

**RESTORATION ECOLOGY MIDTERM – Fall 2009**

**Definitions** – Fill in the blanks in the sentences below with the appropriate term. Answer 10 of the 11 questions (2 points each). [1 point if vague or partly correct]

\_\_Cation exchange capacity\_\_\_\_\_ is the sum total of exchangeable cations a soil can adsorb and an indication of soil fertility.

One of the most effective ways to reintroduce seeds and microorganisms in mine reclamation projects is to \_\_stockpile\_\_\_\_\_ the soil during mining and then re-spread it soon after mining is done.

\_\_Hardening\_\_\_\_\_ is the process of process of exposing plants to the stresses of the natural environment (e.g. wide range of temperatures, low moisture) before outplanting.

Reforestation/afforestation is the term used for planting trees (either native or non-native) for a range of uses such as timber production, carbon sequestration, or facilitating forest recovery.

\_\_Bioremediation\_\_\_\_\_ is the use of microorganisms/plants/fungi to break down or mineralize hazardous chemicals.

A common way to reduce acidity and increase the pH of soil is to apply \_\_lime\_\_\_\_\_.

Vernal pools\_ are shallow seasonally-flooded freshwater wetlands found in inland California that host a variety of rare species.

The most important factor in the success of wetland restoration is to recreate the original hydrology or hydrologic conditions\_\_\_\_\_ - note 1 point for topography.

Monterey pine, California poppy, Douglas fir, or lupine\_\_\_\_\_ is a plant species native to California that is invasive elsewhere.

The most effective strategy for controlling invasive species is preventing their invasion in the first place, or early detection and response.

\_\_r-selected\_\_\_\_\_ species are generally found early in succession, are adapted to disturbance, have good dispersal capabilities, have large numbers of offspring, and are generalists.

**Short answer questions** - Answer 5 of the following 6 questions (6 points each). [so two points for each answer, 1 point for answers that are vague or repetitive]

Whisenant (1999) suggests selecting species that vary across several functional traits/groups to restore ecosystem function. List three of the functional traits he suggests:

1. Different pollination requirements
2. Differ in ability to use abiotic resources – (e.g nutrient cycling – nitrogen fixers, water use efficiency)
3. Differ in successional stage – early vs. late successional
4. Different regeneration mechanisms.
5. Ability to stabilize sites – e.g. grow rapidly and develop a root system
6. Different ability to tolerate specific disturbance types

List three functions that soil microorganisms provide that are important to restoring ecosystems.

1. decomposition – breakdown of organic matter
2. nitrogen fixation – nutrient cycling
3. bioremediation
4. nutrient uptake (mycorrhizae)
5. formation of soil aggregates
6. aeration = ½ credit

List three obstacles to tropical forest restoration that planting native tree species help to overcome.

1. Seed dispersal – establishing trees provides structure that attracts birds
2. Shade out competitive pasture grasses
3. Nutrient cycling – trees can increase available nutrients when leaf litter falls
4. Provide shade for later successional species that are adapted to low light conditions
5. Provide income to land owners if selectively logged –helps overcome cost limitation
6. Habitat for tropical forest spp = ½ cred.

List three types of natural disturbance and one adaptation to each type of disturbance that would facilitate recovery from anthropogenic disturbances. – NOTE 1 point for disturbance and 1 point for adaptation

1. fire – seeds need fire as a germination cue, fire resistant vegetation
2. flooding – aerated roots, water dispersed seeds
3. volcanic eruptions – wind dispersed seeds
4. hurricanes – resprouting
5. treefall – pioneer/r-selected species grow quickly in higher light conditions
6. drought – adaptations to conserve water, delayed germination

List three potential negative effects of irrigating plants as part of restoration projects.

Plants may grow shallower roots so don't survive when irrigation is removed

Fungal infections

Favor weeds

Plant in rows

Leach nutrients

Expensive

Water diverted from elsewhere

Oversaturation

Increase salt concentration

List three ecosystem services that wetlands provide.

1. Erosion control
2. Flood control
3. Water purification
4. Habitat for fisheries
5. Recreation
6. Ground water recharge
7. habitat in general = ½ cred

**ESSAYS** - Give some thought to essay questions and organize your answers before writing. Please write legibly. Essays will be graded for quality not quantity.

**Short essays** - Answer 2 of the following 3 questions (14 points each) on lined paper.

1. It is highly debatable whether restoration to predisturbance condition is feasible. Briefly discuss five important obstacles to restoring predisturbance condition, illustrating each with an example. Indicate which one

of the five you consider to be the overriding factor and why. Note – for the purposes of this essay, the philosophical question of whether or not humans should be restoring ecosystems should not be included as an obstacle.

