Impacts of anthropogenic disturbances on primate ecology

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Abstract

Human impacts are the major threat to health and well-being of forest animals. Primates are particularly vulnerable to various anthropogenic disturbances; therefore, in all taxa, they are threatened by various human factors. This review summarizes anthropogenic factors such as forest fragmentation, degradation, logging, direct human interactions, and primate responses by reviewing the results presented in various research papers. Humans are changing landscapes around the world through overexploitation and consumption of natural resources. Behavior changes in food composition and diversity, population density, group size, and the adult gender relationship in groups are some examples. Habitat fragmentation is a landscape-scale process in which continuous habitat is broken down into small pieces scattered in a non-habitat matrix, which can lead to the loss of many primate species. In general, human invasion can result in habitat loss and fragmentation into various fragments. In addition, primate fragment-scale responses can vary significantly in landscapes of different habitats and composition. Study on primate diversity in the African continent shows that primate species have shown a classical species-area relationship, and of primate species that may become extinct in the country due to deforestation. In this review, I provide clear and consistent terminology to help future studies precisely address the effects of anthropogenic disturbance on primates and to help to form a body of literature where comparisons among studies are possible.

Keywords/phrases: *Anthropogenic factors, Deforestation, Fragmentation, logging, primates.*

1. Introduction

Anthropogenic factors such as habitat change and large deforestation continue at alarming rates worldwide, and the survival of many forest species, mostly in the tropics, is in risk [1]. Particularly, primate populations are highly influenced by the challenge related with the dynamics of their habitats because habitats are usually changing and primates must adapt to modifications of the habitat to continue to exist and failure to adapt may results in species extinction [2]. Primate ecologists are searching for to answer fundamental questions about how and why specific ecological factors have an effect on primate populations [3, 4, 5 and 6]. While primatologists have used a variety of approaches to deal with these questions, the study of a selected taxon across a number of ecological situations gives a useful hypothetical description for investigating key questions about the interactions between primates and their habitats [7, 8, 9, 10, and 11].

Humans are changing landscapes around the world by overexploiting and consuming natural resources [12]. Indeed, forests have been and continue to be utilized and disturbed by humans in many ways, ranging from outright forest clearing for agriculture and other purposes to subsistence level harvesting of forest products. There are four main causes of this occurrence, which I have tried to summarize in this document. The first reason is forest habitats are primarily patchy and scattered in many different countries. Second, most, if not all, of the primate-rich tropical forests occur in economically poor countries. For example, nine of the 15 wealthiest countries in case of primate species are found in Africa.

Some these countries are not only economically poor but their political status is also unstable. Even if foreign aid is available, it is difficult to expect such countries to prioritize forest protection due to different reasons. Third, developing countries, especially in Africa, have high population growth rates, and most people rely directly on natural resources such as land for existence. Therefore, there is a strong need to clear forests to create agricultural land. This is not a precursor to forest conservation. Fourth, most developing countries have external debt that forces governments to encourage forest development. Given the problems, it is clear that conservation of forest habitats needs full commitment and dedication from governments and people of economically poor nations, rich nations, and any governmental and non-governmental organizations from different countries [13].

2. Consequences of habitat Fragmentation on primate ecology

Habitat may be defined as the "range of environments appropriate for a given organisms"[14]. For primates, these are usually large types of vegetation, such as rainforests and dry rainforests [15]. Since native vegetation is important to many species, several researchers have assimilated 'habitat' to native vegetation [16]. Habitat fragmentation is a landscape-degree process in which continuous habitat is fragmented into smaller pieces (fragments) scattered in a non-habitat matrix. This involves habitat loss and its subdivision (fragmentation) into a varying number of fragments [17, 18, and 19]. However, habitat loss can arise with out the subdivision of habitat, and therefore I endorse that it is going to be valuable for researchers to take into account analyzing the independent consequences of habitat loss and fragmentation to decide whether or not it is the overall loss of habitat or the separation of habitat into smaller portions causes negative consequences on primates [20].

