Life is not easy in San Antonio Palopo in the late 1950s. Carlos arises early to care for his onion crop, pumping water from Lake Atitlan as the villagers always have to do during the dry season. After that, he will climb the mountain to prepare his cornfield for planting before the approaching rainy season.

His two-room, dirt-floored hut allows barely enough room for his family, but it is as much as most families in the village have. Fortunately his wife, Rosita, is a skilled weaver. The few tourists who drive here to see the beautiful lake pay only a few coins for her colorful textiles, but that money helps to buy shoes for his children.

On his way up the mountain, he meets his neighbor Iliana coming down the steep path. “Buenos dias, amiga,” he greets her. “Hola, Carlos,” she responds. She is returning home with a load of firewood so that she can prepare the tortillas for her family’s breakfast. “Are you going to the meeting at the church tonight?” she asks.

“Oh, I’d forgotten about it. I appreciate your reminder. Will you be speaking?” Carlos inquires.

“No, I’m much too shy for that,” she says, “but my cousin Victor is coming from Guatemala City with an important proposal for the people of San Antonio Palopo.”

“Victor? Isn’t he the airline executive?” Carlos inquires.

“Well, he’s not really a big boss, but Pan American has sent him because he knows us. It seems like a big deal,” Iliana replies.

“How big could anything ever be in this village?” Carlos wonders aloud.

“I’m not too sure of the details,” Iliana says, “but it’s a plan to bring a new kind of fish to the lake. The airline is hoping to increase tourist flights to Guatemala, and the hotel owners in Panajachel are eager to have more tourists, too. If the lake becomes famous enough, fishermen will come from Norte America and maybe even Europe to catch fish, eat meals, buy my weaving, things like that. Can you imagine a restaurant or a hotel in San Antonio? We might even have to learn English to handle the crowd of customers!”

They chuckle at the prospect of their narrow village streets crowded with tourists, and go their separate ways.

Lake Atitlan, Guatemala
Promoting Tourism by Introducing Black Bass into Lake Atitlan

The name “black bass” is collectively used for three species of bass also known as largemouth, smallmouth, and spotted bass. The fish proposed for introduction is the largemouth bass, *Micropterus salmoides*. It is green with dark blotches forming a dark line along the sides of the body. Because the upper jaw extends far behind the eye, its mouth is relatively large, as the name suggests. In many states in the U.S., it is the most popular game fish. Hundreds of clubs and numerous magazines promote it as a sport fish, and an estimated 26 million Americans fish for this species. The meat is light, flaky, and tasty, with low oil content.

Trophy-sized individuals are common. The world record fish, caught in Georgia, weighed 22 pounds, 4 ounces. Lengths of 32 inches have been recorded.

Eggs are laid in quiet water two to eight feet deep. Each female lays as many as 40,000 eggs, then the male guards the nest. There may be two or three spawnings per year, depending on water temperature. The young hatch in five to ten days and begin feeding on plankton and insect larvae.

Bass are voracious predators, willing to eat almost anything that moves. Starting at about two inches in length they begin to prey on other fish, frogs, salamanders, snakes, small rodents, and small birds. (In the U.S., they contribute to the health of a pond ecosystem by keeping bluegill populations under control.) Invertebrate prey includes crayfish, crabs, worms, insects, and mollusks. The bass tend to remain concealed among rocks or logs in a small home area and wait for food animals to come by. They swallow their prey whole.

Largemouth bass survive well in almost any clear-water environment. Its original distribution covered most of the U.S. east of the Rocky Mountains, but the species has been introduced into most of Mexico and Central and South America, as well as a wide area of Europe.

Basis fishing is an exciting sport. The fish can be caught with the kind of tackle that any U.S. angler would use, but have special appeal to those in scuba gear using spears. They will strike lures aggressively and swim rapidly. Studies of their behavior reveal a great wariness and reluctance to be fooled twice by artificial bait or even live bait on a hook, however.

Raising bass in a commercial hatchery environment has proved to be quite successful and profitable. The young fish can be trained to eat food in pellet form.
Lake Atitlan’s Villages

Only a three-hour drive by car from Guatemala City, the lake is a prime spot for tourists to visit. The roads leading to the area are good.

Thirteen villages lie along the shore, inhabited primarily by a native Mayan population of about 27,000 in 1950. One of them, Panajachel, has a market that attracts some tourists already; the others are less well-known. Some can be reached most quickly and conveniently by boat. The region has one of the highest poverty rates in the world.

Part of the charm of the area is that the lives of the people closely resemble those of their ancient ancestors. Local residents carry on traditions of interest to tourists. Weaving is a skill that every Mayan woman learns, in order to make clothing for the family. Each village has a unique pattern of fabric used to make the costume of the women; sometimes the men have unique costumes also. Textiles are available for sale in the form of scarves, blankets, and fine embroidery.

