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### **Jaguars on the Brink: Unraveling the Tapestry of South American Forests**

When development teams build roads through ecosystems, how does that construction change the balance between species? How can humans alter the foundations which allow for high levels of biodiversity in an ecosystem? Our focus for this project is to explore how habitat fragmentation can affect biodiversity, specifically relating to the Atlantic Forest in South America. Biodiversity hotspots have global value and high resilience that holds species found nowhere else (FAU, 2022), and the disregard for species' habitats can render conservation plans useless without public support from all sectors of industry. Jaguars, more specifically, are largely affected by isolation in fragmentation, and in the Atlantic Forest, nearly 85% of their habitats have been lost (Paviolo et al., 2016). As a group we hope to shed light on the importance of biodiversity protection and the harmful and irreversible impacts caused by human's desire for development. In order to suggest more sustainable and environmentally-friendly alternatives to industry that may cause habitat fragmentation, we suggest "wildlife crossings" or "green bridges" for fragmentation that occurs due to road construction (Nature Canada, 2018). These underpassing and overpasses allow for a form of connectivity between the separated areas, encouraging socialization between the two species. This integrates a development in 'road ecology' where green infrastructure can be designed. We also hope to promote an educated and environmental approach to infrastructure that will protect biodiversity hotspots, like the one found in the Atlantic Forest in South America.

#### **SUBCORE 1: Causes of Habitat Fragmentation**

The agent leads to fragmentation can be divided into two main categories, they are natural agents and anthropogenic agents.

In a short timescale, natural fragmentation agents include natural disturbances such as forest fires, volcanoes, floods, landslides, windstorms, tornadoes, hurricanes and earthquakes modify and fragment landscapes. Besides, ecological forces such as continental drift and climate change such as glaciations, changes in rainfall, sea level rise are the agents in long time scale (Mullu, 2016). In addition, natural fragmentation dealers in river networks consist of physical boundaries like waterfalls, cascades, and canyons, which restrict the dispersal of aquatic organisms. Firstly, herbal lakes can act as complete habitat obstacles due to their loss of waft and distinct conditions. Secondly, wetlands can trade habitat situations and convey annoying water chemistry. Besides, beaver dams and woody debris dams are not unusual physical limitations that may cover good sized stretches of rivers. Intermittent drift in smaller streams or arid regions fragments the aquatic machine into remoted pools. In addition, herbal habitat obstacles along with thermal or chemical barriers restrict the motion of organisms. Furthermore, organic barriers, like predators or strong competition, can also isolate populations inside a river community. The permeability and effect of those dealers range depending on the particular characteristics of the river community and the species involved.

About the anthropogenic agent, a large amount of human activities such as agriculture, settlement, resource extraction including mining, timber, industrial development including the construction of hydroelectric dams can fragment the landscape (Mullu, 2016). It is worth mentioning that agriculture is the leading cause of ecosystem loss and fragmentation nowadays. Also, dams are the main purpose of human-brought fragmentation in river networks globally. With lots of tall dams and thousands and thousands of smaller impoundments, they invent substantial barriers and side habitats that disrupt aquatic ecosystems. Downstream impacts, culverts, and avenue crossings additionally make contributions to fragmentation. Anthropogenic alterations in hydrology and

pollution obstacles further avoid organism motion. Non-native species and illnesses delivered by humans can act as extra biological limitations. It is critical to renowned the extensive ecological effect of human-induced fragmentation, even in certainly fragmented river systems.

### **SUBCORE 2: Sustainable Construction to Prevent Habitat Fragmentation**

Throughout the world the amount of land being taken up by roads and railways varies from country to country. Norway with  $\approx 0.3\%$  of its land and the Netherlands with  $\approx 5.0\%$ . In the case of the Atlantic Forest, over 88% of the original land has been affected by humans (O'Brien, 2006). Due to deforestation and construction hazards, many plant and animal species have been endangered and/or harmed in the Atlantic Forest (Tabarelli, M.) . Although this particular subcore of our final work resonates well with multiple SDGs, such as sustainable cities and communities (SDG 11) and climate action (SDG 13), we will focus on how it impacts life on land (SDG 15), particularly the effects on the jaguars. By studying the challenges and opportunities of the delimitation and impact of potential core areas for jaguars in the region we can propose a development strategy to ensure that the high-human population density areas have a smaller effect on the jaguar population. (De Angelo et al., 2013)

### **SUBCORE 3: Effects of Habitat Fragmentation on Biodiversity and Implementation of the Sustainable Development Goals (SDGs) in the Conservation Process**

