Choose five of the following seven questions (60pts each):

(1) Elevated atmospheric nitrogen (N) deposition has been associated with increased frequency of species invasions in western European ecosystems. Explain how this relates to Davis et al.’s (2000) model of invasibility.

This figure (from Lilleskov et al. 2001. Ectomycorrhizal fungal aboveground community change over an atmospheric nitrogen deposition gradient. Ecological Applications 11:397-410) is an ordination diagram of the genera of ectomycorrhizal fungi (EMF) in the soil community along a N deposition gradient in Alaska. Traditionally, plant community responses to N inputs have focused on plant-plant interactions. Explain how effects of N inputs on the mycorrhizal community may be important in understanding vegetation responses to atmospheric N deposition. (Be sure to refer to this figure’s results in your answer).

Required parts of a complete answer (Corbin):

Describe Davis et al.’s model, being sure to include both nutrient supply and uptake parts of their model. Merely describing the fluctuating resources part isn’t enough.

Lilleskov et al. Fig 6 – Shift in species composition of ectomycorrhizae with N status.

Response of plant community to N deposition:

Best: Van der Heijden et al. show specificity between mycorrhizae and plants. A shift in mycorrhizal composition or diversity could alter plant competitive relationships.

Also OK (But less credit): Relationship between mycorrhizal and vegetation diversity (=van der Heijden, Hartnett and Wilson) suggests that as N inputs decrease mycorrhizal diversity, plant diversity will decrease.

(See Figure on Exam or in cited article)

(2) You have been hired to explore management strategies available to resource managers concerned about forest responses to Sudden Oak Death (SOD). Write a memo to your boss in which you: (a) Assess the appropriateness of using Markov models vs. gap models such as JABOWA to predict forest responses to SOD; (b) Compare the sort of information each model type can tell you, and the assumptions on which
each model relies; (c) Recommend the development of one model type or the other, based on which type is most likely to yield practical information or predictions. (You can recommend either one, as long as you justify your choice).

**Required elements of a complete answer (Corbin):**

*Describe each model type, including the data you would need to collect, the assumptions, and what kind of output the model would give you. What do the models tell you? “Community changes” isn’t enough detail. (30PTS)*

*Describe some important details about Sudden Oak Death, such as the organism causing it, affected species, etc. (10PTS)*

*Recommendation of one model or the other, with explanation as to why it would be the most helpful in responding to SOD (20PTS).*

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(3) Fire suppression has been an official management policy in a variety of North American ecosystems. Discuss examples of how this has impacted community composition. Describe how these examples are either consistent or inconsistent with the predictions of the Intermediate Disturbance Hypothesis. Be sure to take into account various aspects of the disturbance regime (e.g. frequency and intensity).

**Required elements of a complete answer (Abraham):**

*Provide at least two examples of fire suppression and explain how it has affected community structure. If examples were not about fire suppression (e.g. fires effect on fynbos species), the link to the effects of fire suppression must be explicitly stated. (15pts 1st example / 15pts 2nd+ examples = 30 pts)*

*Provide a definition of / predictions of the Intermediate Disturbance Hypothesis (necessary to make your arguments). (10 pts)*

*Support fo/ against IDH from THE EXAMPLES PROVIDED ABOVE. Partial credit given if different examples used. (10pts each = 20pts)*

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(4) Efforts to relate vegetation type and climate, such as Stephenson (1990) and Whittaker (1975; both discussed in lecture April 9) are reasonably successful in predicting continental-scale vegetation types. At smaller spatial scales (e.g. within a region such as California), vegetation type and climate are less closely related. Discuss the difficulty in using climate alone to predict vegetation composition at smaller scales. Be sure to address alternative mechanisms besides climate that may govern patterns in vegetation type, and to include at least one of your assigned readings.

**Required elements of a complete answer (Corbin):**

*Briefly describe the continental-scale relationship between climate and vegetation (=Stephenson) (10PTS)*

*I required at least three distinct mechanisms – such as soils differences (Wolf et al.), disturbance history or successional stage (Connell and Slatyer and many others), time lags between vegetation and climate (Davis), and others, too. Many people used plant competition, but this isn’t really the scale the question was looking for, and I only awarded partial credit. Each answer had to make clear how the mechanism led to a disjunct between climate and vegetation (15PTS EACH)*

*Reference to at least one reading besides Stephenson is support of your alternative mechanisms (5PTS)*
(5) Compare how chance and early colonists affect the pathways of succession in each of the succession models presented by Connell and Slatyer (1977). Explain which of these is closest to how Clements argued succession takes place, and why. In what ways did Clements’ view differ from any of Connell and Slatyer’s models? Provide examples where appropriate.

