

CASE TEACHING NOTES for "Improving on Nature?"

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INTRODUCTION / BACKGROUND

History is filled with cases in which humans have sought to change their natural surroundings with unforeseen and harmful effects. Often the impetus for change is an economic benefit thought conveniently possible with only minor tinkering of the local ecosystem. Typically, in such cases, knowledge of the ecosystem is lacking, and the consequences of the "tinkering" are only understood in retrospect, too late to avert a disaster.

In 1958 a new fish, black bass, was introduced into Lake Atitlan in the highlands of western Guatemala. Making this highly prized fish available was seen as a way to attract tourism and boost the local economy. This was done at the suggestion of Pan American World Airways and with the approval of the local tourism-promotion board. The area around Lake Atitlan, a national park since 1955, was mostly unknown to the rest of the world, and Guatemala was eager to become a prime destination for tourists.

Introducing an alien species is risky enough by itself, but various unforeseen complications resulted in an ecological disaster. The introduction of the bass reduced the lake's other populations and was the beginning of the extinction of a rare bird, the giant grebe. In the end, the introduction of the bass population was not an economic boon. But in the 1950s, when the events narrated in the case occurred, the process of conducting an environmental impact study to predict possible outcomes was not part of anyone's thinking.

This case first casts students in the role of the local population at that time and asks them to judge the proposal. Later, they review the ensuing events from a historical perspective. The case is suitable for introductory biology courses, best used after the students are knowledgeable about ecology, genetics, and evolution.

Objectives:

Upon completion of this case study, students should be able to:

- explain the risks of the introduction of alien species into an ecosystem;
- identify the roles of human activity in the extinction of the giant grebe; and
- describe the effects of environmental change on the Lake Atitlan ecosystem.

CLASSROOM MANAGEMENT

Typically people involved in a discussion see only the parts that they want to see, or are informed only on limited aspects of the issue. To provide this sort of context for the case study, the students are divided into three groups to discuss the proposal, each from its own perspective: (1) those familiar with black bass fishing, (2) those familiar with the local villages, and (3) those familiar with the lake ecosystem. Information useful to each group is provided in separate summaries ("Background Briefings"), one for each group, representing the information available at the time of the bass introduction proposal. The dialogue between Carlos and Iliana can be provided on one side of a handout page and a Background Briefing on the other.

Each group has four tasks:

- become familiar with the information provided;
- discuss the proposal that black bass be introduced into Lake Atitlan to promote tourism and thus aid the economy of the area;
- decide whether to support or reject the proposal; and
- prepare to defend its position in a public forum.

The instructor plays two roles. First, he/she moderates the discussion of the fish introduction proposal among the Guatemalan villagers with "1950s thinking," leading to the acceptance of the plan. Then, he/she facilitates an understanding of historic events as they happened, leading the discussion with some "21st century thinking."

Timing depends on the length of class sessions available. With 50-minute sessions, two days will be required to complete the case. The village meeting can be held during one class session, up to the point at which the bass proposal is accepted. During the next class session, the groups reorganize to analyze the historic events.

Phase I: The Community Discussion of the Proposal

1. Allow the groups time to familiarize themselves with the information provided in the Background Briefings and to discuss the pros and cons of the proposal from their assigned viewpoint.
2. Convening a public hearing on the proposal, ask for the opinion of each group, role-playing the part of a moderator seeking consensus on a major project. You may want to play the role of the representative of the Tourism Commission from Guatemala City. Keep in mind that the setting is 1958. Back then we didn't know as much as we know now, so you may have to watch for insights representing more recent thinking. (If the student-villagers are all opposed to the plan, your case goes nowhere!) It may be that some groups will question the introduction of an exotic species in principle, i.e., we have made many mistakes like this before and should be wary. If this happens, agree in principle, but ask for specific objections based on the information at hand. Accept any idea as a possibility, but lean toward trying the plan.
3. If there is no compelling reason to stop the project, and the consensus seems to be that the people of Guatemala could ultimately benefit, announce that the president of Guatemala has given his approval and that 2,000 young black bass will be introduced into Lake Atitlan tomorrow. "Fishermen, make your plans and pack your bags for some exciting fishing in Guatemala! Amigos, prepare for a new wave of visitors to Lake Atitlan!"

Phase II: The Historic Narrative—What Really Happened at Lake Atitlan

Since this was a real event, the focus changes to a review of history. The groups reorganize to discuss and analyze the historic episodes as they are revealed.

