The Connection Between Selective Logging and Deforestation within the Amazonian Rainforest

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Introduction

Timber has always had a great immeasurable value towards the development of human society. As our population began to grow and expand, we extracted this natural resource for the purpose of economic gain, and are one of the most profitable industries in the South American country of Brazil. The practice of selective logging was first established as an effort to responsibly manage forestland while decreasing the amount of ecological degradation, but has changed with a focus of machinery and efficiency. Further examination of selective logging operations, was found to create significant degradation to the remaining forest. and were also found to be linked to later deforestation of the land.

Selective Logging

Selective logging is a practice of timber harvest, which only removes certain trees within a given area. It was seen as a sustainable alternative, promoting the responsible management of this natural resource, and could improve the overall health of the forest. Authors Uhl and Vieira, describe the beginning of the practice in the Paragomainas region as a more hands on experience (1989). Loggers hand-felled desirable trees with manual saws, and used trucks driven paths cleared by machetes to then hand wench and remove the tree. As technology advanced and became available to these loggers, this time consuming task transformed into a system that valued speed, efficiency, and profitability. Saw mill owners buy land from ranchers seeking to gain funds to renew their degraded pastures. The process now takes no time at all as selected trees are extracted with the aid of destructive heavy machinery, with no incentive that ensures the safety of surrounding trees (Uhl, C., & Vieira, I. C. G., 1989). Even after this change, selective logging is still connected to the idea that it has a low impact on the on the ecology of the rainforest. This could be attributed to the fact that when compared to clear-cut logging, which takes all trees within a stand regardless of the

species, selective logging is still associated with sustainable management. However, upon further examination of this process, selective logging was found to have quite negative affects on the ecosystem.

Monitoring Difficulty

Unlike clear-cut logging, which removes all trees within a stand regardless of the species, selective logging is quite difficult to observe using common satellite images. Many studies mentioned within this paper needed to develop new technology in order to collect data. This is possibly a reason why damage from selective logging had gone on unnoticed for quite some time. Once this was remedied, canopy thinning became an indicator of selective logging. The structure of a rainforest is an integral to its function, and the canopy plays one of the greatest roles within the system. Damage caused by selective logging has far reaching implications on the health of the Amazon.

Ecological Degradation

Rainforest Structure

The forest is divided into layers that are vertically stacked upon on another. These layers have been identified as; the emergent, upper canopy, understory, and forest floor. The tallest trees with the height of 100 to 240 feet characterize the emergent layer. Being the top most layer, it allows the trees to receive uninhibited sunlight. In the Amazon, this layer is less studied than that of the ocean floor (blueplanetbiomes.org). These species of trees that reach this height need buttresses to support their size. They are spread apart with umbrella shaped canopies that grow above the forest. The next layer is the upper canopy that is composed of trees 60 to 130 foot trees. Sunlight is easily obtained here however; it limits it for the following layer known as the understory. The humidity in the layer is constantly high because of low air circulation (blueplanetbiomes.org). It consists of trees reaching to about

60 feet in height. Also present are the trunks of emergent layer trees, small trees, shrubs, and plants. The layers above it constantly shade this level. Lastly is the forest floor, which is completely shaded. Less than 1 percent of sunlight that shines of the emergent layer penetrates to the forest floor (blueplanetbiomes.org). Each level plays an important part in creating the rainforest structure. Losing those key elements causes massive damage to the tree and possibly surrounding areas.

Forest and Canopy Damage

A study on selective logging throughout the Brazilian Amazon found that recent logging operations had high levels of damage to the rainforest canopy (Asner, G. P., 2006). The distribution of gaps immediately after selective logging had increased the number of larger canopy gaps, leaving more than half the forest with gap fractions in the 10-100% range. A study on the role of logging in forest loss found logging processes resulted in the damage of almost twice the volume of trees harvested (Fearnside, P. M., 2005). This observation is a direct contradiction to one of the main principles established by selective logging. To selectively log timber, surrounding trees must remain undamaged and great care is taken to fell the tree in a way that minimally disturbs others in the stand, though in this case it was the opposite. An earlier study also concluded that for every tree harvested, 27 more were either severely compromised or killed (Fearnside, P. M., 2005). The selective removal of trees eliminates the most desirable genetic characteristics of timber species, negatively affecting fitness (Uhl, C., & Vieira, I. C. G., 1989).