**Required elements of a complete answer (Abraham):**

Name and describe (initial colonization, process of plant replacement, final result, chance vs. predictability) each of the three models for succession (facilitation, tolerance, inhibition). (10 pts each = 30 pts)

Name which model(s) is/are closest to Clementsian ideas, and provide an explanation that is unique to the model(s) chosen. (15 pts)

Name which model(s) is/are different to Clementsian ideas, and provide an explanation that is unique to the model(s) chosen. (15 pts)

(6) A particular challenge to successful plant reproduction is the fact that environmental conditions and/or risk of seed predation can be especially harsh in certain seasons or certain regions. For example, drought conditions in certain years may substantially reduce seedling survival. Also, seed predation rates may be very high in certain areas of a forest. What are some strategies that plants employ to “escape” such harsh conditions that may vary in space and in time? Describe **two** strategies that would be useful where environmental conditions/seed predation is likely to vary in **SPACE** and **two** strategies that would be useful where environmental conditions/seed predation are likely to vary in **TIME**.

**Required elements of a complete answer (Metz):**

Describe four strategies that are clearly distinct from one another, and must have two for space, and two for time (15 points each). These strategies had to be related to the reproductive effort of the tree (flowering, seeds, seedlings etc.)

Many mechanisms were accepted as long as your argument was strong and clear, and you included the necessary support. If you had two mechanisms that accomplished the same goal, they counted as only one strategy (e.g. animal dispersal to escape harsh conditions under mother tree, and long-distance wind dispersal to escape harsh conditions under the mother tree). **Different mechanisms had to be described as achieving different goals.** For each strategy described, 15 points were assigned if you:

- Named a valid mechanism (5 pts)
- Explained how this mechanism works as a strategy for escaping harsh conditions (5 points)
- Made it very clear why this mechanism is applicable to conditions that vary in **SPACE** OR **TIME**. (5 pts)

Examples of possible mechanisms we accepted:

- **SPACE** – long-distance dispersal, directed dispersal by animals, relationships with mycorrhizae (only when seeds/seedlings were emphasized)
- **TIME** – dormancy, seedbanks, masting, timing of fruiting or flowering.

(7) You are working near Iquitos, Peru in a lowland rainforest that has large patches of white sand soil spread throughout the area. This soil has a unique chemistry, different from the soil of the neighboring clay-rich areas of the forest, and results in a different composition of trees. In particular, you notice one shrub that is common throughout many of the white sand patches. However, you also notice that some smaller patches of white sand do not have this shrub, though they do have other forest species usually found on the white sand.
a) Briefly describe three factors that you hypothesize may explain the patchy distribution of the shrub;

b) Describe an experiment to test one of these hypotheses. What results would you expect to show support for your hypothesis? What results would not support your hypothesis?

c) What characteristics of the populations on the various patches would be consistent with a metapopulation model for this species?

**Required elements of a complete answer (Metz):**

Briefly and clearly describe three hypotheses with enough of a description to be that you understood your hypothesis. (20 pts – 6 points each hypothesis plus 2 points for overall clarity)

Description of your experiment should have included a clear explanation of what you would do to test the hypothesis. Your answer should demonstrate a clear understanding of how these methods test your specific hypothesis and control for other factors. You must have included the results you would expect in support of hypothesis, and those you would expect to disprove your hypothesis. (20 pts)

Describe what you would expect to see in this shrub population if it was a meta-population. Needed to describe several of the following, (not an exhaustive list though) and make it clear you knew what a metapopulation was (20 pts).

- Gene flow between smaller populations in the region
- Currently uninhabited patches of suitable habitat may later have the shrub on them, and those currently with populations of the shrub later may have a local extinction
- Overall stability of the metapopulation though some smaller local populations exhibit negative population growth
- The larger and smaller patches described in the question may represent “sources” and “sinks” – though these aren’t required for it to be a metapopulation
- Populations may blink in and out, can be positive and negative population growth
- May be immigration and emigration between plots
- Less suitable habitat may be more likely to be a source

Be sure your answer was about patchiness WITHIN white sand habitats, and not just patchiness of the shrub caused by patchiness of the soil it appears to be endemic to. You had to explain why the shrub is not found on the small patches although they appear to be the same substrate as other patches where the shrub is found. Also, these patches are in continuous rainforest – the only thing that changes is the soil composition and the species of trees on the soil. These aren’t gaps, though some descriptions of edge effects were allowed if your argument was clear. Especially good answers referenced relevant papers like Wolf et al.