Species Interactions Class Activity

*In the following exercises, you will have to **identify interspecific interactions** as well as **the outcomes** of these interactions. Carefully read the following texts and answer the questions at the end of each part.*

PART A

Around 50 million years ago, a species of trees (the ancestor of the Brazil-nut tree) was growing on the coast of what would become Brazil. It slowly started spreading inland into the rainforest. Since the area it was colonizing was devoid of its original pollinators, its spread was slow. The ancestor of the Brazil-nut tree was a flowering tree which bloomed at the end of the wet season. It grew to heights of 50 m. It possessed hard-to-open flowers, allowing only strong insects to reach its pollen and nectar.

The plants of the soon-to-be-colonized area belonged to different species. Among these plants, many were orchids. Others were trees. All of these plants produced flowers to attract pollinators. The trees bloomed in general at the end of the wet season (around the month of May) so that their seeds might grow in humid soil. As for the orchids, they would bloom several times during the year. However, they possessed peak blooming seasons. They grew in momentary clearings (such as the ones created by the death of a tree) or in small patches of grasslands.

The pollinators of the area in which the ancestor of the Brazil-nut tree was spreading into were mostly the *Euglossa* bees, as well as different species of butterflies. Usually, when pollinators visit a flower, it is in order to eat its nectar. However, in the process, they get covered by pollen which is carried from flower to flower. This pollen was quite nutritive and was often eaten by the insect transporting it, thus decreasing the efficacy of pollination. The pollinating behaviours of bees and butterflies were quite different. Butterflies, tended to go around and randomly pick flowers. They ate the nectar and the pollen of the flowers they visited. As for the *Euglossa* bees, they possessed a particular habit of pollination: once they fed on the nectar of a flower, they would only visit other flowers of the same species. Note that the bees of the genus *Euglossa* were not honey bees, and they rarely built nests in which more than one female and her own brood would be present. Instead, they fed on plant nectar and made reserves

in their nests. Yet, these bees still sting predators. Interestingly, the male of the *Euglossa* genus visited orchids in order to *perfume* themselves (and feed on nectar) and become more attractive to the females of their species.

The rainforest, although quite dense, presents areas of lesser densities where long grass can be found. These areas are especially populated by the orchids. These open areas are usually the home of different bird species such as the ancestor of the Kingbird that prey on flying insects. This bird prefers areas of light vegetation because it is too large to fly in the dense rainforest.

Question 1. Fill a table with the relationships (mutualism, commensalism, amensalism, predation, competition, parasitism) that existed between each of the different organisms present in this community (orchids, trees, ancestor of the Brazil-nut tree, ancestor of the kingbird, butterflies, and *Euglossa* bees).

	Orchids	Brazil-nut tree ancestor	Other trees	Kingbird ancestor	Butterflies	*Euglossa* bees
Orchids						
Brazil-nut tree ancestor						
Other trees						
Kingbird ancestor						
Butterflies						
Euglossa bees						

Question 2. Evolution through natural selection tends to decrease negative interactions and increase positive interactions. Yet, after 3.5 billion years, there are still interactions with negative effects. Why do you think it is so?

Question 3. We know that the *Euglossa* bees are common today and that they pollinate the Brazil-nut tree, which is found in rainforests. Based on this information, consider each of the species and interactions described above and predict how each of the interactions might evolve.

PART B

Back to the year 2015! Although time has passed, the habitat of the rainforest hasn't changed much. There are still areas of highly dense forest and others with a lesser density of plants. The Kingbird is still present in lightly forested areas. However, the *Euglossa* bees now avoid large clearings in the rainforest.

The Brazil nut tree now blooms during the middle of the dry season (October). It is solely pollinated by female *Euglossa* bees that are the only insects strong enough to open the flowers and feed on their highly nutritive nectar. The other trees and flowers that sustain female *Euglossa* bees bloom during the other months of the year. The connection between the trees that feed the female *Euglossa* bees and this insect is so strong that now *Euglossa* bees solely feed from one or two species of trees per month. However, some of these species can also be pollinated by other pollinators.

Individuals of the Brazil-nut tree usually present a clumped dispersal pattern. The different clumps can be separated by a few kilometers.

The male *Euglossa* bees also feed on, and use the smell of, orchids. These orchids are now solely pollinated by the *Euglossa* bees. The orchids have adopted a shape that causes the pollen to only deposit on *Euglossa* bees. The pollen is deposited on body parts which the bees cannot clean, thus they pollinate flowers more easily. Therefore, no valuable pollen is lost to the random movement of insects.

Question 1. Based on the mutualistic interactions seen above (between different plant species and *Euglossa* bees), do you think there are several degrees of mutualism? Elaborate.

Question 2. Lately, the Brazilian rain forest has been subjected to extensive deforestation. Massive amounts of *Bertholletia excelsa* (Brazil-nut tree) have been cut down and transformed into lumber. However, the Brazil-nut tree's nuts are highly valuable (market value exceeding US$ 200 million in 2008). So, people have been trying to grow plantations of this tree in deforested areas. These plantations are constituted of rows of high (up to 50 m) Brazil-nut tree. What do you think of the success rate of these plantations? What solutions would be available to improve the success rate?

Question 3. Moreover, deforestation affects the Brazil-nut tree in other ways. As cuts are made, some islands of trees are left standing in order to avoid species endangerment. These small islands are usually areas of 100 ha each. Will this affect the reproductive success of the Brazil-nut tree or other rainforest trees? How so?