

Free Response: Step 3 of 6

Question 1 Explained

Read the following article from the Shmoop Scoop and answer the questions that follow.

Shmoop Scoop Fire Ants: Friend or Foe?

Nearly all of us have had some kind of unpleasant experience with fire ants. Since they first appeared in our area, the number of mounds seems to be increasing exponentially, and most of us have been unlucky enough to receive their unpleasant stings. Luckily for us humans and other large animals, fire ant attacks are seldom fatal, but the same can't be said for smaller animals and insects. When on the march, fire ants will destroy anything they encounter on the ground from lizards and birds to seeds, leaves, fungi, and carrion.

Fire ants are currently confined to the southern US, from California to North Carolina. Throughout their range, their mounds can disturb soil and interfere with agricultural equipment. They also have a strange affinity for electrical equipment of all kinds and can cause serious damage. In spite of all this, farmers have noticed declines in populations of agricultural pests such as the sugarcane borer, boll weevils, cotton leafworms, and hornflies.

a) Several aspects of fire ant ecology are mentioned in the article.

i. Describe the likely origins of the fire ant. Describe two biological characteristics that enable them to thrive.

Fire ants are an invasive species, one that is living outside of its native range and was most likely introduced by humans. Since fire ants are currently limited to the southern US, they likely originated in a warm or tropical region (South America to be precise). Invasive species often do not have any natural predators or competitors to limit their population growth. Also, we know from the reading that the number of their mounds is increasing exponentially, which implies that they are able to reproduce rapidly.

Things that you don't want to miss in your answer to get a high score:

- Define all of the relevant key terms, including invasive species and any other biological terms.
- Be sure to clearly indicate and differentiate between BOTH of the characteristics you describe. Your examples should be supported by the reading.

Other possible examples you could discuss include:

- There are several characteristics of a typically "r-selected" (quickly reproducing) species that you might discuss.
- The best example would be that fire ants are very general in terms of their diet and other niche characteristics. The reading describes their scorched earth approach to feeding, which demonstrates that they're not very picky when it comes to their menu.

ii. How is their current range likely to change as a result of climate change?

Fire ants are currently confined to the southern US, so their niche, the environmental conditions necessary for their survival, is defined by warm weather. Their range is probably limited by cold weather, so fire ants will likely spread north as the climate warms northern latitudes.

Things that you don't want to miss in your answer to get a high score:

- Define any terms such as niche.
- The evidence for their limitation by cold weather is in the reading, and you should know that some species, particularly invasives, may spread as the climate warms.

b) It is clear from the article that fire ants have potentially important impacts on ecosystem services. Describe TWO ways in which fire ants either positively or negatively affect ecosystem services related to agriculture.

The primary ecosystem service, a benefit provided by natural systems, is as a natural enemy of crop pests because fire ants eat many different types of insects. They may function as a biological form of pest control. Biological control agents limit the populations of pests through predation or competition, and there is evidence that fire ants are contributing to the declines of common agricultural pests. Conversely, because fire ants are general predators, they will predate or outcompete native insects including pollinators and other natural enemies which might negatively impact agricultural productivity.

Things that you don't want to miss in your answer to get a high score:

- Define all of the key terms such as ecosystem service or biological pest control.
- You should draw on your own knowledge of ecosystem services to correctly answer the question rather than simply repeat the examples in the reading.
- The economic impacts of fire ants on farm machinery do not relate to ecosystem, services and would be considered incorrect if included.

Other possible examples you could discuss include:

- Fire ants create mounds and could contribute to nutrient cycling in the soil.
- Negative impacts include the potential to damage crops and consume organic matter important to soil fertility.

c) Describe TWO ways in which fire ant invasion would impact the ecology of a forest adjacent to the agricultural land.

The impacts of fire ants in the forest might be similar to those seen on an agricultural field. If fire ants invade forests and consume native natural enemies, the declines of those predators could lead to the population growth of prey species which have the potential to become agricultural pests and invade croplands. Predation of native pollinators in the forest would affect those ecosystem services in the croplands.

Things that you don't want to miss in your answer to get a high score:

If forest is adjacent to the agricultural land, the two types of land use will influence each other. If fire ants invade the forest, they will impact the native animals just as native animals in the forest may contribute to the ecosystem services in the cropland. This question requires you to make connections beyond what is described in the reading.

Other possible examples you could discuss include:

- Consumption of leaf litter and carrion would affect nutrient cycling and soil retention in forests.
- If soil is lost in the forest, that will have consequences for erosion and water retention.
- Elevated predation pressure can impact native species of both invertebrates and vertebrates, particularly ground-nesting birds, which will decrease diversity.

d) Describe ONE possible approach for controlling fire ant populations and its costs and benefits.

Chemical pesticides can be effective at controlling insect populations in the short-term but can have non-target effects, impacts on species other than fire ants. They may also contribute to pollution and human health problems. Pesticides become less effective over time as the population becomes dominated by pesticide resistant individuals due to natural selection. Chemicals may also allow other pest species to flourish by decreasing the populations of their predators.

Things that you don't want to miss in your answer to get a high score:

- Define all key terms such as biological control or integrated pest management.
- Clearly identify the approach you will describe.
- Clearly identify both the costs and the benefits.

Other possible examples you could discuss include:

- Biological control is more sustainable with fewer pollution or negative public health effects. However, they are harder to control and can sometimes negatively impact native species.
- An integrated approach might involve targeted application of chemical pesticides after a population of pests has been decreased through biological control.