Tropical Ecosystems; Final Exam

Please put all answers into an EXCEL SPREADSHEET with answers in the first column (answers to questions will correspond to the row number in the spreadsheet) and send the excel file to ecodyer@gmail.com by 5PM on Friday, 6-May.

I will not answer questions about the exam until after I have received all spreadsheets.

Read the questions carefully; many are subtly different from other exams I have given.

FOR THE MULTIPLE CHOICE QUESTIONS BELOW, PUT ONLY THE CORRECT LETTER ON THE CORRESPONDING LINE OF THE EXCEL SPREADSHEET

1. In the model of logistic population growth, what is ‘K’?
   a. Intrinsic rate of increase
   b. carrying capacity
   c. constant flux
   d. fixed competition parameter
   e. Konig’s constant

2. Which of the following was NOT one of Darwin's inferences in the *Origin of Species*?
   a. Production of too many individuals leads to a struggle for existence
   b. Only a fraction of offspring survive each generation
   c. Survival in the struggle for existence is not random
   d. Favorable characteristics accumulate over generations
   e. Most populations are continuously growing

3. What does the species richness of a community refer to?
   a. it is the same as species diversity
   b. it is the number of different species
   c. it is both the species diversity and the number of different species
   d. the relative numbers of individuals in each species
   e. the feeding relationships or trophic structure

4. Which of the following communities would probably have the highest diversity of plants and animals?
   a. a tropical forest at 8,000 feet
   b. a tropical forest at 2,000 feet
   c. a temperate forest at 8,000 feet
   d. a temperate forest at 2,000 feet
   e. they would all have about the same level of diversity

5. Which of the following are abiotic conditions found in the tropics?
   a. more solar radiation over the year
b. stronger tradewinds than in temperate areas
c. more species than in temperate areas
d. more variation in temperature
e. all of the above

6. Which of the following are biotic conditions found in the tropics
   a. more solar radiation over the year
   b. stronger tradewinds than in temperate areas
   c. more species than in temperate areas
   d. more variation in temperature
   e. all of the above

7. What factors are associated with a rough forest canopy?
   a. smaller leaves, rich soils, high water availability
   b. smaller leaves, sclerophyll leaves, poor soils
   c. frequent treefalls, crown shyness, rich soils
   d. optimal crown shapes, sclerophyll leaves, rich soils
   e. frequent treefalls, rich soils, high herbivory

8. Stebbins’ “cradle of diversity” refers to:
   a. Low extinction rates in the tropics.
   b. High extinction rates in the tropics.
   c. High speciation rates in the tropics.
   d. Low speciation rates in the tropics.
   e. All of the above.

9. Which of these mechanisms of diversity focuses on abiotic versus biotic differences in tropical versus temperate ecosystems?
   a. Evolutionary time
   b. Climatic predictability
   c. Primary production
   d. Competition
   e. Predation

10. What is the link between beta diversity at a large site and global estimates of the number of species?
    a. Low beta diversity in the tropics indicates that global diversity is high.
    b. Low beta diversity at tropical sites indicates that existing estimates of global diversity are too high.
    c. There is no relationship between local tropical beta diversity and global diversity.
    d. High beta diversity in temperate forests indicates that global diversity is low.
    e. All of the above.

11. Why would plants in rich soils and high light availability have lower levels of chemical defenses and higher levels of herbivory?
    a. because there are fewer herbivores around in areas with rich soils
b. they are carbon limited because of all the nitrogen in the soil, so they can't make carbon-based defenses
c. it is easier for plants in rich soils to replace tissue lost to herbivores, thus, they do not need high levels of chemical defenses
d. poor soils have toxins that plants can sequester as defenses

12. What is a likely pressure that helped select for drip tips in tropical forests?
   a. epiphylls
   b. lots of rain
   c. fungi
   d. photosynthesis
   e. all of the above

13. Which of the following is true about stratification?
   a. Canopy and emergent trees have crowns that are often wider than deep
   b. Subcanopy trees have crowns that are deeper than wide (or =)
   c. Scarce nutrients leads to “smooth canopy”
   d. Some biologists argue that stratification does not exist
   e. All of the above

14. Why do many tropical trees have buttresses?
   a. because of stresses applied by wind or gravity
   b. they function as a water conduction shortcut
   c. because of a negative geotropism
   d. a and c are both possible explanations, b is impossible
   e. a, b, and c are all good explanations