Some residents are skilled in other handicrafts and arts also, such as painting, woodcarving, and jewelry-making. Weavers also create floor mats from the local reeds and tul, an underwater plant. Lake Atitlan’s reed beds, the finest in the country, are owned or rented by individuals who harvest them for their own use or for sale.

Another aspect of the local tradition is the use of the lake as the community laundry. Almost any morning one can see local women washing the family’s clothing on the rocks at the shore, using homemade soap of pig fat and lye.

Mayan culture is based on a diet of corn, with tortillas and tamales being a menu staple. Farm fields can be seen high on the mountain slopes, where corn, beans, and squash are raised in a traditional manner. Some pesticides are used, but typically no fertilizer is added to the soil. Chicken and pork (never beef) may accompany the vegetarian fare, but perhaps only twice a week. Crab soup is a popular dish, and fish provide a major source of protein in the diet.

Some villages have other cash crops as well, such as onions, avocados, strawberries, and coffee. These crops are raised near the shore and watered by pumping water from the lake as needed during the dry season.

Fish have traditionally been caught in woven wicker traps baited with corn. More recently, simple lines and hooks have been used from their homemade dugout canoes. The use of nets is rare, as they are too expensive. Crab fishermen drag a line of multiple hooks through shallow water at night by torchlight, or spear the crabs from their canoes.

Some villagers offer boat transport service across the lake. There are small hotels in some villages.
The Lake Atitlan Ecosystem

Lake Atitlan, described by some as the most beautiful lake in the world, lies at an elevation of 5100 feet in the highlands west of Guatemala City. It occupies a large volcanic crater with a depth of 1000 feet or more and surface area of 79 square miles.

The water is clear, visibility being as great as 39 feet, and the temperature remains constant year-round at 70-72° F. Two small rivers, rainfall, and underground sources supply the lake with water. It does not have a visible outlet, but drains from the bottom. Because of the alternating rainy and dry seasons, the water level fluctuates by about three feet each year.

Steep slopes, including three volcanic peaks, surround the lake on all sides. Large growths of reeds and cattails grow along about 15 miles of the shoreline. These tend to filter the runoff from the surrounding slopes, and provide wildlife habitat for many species.

Wildlife abounds in, on, and around the lake. Aquatic species include 18 kinds of small fish, various amphibians such as frogs and salamanders, crabs, crayfish, and numerous small invertebrates such as insects.

Heron are large, long-legged wading birds with long necks. They typically stand motionless in shallow water, waiting to spear frogs and fish with their long beaks. They make nests of sticks in bushes and trees.

Ducks of various kinds can be found. A prominent example is the ruddy duck, so named because of its bronze-colored body. Its diet is about one-fourth aquatic animals and three-fourths plants. It feeds on the surface or by diving, often at night. The nest of up to 20 eggs floats among reeds and rushes. This duck flies well, but needs a long run before take-off.

Gallinules and coots are chicken-like birds found wading in shallow-water areas. Their long toes allow a distribution of their weight as they walk across lily pads to feed. They also feed on land, as well as by swimming and diving. Food includes frogs, shellfish, insects, and plants. They are not good flyers. Their nests are either floating or out of water on a clump of grass.

Giant grebes are native birds thought to live only on this lake. Rather than webbed feet, they have long, lobed toes. Their legs are placed far back on their bodies, making them almost helpless on land. Wings are small compared to their body size, so flight is impossible. These birds are excellent divers, however. They make a floating nest for 2-5 eggs in shallow water among reeds. They feed on tul (an aquatic plant), fish and invertebrates.
Getting Underway

By 1960 black bass were caught by the local fishermen, but with difficulty. The Maya cannot afford scuba gear or the type of sturdy fishing tackle adequate for catching black bass. It is unlikely that they would use scuba gear anyway, since they rarely know how to swim.

The bass typically reach sexual maturity at about ten inches in length, which can be as soon as one year. In two years, these bass have attained record size, the average weight being 9 pounds.

An American scientist, Anne LaBastille, came during this year 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 their call).

Upon her return in 1965, the bird expert 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 for the local villagers. Why?

2. What could have happened to the grebe population during the five years between counts?
By 1965 the American researcher knew more about the giant grebe. 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, remaining 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%. 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?
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 for 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 and liked it.

The black bass is such a fierce predator that it has taken 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. Its role 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?
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 20-50 pounds per day, the catch now is a tenth of that amount. The crab catch for the local fishermen has also declined considerably, now one-third of former levels. Overall, fishing as a livelihood is possible for a third as many families as before. In the meantime, black bass weighing 10 to 20 pounds are being caught by spear-fishing tourists.

Question:
1. What effect might the bass have on the other populations in the ecosystem?

2. What measures could be taken reverse this possible damage to the food chain in the lake?
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 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 6

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, 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 7

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, by the way; 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 present 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?