Importance of the Canopy

The canopy maintains the microclimate that lies beneath. As the protective canopy thins, it exposes the forest to increased sunlight and drying winds that can kill organisms reliant on soil, which are essential for decomposition and nutrient fixing. Most of the fauna

reside in this layer because of the great abundance of food available and are greatly affected by habitat fragmentation from the gaps created by selective logging. These gaps also rid remaining trees of being supported by what used to be a high density of crowns, leading to falling over from the weakened root system (Uhl, C., & Vieira, I. C. G., 1989).

Soil Degradation and Hydrological Changes

Despite all of its abundant richness, Amazonia's giant trees grow in the poorest of soil. The top two inches of the acidic soil contains 99% of the nutrients (blueplanetbiomes.org). Nine tenths of the forest's energy is stored in the leaves and tissues of the trees themselves (blueplanentbiomes.org). Cutting down the trees further deteriorates the already nutrient poor soil. The erosion of the soil is also a result of the removal of trees. Rainfall is collected within the forest, slowing it down before it ultimately reaches the Amazon River. However, when large areas of rainforest are cleared, the trees are no longer present to help absorb the rainfall and protect the soil from erosion (Christopher Callahan, 2008). As a result, heavy flooding, soil erosion and the siltation of rivers are daily occurrences in heavily deforested areas (Christopher Callahan, 2008).

Heightened Fire Risk

Removing the enormous trees that reach the emergent and canopy layers eliminate the shade they produce for the lower levels, which then dry out the other plant life and forest floor. The inability to absorb water makes the biome more susceptible to fires that are extremely dangerous to everything that lies in its path. Selective logging leaves behind biomass created by remains of trees, adding fuel to the fire.

Deforestation

Construction of Roads and Increased Access

To transport the harvested wood out of the rainforest, helicopters are sometimes utilized, however more often than not paved roads need to be constructed. Wide spread

construction of roads such as the Transamazon Highway in 1970, began the upward trend of increased logging operations (Fearnside, P. M., (2005). This in turn, creates greater accessibility to the rainforest where it was once only possible to travel by foot, making it easier to move supplies such as heavy machinery into the forest. Roads that allow increased access to and from the site of a selective logging operation has transformed from an issue of ecological degradation to that of deforestation. It was found that the probability of a previously logged area to be deforested greatly increased when located near a major road (Asner, G. P., 2006). Research conducted found in the study, that selective logging that was concentrated between 3 and 15.5 miles of major roads, resulting in a positive relationship between selective logging and deforestation. Areas at these distances are 2 to 4 times more likely to be cleared than intact forests (Asner, G. P., 2006). The construction of roads opens the opportunity for continued development and expansion of land that was previously logged.

Cattle Ranching

The cheapest and most efficient way of maintaining cleared land is by cattle grazing, and the ubiquity of cattle operations with very low stocking densities in Amazonia suggests that maintaining land cleared is indeed a prime motivation for much of the cattle ranching in the region (Kirby, K. et al., 2006). The rainforest deforestation statistics reveal that 60-70 percent of the deforestation in Amazon can be attributed to cattle ranches, while a significant part of the remaining 30 percent can be attributed to small-scale subsistence agriculture (worldpreservationfoundation.org).

Agriculture

Sustenance agriculture is defined as farming that provides the basic needs of food for consumption such as crops and livestock to a family. This kind of practice is the main way for families in many developed countries to live. The unemployment rate is high because there are no jobs present in the rural areas, so living off the land is the only way to survive.

In order to prepare the land for use, a technique called slash and burn agriculture is utilized. Famers cut everything down and burn the lowland vegetation to create fields that can be cultivated. Subsidies have been placed on soybean crop, which promotes the need for land to grow it.

Conclusion

Once seen as a way to consciously consume natural resources, selective logging has changed into a force that contributes to deforestation. Ecological degradation from this practice has left this interconnected ecosystem negatively impacted and suffering. There is a need for development, however accomplished in a smart way. The effectiveness of policy should be addressed in order to see hope for the future. If these trees are continued to be cut down, the change it will have on the world will be immense. Unfortunately, we will never know the extent because of the knowledge that was lost hidden within the trees.