15. Which of the following is true about drip tips?
   a. Drip tips slow water runoff, giving the plant greater access to water.
   b. Drip tips speed water runoff and drying of the leaf surface.
   c. Drip tips prevent caterpillars from eating leaves by dripping water on their little heads and making them leave the plant.
   d. Drip tips are not very common in tropical forests
   e. Drip tips are only found in Bromeliads

16. The term "epiphylls" describes which of the following:
   a. mosses
   b. liverworts
   c. lichens
   d. algae
   e. all of the above

17. What are lianas?
   a. woody vines common in dry forests
   b. thin vines found in disturbed areas
   c. canopy trees
d. tiny plants that grow on the leaf surface

e. rain forest beetles

18. The VEMAP life zone approach utilized by Yates et al. is most useful for:
   a. Addressing specific conservation concerns.
   b. Making broad generalizations about plant species assemblages.
   c. Examining how climate change will affect well-defined ecosystems.
   d. Determining where mutualisms are most likely to occur.
   e. All of the above.

19. According to Dyer et al. (2007)
   a. Tropical caterpillars eat many different species of plants.
   b. Temperate beetles are specialists.
   c. The number of species of plants eaten by caterpillar species increases with latitude.
   d. All caterpillars are specialists.
   e. none of the above

20. Which of the following is true about leaf area index?
   a. it is the total leaf area in a forest
   b. it is greater in tropical versus temperate forests
   c. it is an index of herbivory
   d. it is greatest in savannahs
   e. none of the above

21. Which of the following is true about the dry forest life zone?
   a. .5-2m rainfall/year; prolonged dry season
   b. often merge with savannas
   c. D. Janzen says it is the most endangered ecosystem
   d. trees are deciduous
   e. all of the above

22. Which of the following is true of the Paramo life zone?
   a. occurs at low elevations
   b. dominated by shrubs and grasses
   c. D. Janzen says it is the most endangered ecosystem
   d. trees are deciduous
   e. none of the above

23. Which of the following is true about savannas
   a. they are only found in the old world
   b. very large grassland ecosystems
   c. damaged irreparably by fires and human disturbance
   d. trees are absent
   e. all of the above

24. Cloud forests have
   a. moisture from lowland forests rises and cools, creating mist
b. found in at least 8 different life zones
c. many ferns, mosses, epiphytes
d. high levels of endemism
e. all of the above

25. In the figure above, LS = La Selva, HF = Harvard Forest, Mc = McAbee, BC in the Eocene; Coleoptera = beetles, Hemiptera = bugs. Archibald et al. (2010) used these data to argue that:
A. These data support the hypothesis that the high diversity of beetles and bugs in the tropics is due to greater land mass.
B. Eocene temperate latitudes had lower diversity of bugs and beetles than current tropical and temperate latitudes.
C. Eocene temperate latitudes had the same temperatures as modern day La Selva, thus there were higher diversities of beetles and bugs
D. The low seasonality found in La Selva and Eocene temperate latitudes are responsible for the higher diversities of beetles and bugs at these sites compared to the low diversities associated with highly seasonal sites, such as Harvard Forest.
E. All of the above
26. In the figure above, Mittelbach (2007) presents these hypotheses:
   A. (a) competition is more intense in the temperate zone (thus a higher carrying capacity); (b) there are higher diversification rates in the tropics (speciation minus extinction); and (c) tropical ecosystems have had more time for diversification.
   B. (a) niches are responsible for differences in temperate versus tropical diversity (higher carrying capacity in the tropics for all populations); (b) there are higher diversification rates in the tropics (speciation minus extinction); and (c) tropical ecosystems have had more time for diversification.
   C. (a) niches are responsible for differences in temperate versus tropical diversity (higher carrying capacity in the tropics for all populations); (b) there are higher extinction rates in the tropics; and (c) temperate ecosystems have had more time for diversification.
   D. (a) niches are responsible for differences in temperate versus tropical diversity (higher carrying capacity in the tropics for all populations); (b) there are higher extinction rates in the tropics; and (c) tropical ecosystems have had more time for diversification.
   E. (a) competition is more intense in the temperate zone (thus a higher carrying capacity); (b) there are higher extinction rates in the tropics; and (c) tropical ecosystems have had more time for diversification.
27. In the figure above, Novotny et al. (2007) found that
A. Most of the species beyond 100 km of the Madang study site were new species.
B. Beta diversity was very high between Madang and sites up to 500 km away.
C. At least 70% of the Madang species were not found at other sites.
D. At considerable distances from the Madang study site, there were very few new species.
E. None of the above.

