

Case Studies in Ecology

Instructions

Below are a variety of real-life problems that ecologists are often asked to solve. Each scenario applies a different concept you will learn in the ecology section of this course. Ask your GSI how he or she plans on using these scenarios in your discussion section.

Population Control

With recent urbanization of natural lands and reduction in carnivore populations, local parks have become increasingly concerned about the explosion in the deer populations. In fact, deer-related car accidents are on the rise and local gardeners are complaining that the deer are eating their plants. The state park would like to hear your suggestions for managing the deer population. In particular, they are interested in developing sustainable management practices that will have a minimal impact on other parts of the ecosystem. First, decide what criteria you would use to determine whether the deer population is too high. Assuming the population needs to be reduced in size, provide the park with some ideas for management of the deer. How do you propose to maintain a sustainable number of deer in the area? How would your management practices change if deer were an r-selected species?

Food Web Stability

There is a small arctic island off the west coast of Canada that has very low species diversity. Despite the low diversity, there has been a very stable food chain for thousands of years. Moose browse the three most abundant tree species on the island and the wolves on the island feed on the moose. The moose population size is thus dependent on the abundance and leaf production of the trees and the wolf population size is dependent on the abundance of moose. The population of moose and wolf cycle in the classic predator-prey model, as described in your text book. In the last 150 years, climate change has led to a shift in the species composition of the trees on the island. The newer tree species produce fewer leaves that are less palatable to the moose. As a result, the moose populations have been steadily declining. The locals are concerned about the future of this fragile ecosystem. What do you suggest we do to best preserve the food chain? Provide rationale and pros and cons for each suggestion. What would you expect the cycles in population size to look like before and after the shift in the tree species composition?

Population Surveys and Sustainable Use

You've been hired by a local fishing company to determine the population size of two newly discovered and tasty fish. The first fish is a blue schooling fish. It appears to migrate seasonally from Alaska to Northern California, following an ample food supply. The second, red fish has a very different pattern of movement. The red fish seems to be quite territorial and it hides away in rocky areas by

itself for most of its life. The red fish only emerges from these rocky areas at night to forage for its food, a rare species of sea slugs. How would you sample these two species of fish to give the fishing company the most accurate estimates of the number of fish in each population? What advice would you give the fishing company about their fishing practices? In other words, how can they fish these two species without causing their populations to crash?

Life Tables and Competition

Recent fire has wiped out all of the vegetation in a ten square mile area of a California chaparral ecosystem. Naturalists have begun to make predictions about the species composition of the ecosystem once the plants re-establish based on some simple life history characteristics. They know the number of seed produced by each species each year and how long it takes each species to reach sexual maturity. Based on this information only, they used a model to construct a logistic growth curve that described the numbers of each species in the ecosystem after 30 years. The naturalists return to the ecosystem after 30 years, sample twenty 1m² quadrats along a single transect running through the valley and they discover that their original predictions were totally off. What went wrong? How could they have more accurately projected the species composition of this ecosystem? What other information did they need? What would have been a better way to measure the species composition at the end of the study?

Disturbance and Succession

Back in the 1960s, groups of Berkeley hippies advocated a return to natural living in the Back to the Land movement. One particular group established a colony in the backwoods of Sonoma County. They have subsisted for the past 40 years entirely on their own slash and burn agricultural system. This practice involves cutting down vegetation on a couple hectares, allowing it to dry, burning it, and then cropping the land for one or two years following the burn. Following cultivation, the land is left fallow and the vegetation is allowed to reestablish naturally over the next seven years before the process is repeated. Recently, the Sonoma county government has identified the area surrounding the colony as particularly biologically rich and diverse. In an attempt to protect the ecosystem, the government wants to restrict agriculture on these lands. The colony argues that they should be allowed to continue farming the land because fires would occur naturally in these areas and that the scale of their disturbances is small enough that it has no effect on the larger landscape of the region. Furthermore, the ecological impact of their lifestyle is far less than the impact of surrounding vineyards and suburbs. The government has contracted your consulting team to assess the situation. Having taken Biology 1B, you have a strong understanding of the role of disturbance and succession in ecology. You are to clearly state the pros and cons of removing the colony from the area to set up a nature reserve. Do you think the colonists are having a significant impact on the ecosystem? Would their removal improve the goals of the local government? What do you propose as the “best” solution to this conflict?

