

**The deceptive perception of change:
how human caused species extinction will be our own demise.**

Soren Bondrup-Nielsen

The only thing constant in life is change. We exist because of change, we change by getting older, the seasons change, and the communities in which we live are changing. We perceive some of these changes better than others. When you see a friend that you haven't seen in years, you immediately notice how they have aged, whereas, with friends you interact with frequently, you do not perceive the ageing process. The standard for detecting change within your community or surrounding nature is set when you are young. As you get older, you see a house being torn down and a new one built, and you observe the forest cut down to make room for a mall. Thus, as you get older, you see increasing change, but the total change in a landscape over time is not registered cumulatively.

Different responses to sudden versus gradual change are a general phenomenon. If you put a frog in cold water and then slowly heat it, the frog will swim around apparently unconcerned until the water is so hot it kills the animal. However, if you place the frog in water that is already quite warm, it will do everything to jump out. A sudden change we perceive and respond to while a gradual change we often do not perceive.

Currently, we are living through changes that are global in extent. The covid-19 pandemic is a sudden event affecting everyone around the world. Individuals may not be infected with the virus, but we all certainly feel the impact on our personal lives. Climate change is another phenomenon that people globally are slowly beginning to experience. Winters are milder, storms are more frequent, and floods or droughts are becoming more common. The global biodiversity crisis is a gradual change that is not generally perceived, but the loss of species should be as concerning as Covid-19 and climate change.

We currently live within the recently named Anthropocene Epoch, a period defined by overwhelming human impact. The Anthropocene will witness the sixth mass extinction, though we seem not to perceive this. There have been a number of mass species extinctions throughout our planet's history, but no other has been caused by a single species. Much like the frog that does not perceive the water getting hot, if we do not perceive species' extinction as a threat, we too may not survive.

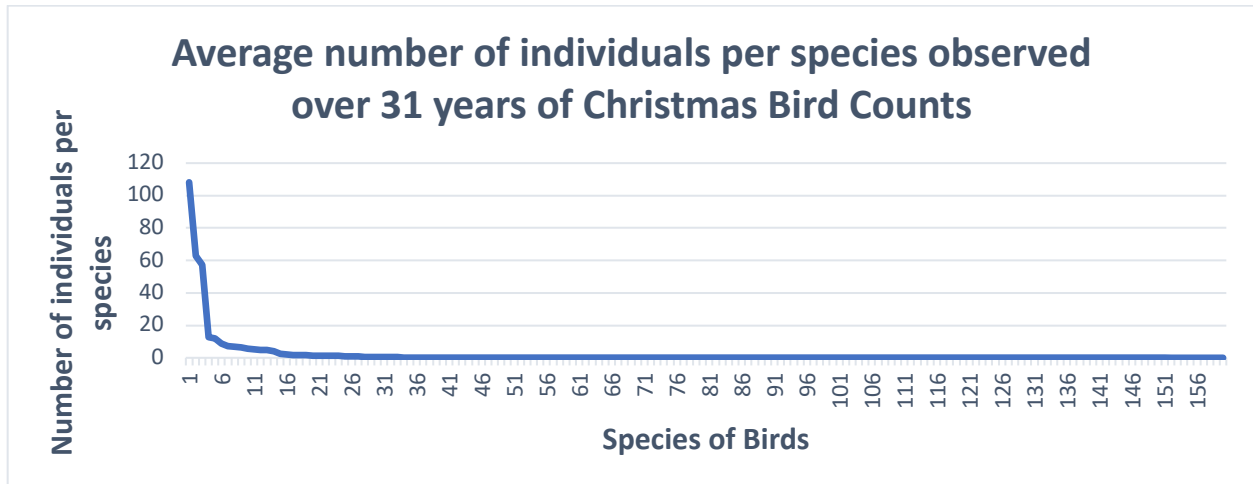
Currently, we have identified and named about 1.5 million species globally. Estimates of the total number of species globally vary, but there are likely between 5 and 10 million. However, the present global total represents only about 2 to 3 percent of species that ever existed during the last 3 billion years that life has evolved on earth. Thus, species evolve and go extinct over time. Although on average a few species may go extinct every thousand years, the most notable diversity changes are the five mass extinction events during the past history of life on earth. The last extinction event wiped out the dinosaurs, as well as many other life forms. A meteor struck our planet some 66 million years ago, wreaking havoc by causing massive fires, sending debris into the atmosphere blocking out the sun for some years; living became impossible for vast numbers of species. This extinction event was sudden; other extinction events in the past have

been more gradual. With each extinction event, new species have evolved, resulting in greater diversity, but this has taken millions of years. The current extinction event which we are driving is not sudden like that caused by a meteor strike, but neither is it slow as some of the past events. However, it is indeed swift enough to cause significant biodiversity loss and just gradual enough that we do not seem to perceive it.