28. In the figure above, why did Hubbell et al. (1999) correct their measure of species richness by calculating richness per plant stem?
A. Number of stems is negatively correlated with richness.
B. They were interested in forest-wide number of species per stem.
C. They viewed any increase in species that was due to greater stem densities as a sampling anomaly.
D. Number of stems always results in greater numbers of plant species.
E. All of the above.
29. In the figure above, Jetz et al. 2009 examined relationships between plant diversity (Plants), animal diversity (Primary and Higher-level), and environmental variables (WetDays and Temp). Based on the results shown above, they concluded:

A. Most of the animal diversity in the tropics is caused by high plant diversity.
B. Plant diversity is not correlated with animal diversity.
C. Plant and animal diversity are correlated mostly because both are increased by the same environmental factors.
D. Both B and C are correct.
E. Both A and C are correct.
30. In the figure above,
   A. A is Oceania, B is Afrotropic, and G is Indo-Malay
   B. A is Oceania, D is Afrotropic, and F is Australasia
   C. C is Neotropic, E is Afrotropic, and F is Indo-Malay
   D. C is Neotropic, E is Afrotropic, and G is Indo-Malay
   E. A is Oceania, F is Afrotropic, and G is Australasia
31. The figure above from Novotny et al. (2010) demonstrates that:
   A. As more plant species were examined, herbivore generalization increased.
   B. Their quantification of host specialization included numerous congenic host species per herbivore.
   C. Most species that they categorized as “generalists” were consuming plants in different genera.
   D. All of the plants at PNG are in different genera.
   E. None of the above is true.
32. Schnitzer and Carson (2001) used the patterns displayed in the figure above to argue:
   A. Recruitment limitation is the reason why no plant groups are more diverse in gaps.
   B. Pioneer tree species and at least some species of lianas appear to require gaps for successful regeneration or to reach reproductive maturity.
   C. Pioneers do not occur in gaps.
   D. Shade-tolerant trees do not occur in gaps.
   E. Diversity for shade-tolerant trees is increased by the occurrence of gaps.

33. What is the purpose of most floral nectar?
   A. attracting pollinators
   B. attracting herbivores
   C. making humans high
   D. deterring herbivory
   E. curing cancer

34. What is a secondary compound?
   A. a drug synthesized by humans
   B. any toxic substance produced by a plant
   C. a compound synthesized by plants that is not necessary for normal life processes
   D. a carbohydrate synthesized by plants an amino acid synthesized by animals
35. The compounds above are:
   A. Terpenoids
   B. Cyanogenic glycosides
   C. Alkaloids
   D. Saponins
   E. None of the above

36. Why would plants in poor soils have higher levels of chemical defenses?
   A. because there are more herbivores around in areas with poor soils
   B. they are carbon limited because of the low soil nutrients, but nitrogen is freely available, so they make very high levels of alkaloids
   C. it is harder for plants in poor soils to replace tissue lost to herbivores, thus, they have evolved higher levels of carbon-based chemical defenses
   D. poor soils have toxins that plants can sequester as defenses
   E. this is usually not true

37. Based on data presented in the figure above (richness of tropical taxa is represented by open bars), Poulin concluded that:
   A. there are more species of fish parasites in all temperate versus tropical fish taxa
   B. there are more species of fish parasites in all tropical versus temperate fish taxa
   C. the diversity of tropical and temperate fish parasites is very similar once phylogenetically independent contrasts are examined
   D. no conclusions are possible because there is pseudoreplication with respect to phylogeny
E. phylogenetically independent contrasts revealed that fish parasite diversity was always higher in temperate versus tropical fish communities.