Land Management and Invasive Species

You've been a cattle rancher your entire life. In the past 20 years, you began to notice that your cattle would not graze on large portions of your land. Concerned about this problem, you explore those areas and discovered that they are overrun by two invasive grass species that are not palatable for livestock. In an effort to control the unwanted grasses, you try three management practices on multiple 10 m² plots. You burned one plot, but the unwanted annuals seem to return just as robust as they were before. On another plot of invaded land, you added fertilizer, hoping that the new ratio of nitrogen and phosphorus in the soil would favor the more palatable species. The fertilizer treatment made everything grow larger, but seemed to have no effect on the species composition. In a last ditch effort, you applied herbicide to a final plot, hoping to kill off the weeds. You succeeded in killing everything, including the palatable species and the productivity of the area dropped so low that the cattle still could not graze there. At this point, your herd is looking very scrawny and you're concerned that you will never find an affordable way of managing the weeds. Why have these management practices failed so far? Did you sufficiently test each of your management techniques? What are some other cheap and environmentally friendly techniques you could try to manage your grassland? What are the prospects of you saving your land from being completely overrun by these invaders?

Pollution

You are a local farmer with a booming business. You fertilize your crops heavily thus increasing the quality and yield of your crops three fold. Your high revenues have given you the opportunity to create new jobs on your farm and to volunteer in the nearby community. Given your positive contributions to your town, you're shocked one day to find an angry letter in your mailbox from the local fishermen. They claim that the nitrogen and phosphorus runoff from your farm is causing problems in the streams where they fish. The fertilizer runoff from your farm seems to be creating toxic algal blooms, making the shellfish and vertebrates they harvest unsuitable for human consumption. In the letter, they threaten you with a lawsuit if you cannot reduce your pollution by fifty percent. You want desperately to amicably resolve this problem with the fishermen, but you already know that if you reduce your use of fertilizer that you risk losing huge portions of your crops every year. You know that you have enough money to legally overpower the fishermen, but you're hesitant to ignore their pleas. What should you do? Is there any way for both you and the fishermen to be happy? If you reduce your use of fertilizer, will the stream bounce back to the way it once was?

Community Restoration

In 2002, over 10,000 Chinook salmon was found dead in the lower 45 miles of the Klamath river. Federal biologists are saying that a lack of water is what caused this fish kill. But as locals gaze down the lush, green valley, they cannot understand how water could be lacking. As it turns out, thousands of cubic feet of water are being diverted out of Klamath river into agricultural lands and to the Upper Klamath lake. This water diversion has reduced the flow in the major tributary and low flows are highly correlated with increased water temperatures. It is likely that the increased water temperature also contributed to this fish kill.

The tourist industry, local farmers, and the US Fish and Wildlife officials are in disagreement about how to prevent further fish-kills. Since the surrounding farmland is only moderately productive, local non-profits have offered to buy the farmland so that water can be redirected down the Klamath river. Since the farms have persisted for generations, the farmers are strongly resisting this proposal since it would irrevocably alter their “way of life.” The federal government prefers the water be directed to farmlands; they signed an agreement allowing 78,000 acre-feet of water to be rerouted to agricultural lands. The tourist industry, anxious to restock the rivers with fish to promote recreational fishing, wants to release hatchery-reared fish into the river until the populations have stabilized. The US Fish and Wildlife officials want to allow the natural fish populations to recolonize the river.

How can the river be restored without disrupting the “way of life” of the local farmers? Should they restock the river with farmed fish or should they wait for the river to recover naturally? Should the water be directed away from agricultural lands and back into the river? What are the advantages and disadvantages of each strategy?