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Effect of Human Activities on Natural Evolution

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Abstract. The knowledge of evolution and natural selection has brought people's understanding of nature a big step forward. This has also greatly improved human autonomy and control over nature. This is not a bad thing in itself, but it also changes the evolutionary laws of nature itself. When natural evolution occurs, the animal and its surrounding environment always gradually adapt to each other. Consequently, when humans speed up this process, it can also lead to surprises. In the analysis and study of these cases, a certain number of cases have had negative consequences, both for humans and the creature itself. In this article, the evolution and adaptation of the brown rat in New York City are introduced and studied in detail, and the data is actively used to provide evidence for the evolution of the brown rat in only a hundred and twenty years. The impact of brown rats on humans will also be manifested in various aspects of New York City's hygiene, disease, diet, and so on. In addition, this article makes a detailed analysis and investigation of the evolution of African elephant ivory. Comparisons are also made in detail in terms of the changes in the habits of African elephants.

Keywords: evolution, urbanization, wildlife.

1. Introduction

The reason for deciding on this topic was after reading a document and realizing how huge the rat population in New York City is. The population ratio of New York City citizens to rats is a staggering 4:1[1]. This means that the average family of four will have one mouse (Rasmussen). This puts the living standards and health of New York citizens at great risk. Rampant rats spread many infectious diseases through their urine and fur. And the main reason for all this is urbanization. The reason for evolution comes from humans, especially rats in downtown New York City. With further exploration, there's other evidence that could apply to wildlife. For example, mule deer, black bear, coyote, etc. tend to be more active during the nighttime as a response to human activities. However, these are only some of the small impacts that changed animal behavior. More severe evolutional influences had caused the species in a dangerous situation which is while their behaviors and physiological features have been changed by unnatural interference, their living environment is not changed along with themselves. These contradictions formed inappropriate settings for wildlife to live their usual lives. These transformations caused by human activities make human beings undergo unlikeable situations and are declining other species' populations or even overpopulating some species would cause suffering for other kinds that share the same habitat with them.

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2. Brown Rats' evolution in Newyourk city

Like all rodents, the brown rat has an extremely strong ability to survive and reproduce. There are no articles that are certain about the origin of brown rats. They might have already been spread by boats and other land transportation all over the world from the early centuries. Apparently, a group of brown rats has been brought to the land of North America and started a new life here, but still with humans [2]. For 19 centuries, when North America massively urbanized, cities were built, and the urban citizens' population was raised consequently. The brown rat used this time to prosper and evolute several times. Urbanization has led to a major change in the environment. This makes the living conditions of brown rats face great challenges. The temperature has risen. Urban lighting makes natural light irrelevant which changes animals' biological clocks. Cars and entertainment, etc. also increase noises. At the same time, urban animals are more likely to eat foods that are not suitable for their diet since these foods are easy to find, which also leads them to consume chemical toxins without notice. In order to live in a new and more toxic environment, brown rats have to deal with these changes [3]. As a result, brown rats' cranial shapes have changed accordingly.

Generally, both natural selection and artificial selection change cranial shapes. Cranial shapes control lots of perspectives such as heat dissipation or what type of food these creatures are suitable for. In order to prove that the skull of the brown rat changes shape due to the temperature in the city, the scientists experimented with several groups of brown rats in batches. What make this easier, the brown rat has a short growth cycle, enabling scientists to quickly draw conclusions about whether the variables matter or not. When testing whether the cranial of brown rats change in size due to cold temperatures, the scientists compared a group of brown rats grown at a low temperature of five degrees with another group of brown rats grown at a room temperature of twenty-two degrees. The brown rats that survived at low temperature were significantly owns smaller sinuses and nasal cavities than the ones that survived at room temperature. Mammals that generally live in cold regions have relatively small noses, auricles, tails, and limbs. This is evidence that the morphological structure is adapted to the environment. Smaller bodies allow them to lose less heat, maintain body temperature, and adapt to colder regions. Another factor that contributes to changes in the cranial is the use of teeth. This time, the scientists divided the subjects into two groups of brown rats that eat whole and soft foods. The soft diet caused the incisors and rear teeth of the brown rats to move further back than those on the hard diet. This freed the mandible of the brown rat from developmental constraints. The larger cranial, correspondingly, gave the brown rat a larger brain. It makes them smarter and are more effectively adapt to changes in the environment [2].

