**Risky or Not?—Discussion Guide**

This is a discussion guide rather than an answer key because the goal is to spark discussion, and multiple answers may be valid and useful. By asking students to make and justify an argument, they are required to use their new learning. With practice they should improve. Consider reviewing scenario 1 all together before allowing groups to work independently on the following scenarios. Alternatively, ask students to choose one question to answer, and ask them to present their answers to their peers. This can generate some really valuable discussion. I try to emphasize to students how thinking about evolution can change their predictions from what they would guess based on ecology below. Below are some possible rankings with rationale. Note that I assume in all cases that the population has not reached its carrying capacity, but it is interesting to think about how changing that assumption would affect the answers.

1. A farm in Washington cultivates fields of common milkweed. They started with a mixture of seeds collected from a few sources around the country and selected the varieties with the highest germination rate to plant. They now cultivate fields of milkweed plants that are open pollinated and harvest the seeds each fall to package and sell.

\_\_\_\_-2\_\_\_\_ a. Suppose large numbers of these seeds are planted at a Minnesota site where a few locally adapted-common milkweed plants are found along a roadside.

Its unclear whether the Washington seeds would be locally adapted to Washington or a more generic mix, given the way they were collected. Nevertheless, when there are large numbers of non-locally adapted individuals at a site with just a few locally-adapted individuals, the non-locally adapted individuals can swamp out the local population. There are negative risks here. Note that Washington is not a site where common milkweed is native.

\_\_\_\_-1 to +1\_\_\_\_ b. Suppose a few of these seeds are planted at a Minnesota prairie site where a large and healthy population of locally-adapted common milkweed plants exists.

Although milkweed is locally adapted, there are not many seeds from the Washington population entering the Minnesota prairie, so it is unlikely they will cause a major disruption. The risks are small here. In fact, they may introduce new and beneficial genes or gene combinations.

\_\_\_\_\_ + 3\_\_\_ c. Suppose common milkweed populations are not locally adapted, and many of these seeds are planted in a Minnesota prairie to supplement an existing healthy population of common milkweed.

Because milkweed is not locally adapted, mixing seeds from different places is unlikely to reduce fitness, although there could be benefits if new genes or gene combinations are introduced that are beneficial. In particular, this seed source is likely to have a lot of genetic variation, which could benefit the local population.

1. A seed company in Vermont plants a field with common milkweed collected from roadsides and old fields within a 20-mile radius of the site. They harvest the seeds and keep them in cold storage before distributing them to customers on Amazon.

\_\_\_-3\_\_\_\_\_ a. Suppose large numbers of these seeds are planted at a Minnesota site where a few locally adapted-common milkweed plants are found along the side of a road.

These answers are similar to above, but because we know these seeds are locally adapted to Vermont, they probably will not grow as well in MN, and vice versa. If they do survive and mate with the native invididuals, the resulting offspring population could be much less fit.

\_\_\_-1 to 0\_\_\_\_\_ b. Suppose a few of these seeds are planted at a Minnesota prairie site where a large and healthy population of locally-adapted common milkweed plants exists.

Because the Vermont individuals are less adapted and are rare, they will probably have a small and decreasing influence on the population.

\_\_\_+2\_\_\_\_\_ c. Suppose common milkweed populations are not locally adapted, and many of these seeds are planted in a Minnesota prairie to supplement an existing healthy population of common milkweed.

These answers are similar to above, but because we know these seeds are locally collected in Vermont, they probably do not have as much genetic variation as the WA population, so the benefits might not be as great.

1. A Minnesota based seed company grows common milkweed plants from seeds collected around the Midwest. They allow the plants to be naturally pollinated every summer, collecting seeds in the fall for distribution.

\_\_\_\_-1 to +1\_\_\_\_ a. Suppose large numbers of these seeds are planted at a Minnesota site where a few locally adapted-common milkweed plants are found along the side of a road.

Probably the seeds are from a similar source to the local population, so the risks are not so big. At the same time, this could bring new and valuable genes into the local population that help it grow.

\_\_\_\_0\_\_\_\_ b. Suppose a few of these seeds are planted at a Minnesota prairie site where a large and healthy population of locally-adapted common milkweed plants exists.

These risks and benefits are probably not much greater than planting seeds from the local site.

\_\_\_\_+2-3\_\_\_\_ c. Suppose common milkweed populations are not locally adapted, and many of these seeds are planted in a Minnesota prairie to supplement an existing healthy population of common milkweed.

This will probably help to increase the population size but is not likely to cause evolutionary change because there is no local adaptation. It may increase genetic diversity in the population, which could be beneficial.