

## **The Current Extinction: Defaunation & Ecosystem Disruption**

*Information taken from: Dirzo, R. et al (2014). Defaunation in the Anthropocene. Science, 345(401).*

Scientists estimate, conservatively, that there are 5 to 9 million different animal species on the planet. But that number is continually changing, and unfortunately, dropping, as we are likely losing 11,000-58,000 species annually, and evidence suggests that on average, there has been a decline of about 28% in terms of numbers of individuals within a species over the last four decades. Both of these statistics are vitally important. The critical nature of the first is perhaps more obvious, as total loss of a species is irrecoverable, but the second, a decline in population sizes of species, though more subtle may actually have more immediate impacts and represents an area where positive progress can be made.

The term “defaunation” (fauna being a description of wildlife diversity) is starting to be used by scientists to cover both the loss of species and declines in numbers within a species, in hopes that its similarity to the term deforestation, which represents an issue the public is highly aware of, will generate more public attention and support for this vital area of biological study and conservation. In fact, the topic and current research findings were the focus of a July 2014 issue of Science and conversations are ongoing in the biological community about the extent of current extinction rates. Some studies suggest that these rates are 100-1000 times higher than normal background extinction rates, which may mean that we are currently in the early stages of the next “mass extinction” for our planet.

So far, research into defaunation has given us important information about current trends, such as the knowledge that amphibians are among the most threatened vertebrates. Amphibians may not be the first organisms you’d identify as having a measurable impact on an ecosystem, or on human well-being, but they play an important role in maintaining balance in aquatic ecosystems. Without them, there can be an increase in algae and detritus, higher than normal nitrogen levels, and a disruption in the metabolic cycles of the ecosystem. Other consequences of defaunation are just as critical. Insect species, which are responsible for pollinating 75% of the world’s food crops, are declining globally. A decrease in small vertebrate predators also has an impact on food production, as they normally help keep arthropod pests in check. These pests are responsible for up to 15% of the losses in major food processes.

Apart from food availability, one of the other major concerns for human populations is health, which, too, can be affected by loss of species diversity and decline in organismal populations. Specifically, research has linked defaunation to increases in disease transmission and prevalence due to changes in host abundance and behavior. Declining numbers can also have a significant impact in parts of the world where wild-animals are a main source of food, and extinction of species means the loss of current or potential future sources for pharmaceutical compounds.

The critical nature of defaunation is clear, but why does it occur? Most of the causes either directly or indirectly stem from disruption the natural interactions and balance in an ecosystem, a phenomenon that can often be traced to human influence. Examples like habitat fragmentation or complete loss of habitat and introduction of invasive species are directly result from human populations, while other

examples like climate change represent how humans affect other aspects of the ecosystem that can then impact defaunation patterns. When we compare current extinction trends to historical data especially that of the past major extinctions, the human influence is obvious and a unique feature driving ecological changes, some of which were, unfortunately, preventable.

While these trends may seem somewhat depressing, the good news is that the more that we understand about what is happening and the causes behind ecosystem disruption and defaunation, the better we, as a society, will be able to come up with solutions to slow down or in some cases even repair some of the damage that has been done. Already, scientists are using what they have learned to plan for the future, but for a real difference to be made, the entirety of our global society must take an interest.

Your goal for this activity is to examine a specific example of ecosystem disruption and share what you have learned and ideas you might have for the future.

With your partner or group, research one of the topics listed below, and then address the following:

- How is this an example of ecosystem disruption? What change has occurred? What was the “normal” state of the ecosystem and the place of the organism involved in it? How might this disruption contribute to defaunation or extinction of species or how is it caused by these phenomena?
- Has human influence played a role in this ecosystem disruption directly or indirectly? How?
- How does this disruption impact other organisms in the ecosystem? Are there specific species interactions that have been affected?
- How might this change impact human society and well-being?
- What is currently being done to mitigate/reduce the impact of this disruption, if anything? Any steps taken to avoid it in the future? Are there any other ethical or societal issues involved (such as the balance between habitat destruction and necessity of crops)?
- What ideas do **YOU** have that might address some of these problems?

With the information that you have gathered, prepare a 7-10 minute PowerPoint presentation on your topic. Include appropriate citations and a works cited section. You need to have at least 3 reliable sources.

You will be assessed on your answers for each question, the connections you make between your topic and ecosystem disruption, the overall quality of your presentation and your answers to follow-up questions.

### Examples of Ecosystem Disruption:

**Warm weather in the Arctic:** potential causes of temperature change and impact on ecosystem/cycles

**Vulture Decline:** normal role in ecosystem and effect of decline on chain/web

**Aquatic Osteoporosis:** potential causes of chemical changes in the lakes and impact on ecosystem/cycles

**Phosphorous pollution in Lakes:** potential causes of chemical changes in the lakes and impact on ecosystem/cycles

**Colony Collapse in Bees:** potential causes of collapse; specific outcomes for ecosystem in terms of pollination impact

**Death of Sea Stars:** why they are a keystone species, potential causes of death rates, and specific outcomes on the ecosystem

**Changes in wind patterns:** causes of differences in the resulting impact on ecosystems (plants and animals i.e. predator/prey relationships)

**Coral Bleaching:** normal symbiotic relationships present, causes of loss, and specific outcome on the ecosystem.

**Asian Carp:** what is the normal food web like where they are invasive, and how do they impact it, how did they end up invading the ecosystem, and why is it a challenge to get rid of them

**Saumatran Rhino decline:** what is their normal habitat, and role in an ecosystem, and why are they declining, how does protecting their habitat impact other species/ecosystems?

**Ocean acidification:** how does the pH of the ocean relate to the carbon cycle? What is causing it to change? How does the change in pH impact ocean ecosystems?

**Zebra mussels:** change in habitat range and status as nuisance/invasive species, impact on local ecosystems, challenges with getting rid of them

**Rabbits in Australia:** attempt at control of invasive species resulting in coevolution with virus

**Changes in fish size:** how does this relate to fishing practices and guidelines? What impact does this have on the fish? What about other parts of the ecosystem?

**Geese populations:** change in habitat range and status as nuisance/invasive species, impact on local ecosystems, challenges with getting rid of them

**Spread of infectious disease from bats:** why are viruses like Nipah not as deadly to the bats? How are they transferred from bats to other animals to humans? How does this relate to deforestation and habitat destruction?

**Arbovirus spread outbreaks:** How do changes in climate and water cycle processes relate to risk of arbovirus outbreaks?

**Changes in the epidemiology of disease driven by deforestation:** how does biodiversity normally help to limit the spread of some diseases? Why does the loss of a species in an ecosystem often result in higher quantities of other organisms like insect carrying rodents? How does this impact the spread of disease?