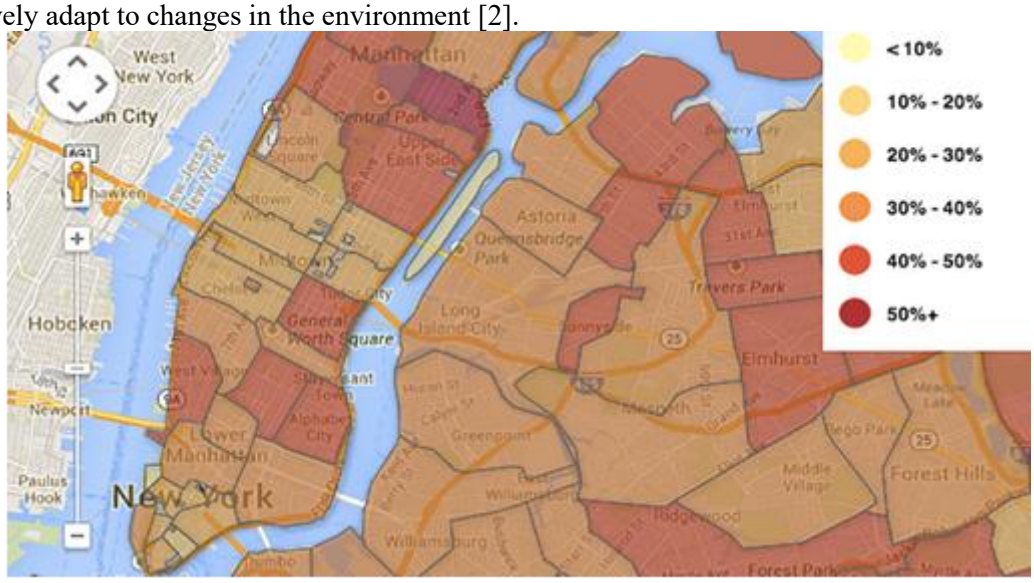

Figure 1. Rodent-Infested Restaurants [11].

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What is certain is that brown rats reproduce roughly three times a year, which makes their evolution faster than bigger mammals [4]. Rapid reproduction allows brown rats to better preserve genes that are suitable for them to survive in cities, and discard traits that are unfavorable or unusable. For example, rodenticides were found to be no longer effective against brown rats, and they also became immune to many diseases. This makes them the perfect virus-delivery tool, capable of taking most kinds of viruses anywhere, making a huge impact on the health and disease safety of cities especially when New York City is one of the most densely populated cities in the US. Even though brown rats are clean-loving animals and spend a lot of time cleaning themselves every day, they are accustomed to feeding on garbage discarded by humans in the dark and dirty sewage system. After going through those unhygienic places, according to figure 1, they also appear in the restaurant, which would make it much more easier to spread disease by people's food. In addition to the viruses they carry, the fleas they carry, and their feces also help spread the disease [5]. Apparently, humans have struggled with the tenacious brown rat for many years. Various methods have been developed to try to eliminate them, not limited to toxic agents, traps, and reproductive suppression. However, some poisonous agents can also cause harm to humans, pets, or other wild animals in the city. It makes eradicating brown rats more difficult. Other than that, living with a large number of humans made food finding simpler than ever. Human approximately left 40% of food uneaten [6]. The brown rat's prosperity benefits from the food discarded by humans. Not only will they not decrease in number due to food shortages, but they have also evolved to better adapt to urban life through these various foods. The favorable environment allows the brown rat to grow larger. The adult brown rats can even reach fifteen to twenty-five centimeters in length. The advantage of their size makes them have few natural enemies, creating a vicious circle. They are very athletic and can reach many places. The brown rat can jump up to two meters, which is several times its own body length [7]. Brown rats even have the ability to dive and swim, which makes their lives even more tenacious. Those huge and bold creatures attack people and other domestic animals randomly, which could cause severe injury. They also have the ability to pull trashes out of the trash cans which make the city unclean and could even affect people's basic living needs. As mentioned earlier, the brown rat is very reproductive, and they can start breeding in about eleven weeks. The pregnancy is about one month. One litter can produce seven to eight young rats. Brown rats can produce three to five litters a year, making their numbers even more staggering [7].