- 1 pt for each obstacle and 1 pt for example, 2 points for justification of choice
- cost - many projects are extremely expensive and there is limited funding – Louisiana wetlands or Everglades project, examples from George, Portia, and Brent
- lack of reference system - California grasslands don't know what system was like before European settlers
- residual stress - it is difficult to restore system with ongoing inputs of nutrients or chemicals into a system – reduced flow in rivers
- poor understanding of how ecosystems works – we often don't know detailed habitat requirements of certain species
- exotic invasives - in some cases nearly impossible to eradicate entirely (i.e. exotic grasses in California coastal prairie)
- long time scale of ecosystem recovery relative to human desire for change – e.g. redwood forest restoration
- climate change – original conditions will not be the same – e.g. precipitation altered in CA
- extinctions- loss of spp or functional groups
- lack of community support for restoration

NOT A VALID OBSTACLE: philosophical question of whether we should be restoring at all.

2 pt for style, organization, and thoroughness of answer

2. As we discussed in class, removal of invasive species is often controversial. Pick an invasive species that was discussed in class, on the field trip, or in readings. Discuss: 1. two arguments in favor of removing the species; 2. two arguments against removing the species, and 3. two possible ways to resolve the conflicts of removing the species.

- 2 points for each argument and each way to resolve, 2 points for style, organization, thoroughness (SOT)
- Example: Eucalyptus, for removal: has alleopathic effect on soils, creates increased fire danger, competes with native species, changes vegetation structure; against removal: species has naturalized and become part of California landscape, provides wintering habitat for monarch butterflies, provides nesting habitat for native birds, provides nectar source for migrating birds; ways to resolve: selectively remove stands not known to provide benefits - ideally out of the public view, leave mature stands and remove new saplings to prevent spread, harvest stands and use wood for economic products (such as biofuels), remove selectively and plant native species
- Feral pigs in Hawaii – problems – root out native plants, pools for mosquitoes to breed, Against removal – some removal methods are problematic ethically, part of the Hawaiian culture, compromise: fence out of parks, and leaves elsewhere, don't use snaring or other less humane methods.

3. You are given a bag of native wind-dispersed grass seeds to use in a California coastal prairie restoration project. First, discuss two things you need to know about the seeds before using them in restoration. Second, discuss two things you will do to enhance seed germination and/or early seedling survival. Third, discuss two tools to manage the restored grassland to favor native species once the seedlings are established.

- 2 pt for each need to know, 2 pt for each what will do

Need to know:

- Where they were collected from?
- What is the percent live seed and/or percent germination?
- Are there invasive seed contaminants?
- How many plants were they collected from?
- germination requirements = ½ cred

To enhance germination/early seedling survival

- Drill seed for better seed soil contact
- Stratify the seed in a refrigerator prior to outplanting

- Note – no credit for scarification since they are wind-dispersed species
- protect from herbivory/seed predation
- start in greenhouse
- remove invasives

To manage grasslands

- Grazing – as native grasses generally adapted
- Fire – as native grasses generally adapted
- Mowing if grazing is not feasible – time to when exotic grasses are setting seed
- No credit for herbicides because exotics are grasses and would kill the natives

**Long essay** - Answer 1 of the following 2 questions (24 points) on lined paper.

1. You are hired by the Nature Conservancy as a consultant. They have a limited amount of money to purchase abandoned pasture land to restore to forest and have two options.

Option 1: Buy a 10-ha parcel of pasture that surrounds a 10 ha remnant patch of forest.

Option 2: Buy a 10-ha rectangular parcel (10 ha long by 1 ha wide – so 1 km long by 100 m wide) of pasture that connects two 10 ha remnant patches of forest.

In both cases the remnant patches of forest are surrounded by a mixture of pasture land, orchard, and second growth forest. Please discuss three biological or management arguments in favor of each purchase. Indicate which of the options you would recommend and why. Also, discuss two additional pieces of information that would be helpful in making this decision; in other words, where should research efforts be focused?

2 pt. for each argument (12 pt total), 1 pt. when vague or repetitive

Option 1:

1. Restored area can act as a buffer to minimize edge effects such as temperature, light, altered biotic interactions, invasion of exotics
2. Area easier to manage because is one large block
3. More interior habitat so can host animals that need large home ranges
4. There is more potential for colonization of flora and fauna into the restored area as the source of propagules is nearer.
5. Reduced brood parasitism
6. Larger island = more species (IBT)
7. More “natural” succession (ala nucleation)

Option 2:

1. Movement between intact parcels can reduce demographic stochasticity.
2. Movement between intact parcels can allow for greater genetic diversity.
3. Corridor is longer so may cross a greater topographic gradient and therefore harbor more diversity.
4. More habitat restored (30 ha affected by actions as opposed to 20)
5. Rescue effect (i.e., reduction in risk from environmental stochasticity)
6. Mitigation of climate change (since species can migrate somewhat)
7. Increased edge habitat for game species like deer & turkey

3 pt. stating (1 pt) and justifying (2 pt) your argument

2 pt for each other piece of information (4 pt total)

1. Need more information on what habitat needs are of animals you are managing for. For example, how wide would the habitat corridor have to be?
2. Need more information about the composition of the habitat surrounding the forest to determine how strong edge effects would be.

3 pt - S/O/T (style, organization, thoroughness) - overall points for style, organization, and thoroughness of answers, generally if you outlined essay received 0 or 1 point for this category