38. Based on data presented in the figure above, Van Bael and Brawn concluded that:
A. The positive effects of bird exclosures on herbivory were greatest in dry forest canopy leaves, partly due to greater bird foraging over two seasons and two years.
B. Dry forests had leaves that were better defended than those in moist forests for two seasons across two years.
C. Leaves in the dry forest canopy had the highest levels of bird foraging, resulting in the largest decline in herbivory when birds were excluded.
D. Leaves in the wet forest canopy had the highest levels of bird foraging, resulting in the largest decline in herbivory when birds were excluded.
E. None of the above.
39. Based on the phylogeny above, Smith et al. concluded:
   A. These taxa of hylid frogs are most diverse in the tropics, reflecting intense competition between tropical hylids.
   B. These taxa of hylids exhibit similar patterns of diversification at different longitudes and they are probably restricted from dispersal to adjacent habitats due to strict niche conservatism.
   C. These taxa exhibit a random distribution throughout their range, as demonstrated by shaded areas.
   D. The North American hylids form a monophyletic group.
   E. None of the above.

![Figure 2](image)

**Figure 2.** Latitudinal patterns in the turnover of sciurid genera throughout the world, calculated according to Wilson and Shimida’s (1984) index. For the numbers relative to the latitudinal bands, see Table 1.

40. In the figure above, bands 6-13 are tropical. This figure indicates:
   A. Genera in band 8 are found in most other bands.
   B. Genera in band 4 are unlikely to be found in other bands.
   C. Band 12 has many genera that are not found in other bands.
   D. Turnover of genera increases as you go up in latitude.
   E. None of the above are true.

41. Fig plants have evolved very close associations with which type of pollinator?
   A. flies
   B. butterflies
   C. wasps
   D. birds
42. According to the figure above from Kursar et al. (2009), one could conclude the following:

A. the search for anticarcinogens in the tropics is unlikely to yield active secondary compounds
B. young leaves cure cancer
C. mature leaves are nutritious
D. focusing on young leaves in tropical forests increases the probability of discovering anticarcinogens because they contain more toxic secondary metabolites
E. focusing on mature leaves in tropical forests increases the probability of discovering anticarcinogens because their activity is similar to that of extracts prepared by the National Cancer Institute (NCI)
43. In the figure above:
   A. Fabaceae is less common than expected in Lambir
   B. Rutaceae is less common than expected in Lambir
   C. Rubiaceae is more common than expected in Lambir
   D. Ficus is more common than expected in Lambir
   E. None of the above

The following figure (from Dyer 2009) is for questions 44-46.

44. Which path coefficients in the diagram above are most relevant to the results from van Bael and Brawn (bird exclosure experiments) and Sinclair et al. (studies of artiodactyla and carnivora in the Serengeti).
   A. A2 and C3
   B. C1 and B3
   C. B3
   D. A1, A2, C2, and B2
   E. None of them

45. In the *Piper cenocladum* system, which pathways were more important for affecting densities of specialist versus generalist herbivores?
   A. Specialists and generalists were both affected most by B1
   B. Specialists were affected most by B1 and generalists by A1 and A2
   C. Specialists were affected most by A1 and A2 and generalists by B1
   D. Specialists and generalists were both affected most by A1 and A2
   E. There were no significant effects on specialist or generalist herbivores

46. Which pathway is most relevant to the Kursar et al. paper about bioprospecting?
   A. A1 and A2
   B. just A2
   C. just A1
47. Sinclair et al. compiled the data above for mammalian herbivores and predators of the Serengeti and demonstrated that:
   A. Small prey, such as oribi and impala, have a greater diversity of predators, resulting in a strong top-down cascade when predator diversity is high; larger prey are regulated by resource availability.
   B. Large prey, such as rhino and giraffe, have a greater diversity of predators, causing a strong trophic cascade when predator diversity is high; smaller prey are always at low densities due to nutrient limitation.
   C. Mammals in the Serengeti are attacked by a greater diversity of predators, resulting in greater control of all size classes of mammals by predator diversity.
   D. Each predator attacks only one prey species, based on its weight range.
   E. None of the above.