Many approaches to fragmentation are often related to the amount of habitat in different landscapes. In this sort of way that under a sure threshold of habitat area, small modifications within the volume of the habitat lead to big modifications in these measures [21]. For this reason, it is often difficult to determine the difference between the effects of habitat loss and fragmentation. For example, studies of plants [22] and animals [23] suggest that species diversity in a fragment of a given size can vary in landscapes with different habitat areas. The effects of fragmentation become relatively important below certain thresholds for habitats remaining in the landscape [24]. Below this habitat threshold, the chances of a population surviving are greatly reduced. Furthermore, the relationship between fragmentation and habitat patterns is very complex [19].

The fragmentation process reduces the area of the habitat, increases the diversity of the habitat fragments, and reduces the length of the habitat fragments. However, various spatial characteristics such as a total habitat margins and average fragment departure can increase or decrease with fragmentation although the variety of measures of fragmentation is large. i.e. greater than 40 measures: e.g., range of fragments, fragment density, total edge, edge density, landscape shape index, largest patch index, researchers generally measure only one impact (fragment size is the most frequent), whereas others investigate 3 effects, but not more [19], and rarely recognize the interrelationships amongst measures of fragmentation. As stated [19], "This leads to ambiguous conclusions concerning the effects of habitat configuration on biodiversity and makes results difficult to interpret." further, as every aspects of fragmentation could probably affect primates in different methods [25]. For instance, both abiotic conditions, which include temperature, humidity, and wind speed, and biotic conditions, inclusive of population density, and species richness, can be altered near habitat edges: the so referred to as edge effects [26]. Those edge effects can cause vegetation changes, mainly in smaller and more irregularly fashioned fragments [27, 28], that may affect the abundance of the most often eaten food plant species for primates, lowering the quantity and quality of food sources available to them [29]. Even though these Vegetation modifications can significantly affect primate's distribution [30] population density [31], and feeding behavior [32], studies reporting "vegetation results" as synonymous with "fragmentation effects" are misusing the term "fragmentation.

3. Impact of deforestation on Primates

Since the majority of primates depend directly or indirectly on forests, deforestation can be the greatest threat to the survival of most primates in the world. In order for forests to regenerate in devastated lands, intact forests that serve as seed sources must be nearby, and animal seed dispersants and lands must be protected from further disturbance [33]. Investigation of primate diversity on the African countries has shown that primate species show a relationship of classical species range between countries. This suggests that deforestation can predict the number of endangered primates in the country [34]. Despite extensive deforestation in different parts of the world, there was no primate species extinction in the last fifty years. However, he did an analysis based on the presence or absence of primates and did not consider whether the country's population was viable. Therefore, primate species found throughout the country may have actually become extinct in some forests within its historic range.

In a study conducted by [34], the fact that no African countries have lost a single primate species despite widespread deforestation over the last 50 years is due to a time interval between deforestation and extinction of primate species. It refers to the temporal shift as extinction debt, which could reach 50% (4 to 8 species) of existing species for some countries. The study based its analysis on historical deforestation and did not take into account other factors such as the current deforestation and hunting in which the extinction threat could be much worse than he predicted. Deforestation and forest destruction at high rate is one of the expected consequences of global warming. Therefore, in the event of global warming, the risk of extinction of forest primates may increase. A possible explanation for the particular sustainability of historic deforestation, or at least the delay in extinction, is ecological flexibility in habitat use, behavior, or diet. Some primates can survive in many different habitat types and in degraded habitats, while others cannot. Perhaps the most important factor in the extinction of primates due to logging is the limited geographic range of many primate species [35].