The student groups should be "shuffled" so that each contains about equal representation of the original factions: bass promoters, ecology experts, and those familiar with the villages around Lake Atitlan. This reorganization can be done conveniently by marking a code number or letter in advance on each of the Background Briefing sheets. The reorganized "jigsaw" groups then represent a broader knowledge base than the first ones, and the members pool their expertise to better understand the predicaments that history recorded. In a large class section, more than three groups may be needed. The instructor will have to decide on the appropriate size of the groups, but six (two from each original group) is a good maximum for getting the involvement of all in the discussion.

The historic narrative reveals new information little by little, in much the way we tend to find out things too late and then must try to make adjustments based on the new information. The new information is divided into segments called "Historic Updates," each presented on a separate page with discussion questions. Typical responses to the questions posed in each of the Historic Updates are given in the [answer key](#) to this case.



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ANSWER KEY

Answers to the questions posed in the case study are provided in a separate answer key to the case. Those answers are password-protected. To access the answers for this case, go to [the key](#). You will be prompted for a username and password. If you have not yet registered with us, you can see whether you are eligible for an account by reviewing our [password policy](#) and then [apply online](#).

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Note: Considerable background information was gained by the author in a visit to Lake Atitlan which is not necessarily represented in these references.

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Historic Update I

"Getting Underway"

By 1960, black bass were caught by the local fishermen, but with difficulty since the Maya can't afford scuba gear or the type of sturdy fishing tackle that's best suited for catching black bass. It's unlikely that they would use scuba gear if they had it, since few know how to swim.

The bass typically reach sexual maturity at about 10 inches in length, which can be as soon as one year. In two years, the bass have attained record size, the average weight being nine pounds.

An American scientist, Anne LaBastille, came in 1960 to study the giant grebe, a bird that apparently lives only on Lake Atitlan. She counted 200 birds, a number close to that known from the last count in 1936. The population seemed to be stable, but she was so fascinated by the rarity of the bird that she planned to return for further study. This bird is also called the Atitlan grebe, or locally, the *zambullidor* (in Spanish) or the *poc duck* (imitating the sound of its call).

Upon her return in 1965, LaBastille searched the reed beds along the shore for months. She found only 80 birds.

Questions

1. It seems unlikely that the black bass will be directly useful to the local villagers. Why?
2. What could have happened to the grebe population during the five years between counts?

Historic Update II

"Researching the Giant Grebe"

By 1965, Anne LaBastille, the scientist and bird expert, knew more about the giant grebe, *Podylimbus gigas*. It is one of three species of flightless grebes, all confined to high-altitude lakes in Latin America. Its wings and flight muscles are too small to lift its large body off the ground for flight. It is highly successful as a diver, however—able to remain submerged for as long as 90 seconds.

Pairs of grebes claim and defend a territory requiring dense, wide reed beds along 300 feet or more of shoreline. This species builds a giant nest in the reeds, 18 inches wide on a base 36 inches deep. Other species of grebe typically build a more flimsy floating nest, also placed among the reeds for protection from wave action.



Both parents care for grebe chicks for their first three months. During that time the mortality is about 50 percent. As the grebes mature and go out on their own, their death rate increases. The chicks eat insects, crustaceans, and small fish, but the young black bass are so spiny that they are difficult to swallow.

Questions

1. Based on its nesting behavior, predict a likely maximum population of giant grebes that could survive on Lake Atitlan.
2. Starting with the 200 birds counted in 1960, and assuming that the adults counted in any given year survived at least long enough to reproduce, should this predicted maximum population have been attained by 1965?

Historic Update III

"Why is the Grebe Population Dropping?"

By this time, many reasons for the reduction in the grebe population have been examined. Although the natives supplement their diet with birds occasionally, hunting of these birds is not likely. They are too quick for the traps and slingshots the natives use to hunt other birds. Guatemalan law forbids ownership of firearms, so they are not being shot. The harvest of reeds and tul is happening at no greater rate recently than in the past. Population increases by other birds have not been noticed in recent years. Mayan farmers do not normally use fertilizers or pesticides in amounts that could run off their cornfields to pollute the lake. Not enough is known about these secretive birds to determine whether disease or parasites could be involved at this time.

The pied-billed grebe, which is widespread over much of North and Central America, colonized the lake in 1965. This grebe and the giant grebe may be two varieties of the same species. The two birds look much alike, but the native one is distinctly larger and has slightly different markings. This new grebe also has small wings, making take-off difficult, but it does fly. Presumably some birds landed on the lake one day, liked it, and stayed.

