlement processes
   e. competition and post-settlement processes are unimportant

8. The ideal free distribution predicts that individuals will move from "better" habitats to "poorer habitats" in response to
   a. temperature
   b. the density of individuals
   c. refuge quality
   d. reproduction
   e. none of the above

9. The dilution effect should normally reduce predation risk. However, what response by predators can actually increase predation risk for fish that would benefit from a dilution effect?
   a. functional response
   b. developmental response
   c. numerical response
   d. aggregative response
   e. growth response

10. Extensive vertical migrations over 10's or 100's of meters would be prevalent in what fishes?
   a. freshwater fishes
   b. pelagic fishes (will allow because it includes mesopelagic fishes)
   c. bathypelagic fishes
   d. anadromous fishes
   e. none of the above

SHORT ANSWER / ESSAY

11. Why would hemaphroditism be beneficial in bathypelagic fishes? (4 pts)

Because hermaphroditism means that each individual has both male and female reproductive capability, successful mating would be possible 100% of the time when two individuals come together. This is beneficial in an environment in which the density of individuals of a species may be very low; if hermaphroditism was not evident in a species, chance encounters between individuals would result in mating at best only 50% of the time.

12. (a) What are the terms for lakes that have low vs. high productivity? (2 pts) (b) Contrast the features of these two types of lakes in location, sedimentation, nutrients, and fish production. (4 pts)

oligotrophic = low productivity eutrophic = high productivity

	oligotrophic	eutrophic
location →	mountains, higher elevation	valleys, lower elevation
sedimentation →	low	high
nutrients →	low	high
fish production	low	high

13. Define a trophic cascade (2 pts). How could this ecological concept be used in management practices to increase water clarity? (2 pts)

Trophic cascade = "top-down" effects generated by consumers (carnivores) that cause differences in abundance that alternate with subsequent lower trophic levels

Water clarity would be low because of algal blooms. If you add a piscivore that will eat zooplanktivorous fishes, the zooplankton abundance would increase because the abundance of zooplanktivorous fishes would decrease. In turn, the increase in zooplankton abundance would drive down phytoplankton abundance, increasing water clarity.

14. Contrast mesopelagic and bathypelagic fishes: name four body features and how they differ in these features (6 pts)

	Mesopelagic	**Bathypelagic**
Eyes	Large, developed	Small, regressed
Jaws	Normal	Large, hinged
Musculature	Well developed	Weak, watery
Color	Silvery, countershaded	Black
Photophores	Numerous, countershading	Few, used to lure prey
Gills	Well-developed	Small

Swimbladder	Well developed	Absent or regressed
Skeleton	Bones and scales	Cartilaginous

15. Calculate the estimated population size for the "yellow-throated algae sucker" from the following mark-recapture data, using both the Petersen and modified-Schnabel methods. Show your work. (6 pts)

Sample No.	Unmarked	Marked
1	23	0
2	18	5
3	32	10

Petersen: $N = [(23+1)(23+1)/ (5+1)] -1 = 95$

Modified Schabel: $N = [(23*23^2) + (42*41^2) / (5*23) + (10*41)] = 158$

16. (a) List in order the seven stages of predatory foraging behavior. (7 pts)

1) Motivation
2) Search
3) Detection
4) Selection
5) Pursuit
6) Capture
7) Handling

17. Describe two examples how predators can increase and decrease competition (one example for each) in their prey. (6 pts)

Predators can increase competition by confining prey to refuge areas. Such confinement increases prey density and can thus increase competition among the prey because of higher densities.

Predators can decrease competition by removing prey, thus lowering prey density and relaxing competition. Predators can also selectively remove the superior competitor, releasing an inferior competitor from competition or lowering the intensity of competition.

18. (a) Define altricial and precocial larvae (2 pts). (b) Under what environmental conditions would producing altricial larvae be a better strategy? (2 pts)

a) Altricial larvae are small, poorly developed larvae with much lower yolk reserves for energy use

Precocial larvae are larger, better developed larvae (or juveniles) with large yolk reserves or capability for capturing food

b) If food supply was abundant and more predictable, producing altricial larvae would be a better strategy for dispersal of young and potentially high numbers of survivors.