48. Which of the following plants have very specialized pollinators?
   A. *Ficus* species (figs)
   B. Orchids
   C. Aroids
   D. only b and c are true
   E. a, b, and c are all true

49. Which of the following diseases are vectored by insects?
   a. Plague
   b. Malaria
   c. Chagas disease
   d. Typhus
   e. All of the above

50. Which of the following are associated with tropical flies?
   a. incomplete metamorphosis
   b. malaria
   c. pollination of grasses
   d. seed dispersal
   e. all of the above
51. About how long ago did humans arrive in the neotropics?
   a. 5,000-10,000 years ago
   b. .5-1 million years ago
   c. 12,000-40,000 years ago
   d. 2,000-4,000 years ago
   e. .1 - .2 million years ago

52. The Huaorani live near which of the representative sites for this course?
   a. La Selva
   b. Milne Bay
   c. Yanayacu
   d. Serengeti
   e. BCI

53. The Pawaia live near which of the representative sites for this course?
   a. La Selva
   b. Milne Bay
   c. Yanayacu
   d. Serengeti
   e. BCI

54. Which of the following is true about global climate change projections?
   A. Global mean temperature is not rising.
   B. Warming will be greater in the tropics than in temperate regions.
   C. Atmospheric CO$_2$ will decrease over the next 100 years.
   D. Catastrophic weather events (e.g., hurricanes) will be more intense and more frequent in the tropics.
   E. None of the above

55. The increase in CO$_2$ concentration in the atmosphere is mainly a result of an increase in
   a. primary productivity
   b. methane production by termites and bacteria
   c. the absorption of infrared radiation escaping from the earth
   d. the burning of fossil fuels and wood
   e. cellular respiration by the exploding human population

56. Which of these is the source of the most deforestation in the neotropics:
   a. slash and burn agriculture
   b. grazing
   c. heating fuel
   d. construction material
   e. paper

57. What are some of the direct consequences of deforestation of tropical rainforests?
   a. greater biodiversity
b. decrease in nitrous oxide levels
c. increase in carbon dioxide levels
d. increase of important biological resources
e. all of the above except b

58. According to Costanza et al. (1997), what is the estimated minimum economic value of 17 ecosystem services:
   a. $33 million per year
   b. $33 billion per year
   c. $33 trillion per year
   d. $33 thousand per year
   e. They concluded that an economic value cannot be placed on ecosystems

59. Which of the following is probably the most effective method of decreasing impacts on all tropical ecosystems:
   a. recycling
   b. reducing production of CFCs
   c. stopping deforestation
   d. reducing human population growth and reducing resource use
   e. replanting trees

60. Which of the following is an economically important pest in Suriname
   a. Sigatoka fungus on banana leaves
   b. Nematodes on banana roots
   c. Corn borer (caterpillar) on corn
   d. Leaf-cutting ants
   e. All of the above

61. Which of the following plants are not native in the Neotropics
   a. bananas
   b. corn
   c. potatoes
   d. squashes
   e. they all all native to the Neotropics

62. What resource in the Oriente is responsible for the construction of roads into Huaorani territory?
   a. timber
   b. gold
   c. silver
   d. oil
   e. coconuts

63. Which of these is NOT produced by insects?
   a. clues at the scene of a crime
b. wax
c. silk
d. rubber
e. shellac

64. Which of the following countries utilizes the highest percentage of steel, energy, and plastic?
   a. Kenya
   b. Ethiopia
   c. Russia
   d. United States
   e. India

65. Which of the following indigenous groups is from Ecuador
   a. Huaorani
   b. Pawaia
   c. Hinterland Powakka
   d. garimpos
   e. None of the above

66. Which of the following is NOT a greenhouse gas?
   a. O₂  b. CFCs  c. CO₂  d. methane  e. nitrous oxide

67. According to Holt, a protectionist argument dismisses local residents because
   A. They are still living in harmony with nature
   B. They are becoming too “like us” in their consumption habits
   C. They possess excellent abilities to steward nature
   D. They are too scientific in their approach to managing resources
   E. None of the above

68. Why does the figure showing increase in atmospheric CO₂ go up and down every year?
   A. Error in the measurements
   B. Photosynthesis of trees is higher in the summer than the winter
   C. The data were fabricated
   D. A and C
   E. A, B, and C

69. What term did Forister and Feldman (2011) use to describe shared evolutionary histories across multiple trophic levels?
   A. Diffuse Coevolution
   B. Geographic Mosaic of Coevolution
   C. Phylogenetic Cascades
   D. Diversifying Coevolution

70. Which of the following tropical diseases would you describe as a zoonosis?
   A. Malaria
B. Dengue (DHF)
C. Yellow Fever
D. Sleeping Sickness