The black bass is such a fierce predator that it has caught and killed birds such as swallows, warblers, and red-winged blackbirds as they fly near the surface of the water. The intestines of a couple of the larger bass have been opened to determine their feeding habits. As expected, they have been eating smaller fish, frogs, snails, crabs, and insects. Their intestines also contain skeletons of young birds. The role of the bass in the disappearance of the grebe needs to be studied more thoroughly.

Questions

1. What effect could the introduction of a new bird species have on the present populations in the lake?
2. What influence could the bass feeding habits have on the lake ecosystem?

Historic Update IV

"The Lake's Populations Have Decreased"

About two-thirds of the fish species are now gone from the lake. Whereas a local fisherman could once catch 20 to 50 pounds of fish per day, the catch now is a tenth of that amount. The crab catch for the local fishermen has also declined considerably, now at one-third of former levels. Overall, fishing as a livelihood is possible for one third as many families as before. In the meantime, black bass weighing 10 to 20 pounds are being caught by spear-fishing tourists.

Questions

1. What effect might the bass have on the other populations in the ecosystem?
2. What measures could be taken to reverse this possible damage to the food chain in the lake?

Historic Update V

"Protecting the Giant Grebe"

By the late 1960s, the Guatemalan government had taken three steps to protect the grebe:

- a part-time game warden was hired to enforce laws against killing animals in the national park;
- new laws were passed that prohibited cutting of reeds at the shore between May and August; and
- a wildlife refuge (the first in the nation) was established in a secluded five-acre bay.

With the black bass excluded by a stone barricade, the scientist and the game warden released two pairs of giant grebes, 6,000 young native fish, and non-native bluegills in this refuge.

The population of the grebe recovered from its all-time low and increased over the years:

1965: 80
1968: 116
1969: 122
1971: 157
1973: 210
1975: 232

The population of the giant grebe seemed assured.

Questions

1. Why was the reed harvest restricted by law?
2. Why were bluegills introduced into the refuge?

Historic Update VI

"Drastic Changes"

In 1976 a massive earthquake struck Guatemala. The lake bed was apparently fractured in such a way that water began to slowly leak from it. (The water level dropped four feet in two years, 12 feet in four years, 29 feet in 18 years.) Since the lake occupies a steep-sided crater, the immediate effect was the reduction of the regions of shallow water at the lake margins. Some docks were left far inland. The grebe refuge began to dry up, so the birds were released from it.

By 1980, the human population around the lake had increased to over twice its 1950 level. Interest in the lake as a place for non-Mayans to visit and live also increased. In Panajachel, a three-tower, 16-story condominium was built. Speedboats and skiers crowded the lake on weekends. By this time there were 350 weekend cottages and villas, compared to 28 in 1960, built on newly-cleared land along the shore. Six and a half miles of reed bed remained, representing a 57% reduction in a few years.

Despite the human population pressures, there were no controls on the quality of the environment. Villages, hotels, and homes dumped raw sewage into the lake; pesticides and chemical fertilizers were used at levels previously unknown. The native women began to use detergents instead of the traditional home-made soaps while doing laundry in the lake.

Questions

1. Why would loss of shallow water at the margins be generally a problem for the lake ecosystem?
2. What do you foresee for the future of the lake as wildlife habitat and as a desirable place for humans to live?

Historic Update VII

"The Last Days of the Giant Grebe"

Civil strife in Guatemala accelerated in the 1980s, making it unsafe for the American scientist to stay and monitor the grebe population. In 1982, the only game warden patrolling the lake was murdered. By 1984, about 20 percent of the original reed beds remained. The population update for the giant grebe looked like this:

1980: 130

1982: 80

1985: 56

Finally, the grebes disappear.

1989: 4

1991: None could be found

It's possible that the presence of the pied-billed grebe in the same lake influenced the loss of the giant grebe by interbreeding with it.

The bass population still exists; black bass is a standard feature on local restaurant menus. Its initial large population could not be sustained, however. For the local residents, the fish now most often eaten is bluegill.

Questions

1. Hypothetically, a population of two (male and female) can keep a species alive. Realistically, however, a small population size presents a survival risk. Why?
2. How could we determine whether the pied-billed grebe "swamped" the giant grebe with its genes?
3. Why didn't the bass population succeed in the lake?