4. Logging and its consequence on primate population

Knowledge of the impact of logging on native primates is important for developing comprehensive conservation and management plans. It is believed that primates are biological indicators for assessing the impact of logging on wildlife habitats due to their strong association between forest cover and vegetative complexity[36]. Proper understanding of primate populations in the exploited area requires several years of observation, which may not be consistent with logging plans [37]. Therefore, the most practical way to study the response of primate populations to habitat changes caused by logging is to combine the primate population in the logged area with the primate population in the adjacent forest. However, this is not always the case, which may explain conflicting results on primate population responses to logging in rainforests [38].

The work by [37] and [39] summarizes some recent work, but provides contradictory conclusions. For example, of the 38 species of tropical primates examined [38], 71% decreased after logging, 22% gained weight, and 6.7% were unaffected. Some differences may reflect primate feeding-related differences (for example, leaf eaters, fruit eaters, insectivores). However, the significance of such assessments is limited by many factors including: Field methods, primate composition, logging intensity and accidental damage to forest trees, vegetation types adjacent to logging areas, forest age, and pre-logging species specificity and density, and forest habitat types, differences in natural variability and species diversity of large terrestrial herbivores. These factors can affect the outcome of studies attempting to monitor the response of primates to logging, explaining why the conclusions from multiple studies differ, even when considering the same primate species [38].

Ghana's Kwabre rainforest is a unique community-owned forest and is said to be a habitat for internationally important primates, including Roloway monkey (*Cercopithecus roloway*), white nape mangabey (*Cercocebus lunulatus*) and Geoffroy's black-and-white colobus (*Colobus vellerosus*) [39, 40]. These species are recorded in the International Union for Conservation of Nature (IUCN) Red List of Threatened Species [41] and Appendix I of the Convention on International Trade of Endangered Species (CITES) [42, 43]. Unfortunately, this rainforests is under threat of deforestation due to different illegal logging and agricultural activities.

5. Effect of habitat quality and tree species composition on Primate Population

Animal taxa commonly occupy numerous distinct habitats [44], and expertise the outcomes of habitat quality on population growth rates have been a subject of massive interest for animal ecologists for many years [45, 46]. Habitat quality affects the birth, death, immigration, and immigration rates of the population that lives there in a non-uniformly distributed population, some individuals occur in habitats where births exceed death and immigrants exceed immigrants [46]. In contrast, sink habitats, where deaths exceed births and immigrants outnumber immigrants, have a negative net population growth rate. Without immigrants from the source, sink habitat populations are inevitably endangered [47]. Some of the reported declines were clearly due to ecological emissions. Some groups of monkeys left the primeval forest or expanded their home range as forest settlement created more habitat. Such changes are difficult to detect with a fixed census route. A study of Kibale's Red Colobines found that species was extremely flexible with respect to plant species and food-producing parts [48]. This flexibility in food demand may allow them to live in colonized forests. The same may be true for black and white colobines and red-tailed monkeys. The composition of tree species in the forest can affect primates. Information about the species and quantity removed is important, as not all trees are equally important as food sources for primates. Removal of non-edible tree species may have little or no impact on the primate community [49]. This species has limited importance as a food source for primates [50, 51].

6. Conclusions and Recommendations

Despite the fact that many research had been conducted on primate population, I found that majority of the study do not consider the anthropogenic impacts. Assessing anthropogenic influences on primates requires assuming a landscape perspective, which incorporates quantifying the habitat configuration together with; forest cover, connectivity, quantity of fragments, fragment size, and overall forest edge within the landscapes. I have found that many primate studies are at the fragment scale, and therefore no studies have evaluated global anthropogenic impacts. To quantify the relationship between the degree of different anthropogenic factors and the magnitude of the species responses, researchers need to assess primate responses in a range of landscapes with different types of anthropogenic factors. By means of increasing the sample size, researchers may also investigate threshold habitat values below which the possibility of persistence of wild populations decreases substantially. With such a study design, researchers can also study the effect of important interactions, [15]. Such study design also allows researchers to investigate the effects of important interactions such as the effect of post-fragmentation activities in parallel with the effect of fragmentation

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