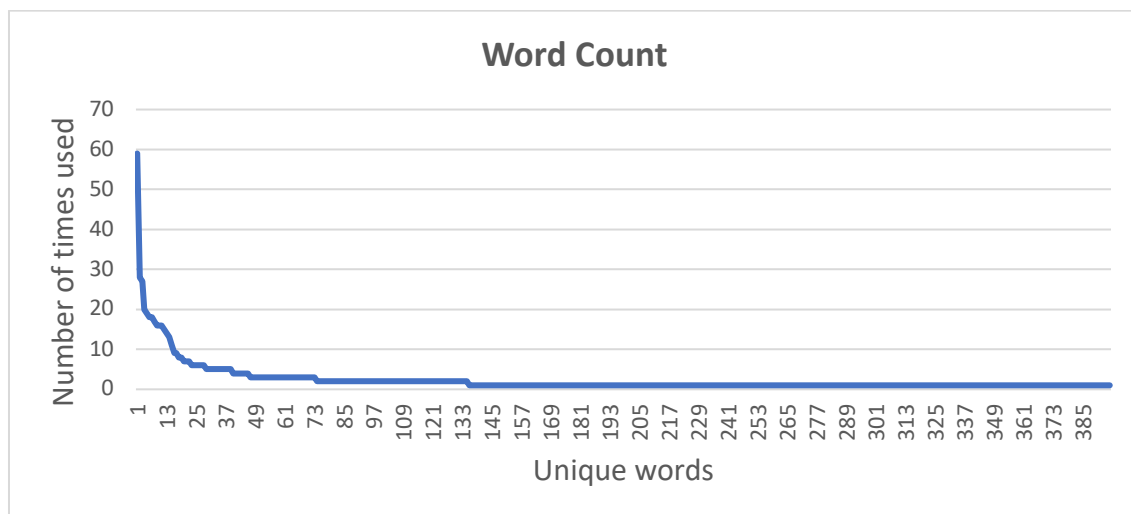
The exponential increase of humans, the insatiable greed for resources, and the dependence on energy from burning fossil fuels are eliminating habitats, driving climate change, and causing the sixth species extinction event. Ice cover in the arctic is retreating due to climate change and we see images of polar bears balancing on small ice floes. The tropical rain forests of Brazil, a biome with an astonishing diversity of life, are increasingly levelled and burned to make room for human uses. This is causing extinction of species that we haven't even discovered yet. In northeastern North America the recent disappearance of bat species has been attributed to white-nose syndrome, an invasive introduced fungus that has spread north due to climate change. Around the world, fish populations are harvested at unsustainable levels to feed us. These are but a few examples.

We may think that the loss of species cannot be that significant. After all, is it not the rare species that are disappearing and not the common ones? No, the bats were common until white-nose syndrome came along. As another example, we have become excellent at finding common fish in the ocean and potentially catching them all. As species are lost, ecological processes are affected. There is redundancy in nature, and the loss of some species may not necessarily impact an ecological process. However, at some point, often referred to as a tipping point, an ecosystem rapidly changes from one state to another. Desertification is an example. Arid and semi-arid landscapes, which can support organisms' diversity, may turn to desert if perturbed by over-grazing.

If you count the number of individuals of each species, whether globally, locally, or even within distinct habitats, only a few species are abundant, while most will be considered rare. If you plot population size of all species from largest to smallest, you will get a curve that near the origin on the horizontal axis is initially high but very quickly declines and continues for a long distance to the right. For example, the average count per species for all species encountered over 31 years of Christmas Bird Counts in Wolfville, Nova Scotia has such a distribution.



The prevalence of rare entities is in fact a common phenomenon. The word count from beginning to end in this essay is 947, and contains 396 distinct words. The plot below shows the number of times each word is used.



The distribution of word usage or individual birds are basically identical; both have very long tails.

In the text above, the word used most frequently is “the”, appearing 59 times, followed by “of” (28 times) and “a” (27 times). Only 15 words appear more than 10 times, and 58 words appear three to nine times. Most words, 324, appear only once or twice. Of the 39 words used more than five times, most relate to the topic of the essay and include “species”, “extinction”, “change”, “perception”, “years”, “events”, “life”, and “globally”. The remainder are primarily conjunctions, simple verbs or pronouns.

Thus, a few commonly used words provide scaffolding upon which rare words are draped to supply meaning. The sequence of words is of course important, and the same words can be strung together to convey other meanings or potential. Again, we can find parallels in nature.

Different species of organisms may co-exist in different groupings, similar to different words strung together to convey different meanings. We may consider the frequent species, whether of trees in a forest, herbaceous plants in a field or plankton in the sea as providing the structure for the rarer species to exist, giving the system its unique essence. Remove the common species or words, and the system is left without structure; remove the rare species or words, and the system is left without potential. Thus, all species in an ecosystem are important.

The analogy of an airplane that ultimately crashes after removing rivets one by one has been used to convey the effect of species loss. But this may be too simplistic; the rivets are the same and thus do not reflect the diversity that exists in nature. We know that species may co-exist together in different groupings. Thus, there is not necessarily a one-to-one dependence among species but nor is there a delicate balance. Different groupings can exist in nature and there is a certain amount of redundancy, which results in what might be termed different harmonies. Think of a full symphony orchestra that can play any number of symphonies. A full symphony orchestra consists of a few common instruments but several that are rare, similar to words in a paragraph or species in an ecosystem. More than 50 string players dominate, but rarely is there more than one piccolo, one bassoon, or one harp. If we slowly eliminate instruments during a concert, the audience might not notice immediately, but eventually it would be difficult to recognize the symphony being played.

The increasing loss of species must be addressed before we perceive it is happening, because by then it will be too late. How would an essay be intelligible if an increasing number of words were left out as you read?

It is not necessarily to perceive change, especially if it is occurring at a slow rate. Climate change now to be occurring at a rate where we do feel its . One summer seems hotter than the previous , and snow the ground may not be as as we remember. We see pictures enormous shelves breaking in Antarctica and polar balancing on isolated small ice floes. the loss species is not we readily notice. World Wildlife estimates that some 200 to species extinct year. That is a lot. of these are tropical species we in are not with, but . As change, as diminished habitat or environmental , particular may in abundance. can a cascading effect in a in abundance other . talk about extinction vortex. is a where a species to decline abundance, much be done to reverse the problem, the is sucked vortex extinction. we may currently loss species, ultimately consequence extinction rapid notice .