3. Afican Elephants' evolution in the wild

For the second case that represented wildlife that human activities affected, African elephants was chosen. Unlike the first case, the African elephant population is not prospering like the brown rat, but declining due to human activities. When people think of elephants, they tend to think of this kinds' special long trunk and two beautiful huge tusks. But African elephants are dwindling in numbers because of their tusks. In many cultures, ivory is a raw material for beautiful ornaments, and it is also very expensive. Obtaining elephant's tusk is not as simple as pulling teeth from other animals but requires cutting off the entire elephant head to get the tusks. Therefore, poachers kill elephants in large numbers for profit. From 1900s, the population of African elephants had been declined rapidly [8]. This made African elephants' evolution accelerated. Data shows that more and more elephants are no longer growing teeth. In the beginning, the situation was not that extreme. The Kenya Wildlife Service compared ivory seized from poachers between 2005 and 2013 with those seized from poachers in the late 1970s. The research found out that during those tough poaching period, African elephants' tusks tend to be smaller. Smaller tusks don't seem to have any effect on African elephants [9]. However, when African elephants started to not grow their tusks, things changed. Almost all elephants that don't grow tusks since birth are females. They are no longer valuable to poachers. This allowed them to survive and makes it easier for tuskless females to pass on their tuskless genes to the next generation, comparing with normal elephants. According to figure 2, in Ruaha National Park, up to 35 percent of female African elephants over the age of 25 were tuskless in the most heavily poached areas in the 1970s. Overall, from the graph alone, there are more female African elephants over the age of 25 without tusks, comparing with younger female African elephants. However, it's needed to note that the

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overall number of African elephants are also decreasing. This means that there would be more and more tuskless female African elephants in the future. The imagery also shows that elephant herds in the wild that have not been affected by human activity (poaching) have a tuskless rate of only four percent, much less than tuskless female African elephants in national parks.

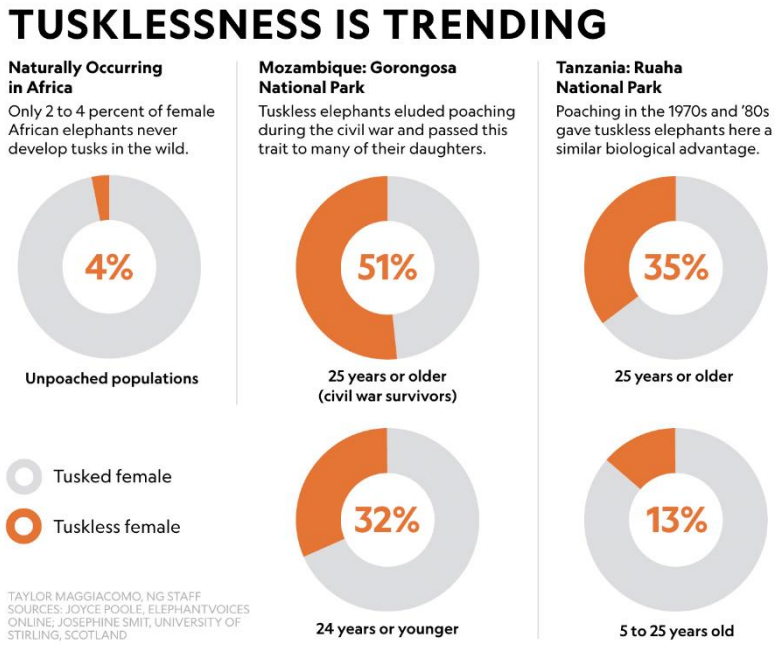

Figure 2. Tusklessness is Trending [9].