Habitat fragmentation poses significant threats to biodiversity through loss of habitat resulting in isolation of populations and increased extinction risk. Two primary mechanisms are involved. Firstly, as habitats fragment, the reduced patches may become inadequate to sustain local populations or individual territories for various species. This confinement to smaller patches, especially for species incapable of navigating nonhabitat areas, reduces overall population size and decreases the probability of long-term survival. Secondly, fragmentation introduces increased edge effects, where the expanded habitat edges raise the likelihood of individuals straying into nonhabitat areas or the surrounding landscape. Prolonged periods spent in these adjacent areas elevate mortality rates and reduce reproductive success, intensifying the challenges faced by fragmented populations. Additionally, species interactions, particularly increased predation at habitat edges, contribute to the adverse effects of fragmentation on biodiversity. Apart from the direct effects on biodiversity measures like species richness and population abundance, habitat loss also influences several indirect factors essential for biodiversity preservation. Research indicates that areas experiencing significant habitat loss are more likely to host species with decreasing global abundance trends compared to those with stable or increasing trends (Fahrig, L. 2003).

The connection between habitat fragmentation and the risk of extinction remains significant. It is expected that species inhabiting fragmented habitats exhibit a reduced portion of highly suitable habitat within their range, along with a reduced proportion of such habitat within protected areas, consequently increasing the risk of extinction (Crooks, K. et. al. 2017). The International Union for Conservation of Nature (IUCN) has listed the jaguar (*Panthera onca*) as Near Threatened at the IUCN Red List of Threatened Species. The population trend of jaguars is currently decreasing, and they have already become extinct in El Salvador and Uruguay due to factors such as ecosystem modifications, biological resource use, roads and railroads, and many other human intrusions and disturbances (IUCN Red List). The South American Atlantic Forest is known for its exceptional biodiversity, but even here there is a pressing issue of habitat fragmentation affecting jaguar populations. This region has witnessed substantial habitat loss and fragmentation primarily due to human activities such as deforestation and urban expansion. The fragmentation of the forest landscape disrupts the natural connection between jaguar habitats leading to isolation of populations and impeding the free movement of individuals resulting in population declines and genetic isolation due to difficulties in finding suitable mates and adequate prey. Studies have shown that there is a need for immediate conservation efforts aimed at addressing habitat fragmentation and establishing connectivity corridors to facilitate the movement of jaguars across fragmented landscapes (Paviolo, A. et. al. 2016).

It is essential for the species impacted by fragmentation to prioritize the implementation of Sustainable Development Goals (SDGs) in the conservation process, such as Goal 15: Life on Land, which focuses on protecting, restoring, and promoting sustainable use of terrestrial ecosystems. Conservation initiatives may include goals like involving local communities in conservation endeavors to ensure their livelihoods remain sustainable and supporting research and monitoring efforts to better understand the impacts of habitat fragmentation, while informing conservation strategies. Such initiatives could lead to protection and restoration of fragmented habitats to maintain biodiversity and ecosystem functions, the promotion of sustainable land management practices to mitigate additional fragmentation, and enhancing connectivity between fragmented habitats to facilitate species movement and gene flow. By integrating approaches like these, conservationists can work towards minimizing the impacts of habitat fragmentation on biodiversity in South American forests while contributing to broader sustainable development objectives outlined in the SDGs.

## **Conclusion**

The significant issue of habitat fragmentation in the South American Atlantic Forest and its devastating impact on biodiversity, with a particular focus on jaguar populations was discussed above. Human development activities, such as road construction and urban expansion, have drastically altered the ecosystem's balance, leading to nearly 85% habitat loss for jaguars in this region. This habitat degradation affects not just jaguars but also a wide range of flora and fauna, endangering the rich biodiversity that characterizes these environments.

Sustainable construction and the implementation of wildlife crossings or "green bridges" would be viable alternatives to mitigate the negative effects of habitat fragmentation, for example infrastructure that allows connectivity between fragmented areas. Moreover, the importance of an integrated approach that considers biodiversity protection in development policies has been highlighted. Therefore, conservation efforts which would establish connectivity corridors to facilitate the movement of jaguars and other species across fragmented landscapes is urgent.

In conclusion, effective biodiversity conservation and, in particular, the protection of jaguars in the Atlantic Forest, require a global commitment to adopting more sustainable development practices that respect and preserve natural habitats. It is crucial to promote environmental education and the participation of all society sectors in conserving these critical ecosystems. The implementation of innovative solutions like wildlife crossings, along with conservation policies that encourage the creation of ecological corridors, are key steps to reversing current trends of biodiversity loss and ensuring a future where both jaguars and other species can thrive.

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