71. What factors influence productive soils in the tropics?
   A. Young soil age
   B. Nearby volcanic activity
   C. Heavy rain
   D. A and B are both correct
   E. A and C are both correct

72. Which two organisms are major drivers of decomposition?
   A. Earthworms and Bacteria
   B. Vultures and Earthworms
   C. Bacteria and Fungi
   D. Arthropods and Fungi
   E. None of the above

73. The figure above demonstrates:
   A. the effects that beetles in *Piper* plants can have on understory diversity.
   B. that crazy ants can eat just about anything, including understory plants.
   C. that crazy ants are effective at killing millions of red crabs.
   D. that crazy ants kill trees via their mutualisms with honeydew-secreting Homoptera.
E. when ants are excluded from *Piper cenocladum*, herbivores are released, resulting in extremely high levels of understory herbivory.

**THIS FIGURE IS FOR QUESTIONS 74 AND 75**

74. The figure above demonstrates:
   
   A. That the herbivore haplotypes shown in E and F show both geographic and host associated genetic structure. For example, there are private haplotypes from Morox (green) that were found only on the M. quadriglandulosa (blue) host plant.
   
   B. That the herbivore haplotypes shown in E and F show no geographic and host associated genetic structure, despite high levels of specialization for this species.
   
   C. That the herbivore haplotypes shown in G and H show both geographic and host associated genetic structure. For example, there are private haplotypes from Elem (yellow) that were found only on the M. quadriglandulosa (blue) host plant.
   
   D. That the herbivore haplotypes shown in G and H show no geographic and host associated genetic structure, despite high levels of specialization for this species.
   
   E. That there is no turnover in preferred host plant species for any herbivores across the geographic range of this study.

75. Based on the figure above, what can you conclude?

   A. That specialization and diversity are not correlated.
B. That there is very high beta diversity in PNG
C. That there are some geographically isolated specialist herbivores as well as some widely distributed generalists in PNG.
D. That the four selected herbivore species in this figure are almost genetically identical.
E. That T. sexpunctalis is a specialist.

76. Which of the following is a potential conclusion from the path analysis above:
A. Older brick making ponds harbor greater abundance of malaria vectors.
B. An increase in culicine abundance causes an increase in malaria vectors.
C. Older brick making ponds decrease culicine abundance, resulting in an increase in malaria vectors.
D. A higher diversity of predators in aquatic communities causes lower malaria transmission.
E. Abundance and diversity of all insects causes greater malaria transmission.
77. How does the figure above link gold mining to malaria in Brazil?
A. Because workers in gold mines have high levels of mercury in their blood and are transient, they are more susceptible to malaria and more likely to facilitate spread to other regions.  
B. Because workers in gold mines have high levels of gold in their blood and are transient, they are more susceptible to malaria and more likely to facilitate spread to other regions.  
C. Levels of mercury in the blood are increased by malaria in gold mining regions of Brazil.  
D. Levels of gold in the blood are increased by malaria in gold mining regions of Brazil.  
E. Hg in the blood is unrelated to malaria and gold mining in Brazil.

78. According to the figure above an emerging infectious disease could result from:  
A. a specialist parasite in panel e colonizing human host 2  
B. a specialist parasite in panel d colonizing human host 1  
C. an apparent specialist parasite in panel i colonizing a human host  
D. a specialist parasite in panel h colonizing a human host within the gray operating environment.  
E. all of the above

FOR THE QUESTIONS BELOW, LIMIT YOUR ANSWER TO ONE WORD OR SENTENCE IN YOUR EXCEL SPREADSHEET.

79. Where in the forest stratification would you find a plant that displays its leaves in a flat, horizontal monolayer with minimum overlap?  

80. What is the relationship between specialization and diversity? (Keep your answer to one phrase or sentence.)
81. In one sentence, explain how the Janzen-Connell hypothesis accounts for high alpha diversity of plants.

82. The above figure shows the combined effects of insect treated bed nets, indoor residual spraying and anti-malarial drugs on malaria-related in-patient hospital visits. This comprehensive malaria control program was implemented in what African country? What is the significance of this analysis of multiple treatment approaches?

84. How was Brian Farrell (1998) able to conclude that beetles feeding on angiosperms support Ehrlich and Raven’s (1964)” escape and radiate” hypothesis?

85. What technique did Farrell use to indentify increased rates of diversification in the beetle phylogeny?