Elephants who have lost their tusks are not as unaffected as they might seem. For elephants, the tusk is not just a decoration, but very useful tools. Tusks play an essential role of protecting the trunk. Elephants also use their tusks for grabbing food such as bark from trees. It is also a very handy weapon when fighting between males during mating seasons or with other species. Apart from these, their tusks are used to knock down trees. Some animals use the trees the African elephants knock down as habitats. Therefore, for other creatures in the African elephants' ecosystem, elephant tusk is also an indispensable part. Not to mention that during the dry season, African elephants use their teeth to dug deep hole in order to quench their thirst, which benefits other animals too [10]. But these are only some long-term damages to the ecosystem. More intuitively, male African elephants are gradually decreasing. This is because the gene of the tuskless elephant is a genetic mutation and a kind of syndrome. It's this syndrome that makes elephant tusks tinny and even missing. And they happen to be on the X chromosome. When something is missing from the X chromosome, this kind of situation can kill male elephants. Simply put, for a tuskless female elephant, the probability that a female calf will have half chance to be tuskless and half chance with tusks as normal. However, for male calf, half of them will have tusks and the other half will die because of the syndrome. Only in rare cases do males appear to be tuskless [9]. However, such male African elephants are unable to compete with other males for the right to mate with females because they have lost their important weapon.

4. Conclusion

In general, human activities have had a very large impact on animal evolution. The evolution of brown rats due to urbanization has made it harder for people. They evolved with better immune systems and stronger bodies. The brown rats have been prospered and made their lives extraordinarily tenacious due to those human activities and environmental changings. These evolved brown rats help spread diseases and affect people's normal lives. However, due to the aggressive poaching of hunters, African

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elephants are not only at risk in numbers, but also affect the most fundamental factor --fertility. The diseased genes are encouraged to be inherited by unintentional selection by poachers. This is causing more and more African elephants to lose tusks that are important to them or to other animals that live around them. At the same time, the birth rate of male elephants is decreasing. African elephant herds are losing their gender balance. The brown rat and the African elephant were chosen to represent urban and wild animals, respectively, that have been affected by human activities. Obviously, the influence of the brown rat on the human beings in the city is already obvious, so there is no need to say more. It is more worth to think deeper about the current situation of African elephants. Human activities are making such big change that even could affect wildlife nowadays. It's important to state that all parts in food chain and the ecological chain are crucial. Even a single little grass has its unique position in its ecological system. It might make several rabbits lost their food. As a result, a fox might starve to death. When such influence is amplified and put in real life, it is no longer a few grasses, rabbits and foxes that die. There would be a large number of creatures die, as what the butterfly effect is, a gentle flapping of wings can even cause species extinction. When the scope expands and looks at the entire earth, these animal behaviors or physiological form evolved by human activities occur where no matter human could see or not at all. Many pet dogs and pet cats are artificially selected as deformed species by human aesthetics and have to endure undeserved congenital diseases and life pressures. When humans fish, unlike the balance that exists in nature, they only select the largest, "best" fish. The slower growing fish will be smaller. Theirs are more likely to escape fishing nets and thus have a higher chance of passing their genes on to the next generation. As such, fishing leads to rapid evolutionary changes in growth rates and other traits. Examples are numerous. Humans have now paid attention to the impact of various human activities on the environment. Scientists in different fields are also beginning to realize that if the current situation continues, the consequences will be disastrous.

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