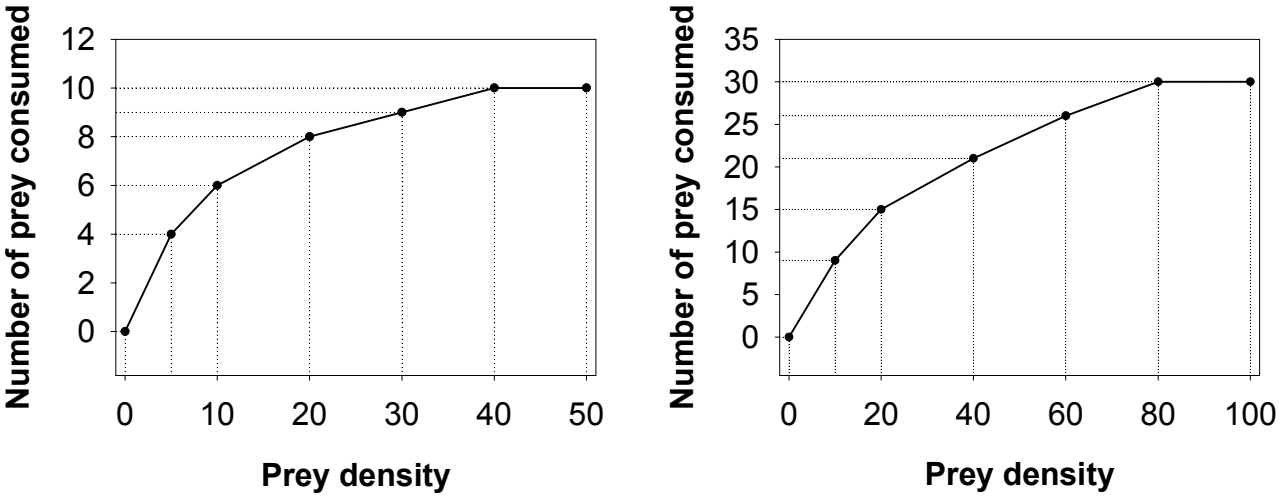
19. Describe the difference between interactive and selective segregation in competition. (4 pts) Why does resource partitioning not necessarily indicate competition? (3pts)

Interactive segregation:
Resource use differs between species when sympatric but not allopatric. This may indicate current competition, but could also be confounded by environmental variation among sites.

Selective segregation:
Patterns of resource use different by adaptations of species (resource partitioning): could have competed in the past but also could have different resource requirements

Resource partitioning does not always indicate competition ("ghost of competition past") because the individual requirements (niche) of a species may just differ independent of competition (autecology)

20. Below are two graphs (the solid line represents the data; the dotted lines show the data values at those points). (a) Interpret these graphs to determine if an individual fish at a density of 80 fish in the right graph has greater or lesser predation risk than a fish at a density of 40 fish in the left graph. Show your work in how you came up with this conclusion. (2 pts) (b) If the graphs below were a result of the functional response only, what **type** of response is indicated? (2 pts) (c) Do these graphs indicate density-dependent mortality? Why or why not? (2 pts)



a) left graph: 10/40 = 0.25 right graph: 30/80 = 0.375

Individual fish at density of 80 fish has greater risk of predation because proportional mortality is larger

b) Type II functional response

c) No, because proportional mortality decreased with prey density. For density dependence to occur, proportional mortality must increase with prey density. For example, in the left graph, 6 fish were consumed at a density of 10 (60% mortality). At the highest density (50), there is only 20 percent mortality.

21. Name and **briefly** describe two equilibrial and two non-equilibrial hypotheses of community structure in marine fishes. (8 pts)

Equilibrial

Niche Diversification hypothesis: competition-based resource partitioning. Each species is a superior competitor in its particular nich

Predation Compensatory Mortality hypothesis: predator feeds on most abundant prey and then switches to next most abundant prey as prey densities converge; allows persistence of inferior competitors

Non-equilibrial

Lottery hypothesis: competition-based, assumes large larval pool; likelihood of obtaining limited space is by chance

Lottery Storage Effect hypothesis: recruitment success of species over time; persistence comes from storage of future reproductive events in long-lived females

Recruitment Limitation hypothesis: high mortality of larvae in pelagic zone; larval supply is below what is required to saturate resources of recruits. No competition, density-independent mortality

Predaton /Disturbance hypothesis: predators reduce numbers of recruits below which resources are saturated. No competition, similar to Recruitment Limitation hypothesis but different mechanism.

22. You are out sampling fishes in the intertidal zone (sound familiar?) and you come across six species and count 90 individuals. In Table 1, allocate the number of individuals among species that would maximize species diversity. (2 pts) In Table 2, allocate the number of individuals among species that would minimize species diversity. (2 pts)

TABLE 1

	# fish
woolly sculpin	15
kelp clingfish	15
crevice clingfish	15
opaleye	15
cabezon	15
cryptic shark	15

TABLE 2

	# fish
woolly sculpin	85
kelp clingfish	1
crevice clingfish	1
Opaleye	1
cabezon	1
cryptic shark	1

23. Consider the papers we read by Carr et al. 2002 and by Doherty and Fowler 1994, and contrast them in how their studies each supports a different hypothesis of what determines the dynamics and regulation of reef fish populations. (6 pts)

Carr et al. tested for post-settlement effects of predators and competitors on mortality of a reef fish manipulated at different densities. They found that both predators and competitors were required for density-dependent mortality to take place. This supports the idea that the dynamics of resident populations of fishes are determined post-settlement through biotic interactions.

In constrast, Dohery and Fowler assert that recruitment limitation is the means by which the dynamics of resident fish populations are driven. They monitored recruitment over several years and by the aging of older individuals concluded that the relationship between recruits and the densities of those cohorts in later years was linear and density-indepent, supporting the idea that the supply of larvae delivered to a reef is the most important factor in determining the structure of populations.