Annotated Bibliography and References

Asner, G. P., Broadbent, E. N., Oliveira, P. C., Keller, M., Knapp, D. E., & Silva, J. M. (2006). Condition and fate of logged forests in the Brazilian Amazon. *Proceedings Of The National Academy Of Sciences Of The United States of America*, *103*(34), 12947-12950. doi:10.1073/pnas.0604093103

This article examined the amount of forest disturbance caused by selective logging and the amount of logged forest converted to cleared land after this type of resource extraction was implemented in the Brazilian Amazon. Results showed that selective logging operations were dominated by high-damage operations, which later led to a higher probability of later deforestation after logging. The probability grew even greater when the site of the operation was located near a major road. This is a helpful observation that implies the increased access to once inaccessible land contributed to inevitable fate of the deforested area.

Asner, G. P., Knapp, D. E., Broadbent, E. N., Oliveira, P. C., Keller, M., & Silva, J. N. (2005). Selective Logging in the Brazilian Amazon. *Science*, *310* (5747), 480-482.

The purpose of this study was to quantify the amount of selective logging that occurs within the Amazon Rainforest. Selective logging can go unnoticed and is hard to monitor because the usual indication of thinning tree canopies is difficult to detect from satellite observation. Researchers were able to develop a large-scale, high-resolution, automated remote-sensing analysis of the top five timber-producing states of Brazil. Concluding the new examination, it was found that selective logging added 60 to 123% more forest area damage than deforestation alone, which was not previously accounted for. Up to 1200 square kilometers per year of selective logging was observed on lands that were once thought to be protected by conservation.

Fearnside, P. M. (2005). Deforestation in Brazilian Amazonia: history, rates, and consequences. *Conservation biology*, *19*(3), 680-688.

The present article discusses the rates of deforestation that were dictated by historical events beginning with the "modern" era of Brazil. The authors also explain the many consequences that process of rainforest deforestation has on this biome including; loss of productivity and biodiversity, changes in the hydrological regime, and greenhouse gas emissions, furthering degradation. They suggest strategies in the way of policy reform to slow deforestation. The article assisted with understanding trends in deforestation, as well as how the need to construct road infrastructure has paved the way for development.

Fearnside, P. M. (2008). The Roles and Movements of Actors in the Deforestation of Brazilian Amazonia. *Ecology & Society*, *13*(1), 1-22.

This journal discusses the major actors within processes of deforestation, setting out to understand the complicated social aspects of all those involved. It was well organized in the fact that the author explains each role of the stakeholder, whether it be the cattle ranchers or miners, and how they affect the amazon and their reasoning to do so. Policy is another driver of deforestation and the journal recounts laws that have governed the Amazon. The author suggests policy reform, enforcement of laws, and cutting subsidies among others in order to address the issue of deforestation.

Uhl, C., & Vieira, I. C. G. (1989). Ecological impacts of selective logging in the Brazilian Amazon: a case study from the Paragominas region of the state of Pará. *Biotropica*, 98-106.

This case study recounts the construction of major Brazilian highways and technological changes of timber operations that lead to negative ecological impact to the Amazon rainforest. Damage was expressed in terms of loss of canopy, loss of crowns, uprooting, and removal of bark. Conducted in the Paragomainas region of the state of Para, researchers surveyed plots of land along a logging road divided into two sections. It was found that even though only 2% of the trees were harvested, 26% were killed or damaged due to the felling of removed trees. Tree canopy was reduced by nearly half of what it was before the harvesting had occurred. Even though the trees that were harvested were chosen through selective logging, immense ecological damage left the remaining forestland vulnerable. The road system that was constructed in order or move supplies and trees encouraged the settlement of landless immigrants that would further extract resources from the area.

Peer-Review Journal

Kirby, K. R., Laurance, W. F., Albernaz, A. K., Schroth, G., Fearnside, P. M., Bergen, S., & Da Costa, C. (2006). The future of deforestation in the Brazilian Amazon. Futures, 38(4), 432-453

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Shaffner, Brynn. *Amazon Rainforest.* Blue Planet Biomes http://www.blueplanetbiomes.org/amazon.htm

NASA. *Small-Scale Logging Leads to Clear-cutting in Brazilian Amazon.* (2006) http://www.nasa.gov/centers/goddard/news/topstory/2006/brazil_logging.html