Palm Oil Impacts on Orangutan Populations and Concomitant Rainforest Ecosystems

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Abstract

When analyzing the effects of oil palm production on keystone species and the ecosystems they inhabit, researchers have often noted a reduction in species populations from deforestation and significant collateral damage to the overall ecosystem from the decrease and/or absence of keystone species populations that the ecosystem depends on. This is particularly true in the rainforest ecosystems of Borneo and Sumatra, two Southeast Asian islands that are home to a decreasing number of orangutans (*Pongo* spp.), a genus of forest apes that play a critical role as an arboreal and seed-dispersing species in the regeneration of remaining forest habitats. The following looks at how agribusiness (oil palm) has led to the critically endangered state of orangutans and their concomitant rainforest ecosystems, examines specific impacts on the orangutan populations, deforestation, and the mutualistic relationship between orangutans and their forest homes, and offers alternative, sustainable solutions to mass monoculture that will principally benefit local people, orangutans, and the rainforests that human and nonhuman life vitally depend on for present and future survival. Above all, the following essay stresses the fact that agribusiness schemes such as mass palm oil production will ultimately lead to the irreversible destruction of precious ecosystem services that orangutans and their forest homes provide.

Introduction

***Pongo pygmaeus*. Wikimedia Commons**

There are a myriad of anthropogenic activities generating profoundly adverse effects on the integrity of ecosystems, the communities of different species that live in them, the populations of species that each have an ecological niche to fill, and genetically, physiologically, and morphologically varied individuals of plants and animals that collectively comprise different species populations. Yet there is one practice - composed of many different parts - that has yielded serious effects on ecosystems, particularly those that are high in biodiversity.

Palm oil (*Elaeis guineensis*) is a major component of international agribusiness activity, particularly in tropical and subtropical climates where it thrives best. Grown in monoculture

forests, palm oil plantations displace natural habitats, often fragmenting them into isolated island patches, thus limiting the ability for populations of specific species to biologically disperse. In addition to habitat fragmentation, industrial palm oil farming is also a direct cause of deforestation, which not only threatens the important role that forests play as carbon sinks, but likewise reduces the number of species within any given population as a result of disappearing forests. The health of species populations depends on ecosystem cohesion, and the integrity of an ecosystem often depends on if a species is at acceptable carrying capacity levels. This is especially true if the population is considered a keystone species, which other species of plants and animals depend on as an integral link in the food web (Spehar et al., 2018). Yet it is mass palm oil production which threatens the balance of these ecosystems.

Researchers have long observed the ecological significance of the three extant orangutan (*Pongo*) species of Indonesia and Malaysia: the Bornean orangutan (*P. pygmaeus*), the Sumatran orangutan (*P. abelii*), and the Tapanuli orangutan (*P. tapanuliensis*) (Nater et al., 2017; Schwartz, 2019). In short, the health of tropical lowland moist rainforests greatly depends on the population stability of all three species as much as the three extant species of arboreal apes depend on the forests for food, growth, reproduction, and ensuring the survival of orangutan offspring. However, the introduction and utilization of palm oil production in Borneo and Sumatra threatens the future of each species, their forests, and the local communities of people that depend on the forest for a variety of ecosystem services.

What makes this situation especially challenging is that palm oil is in high demand globally. As a biofuel, it is used in many everyday household products such as drinks, food, makeup, and shampoo. Moreover, it is often listed under a variety of different ingredient names, making it difficult for consumers to realize or understand what is being purchased, let alone the enormous cost at which each purchase comes. As such, deforestation continues, as does the reduction of critical plant and animal species in biodiverse ecosystems such as the Bornean and Sumatran rainforests.

Background Information

Earth prior to the Neolithic Revolution looked strikingly different; the natural world remained largely undisturbed and human activity had little impact on its overall ability to function. From a biogeographical perspective, some places on the planet were bursting with high levels of biodiversity, while others were less to significantly less so. Adaptive radiation, immigration, emigration, and other forms of adaptation and dispersal occurred. The climate changed drastically at times and the landscapes shifted, settling and resettling species. Extinctions occurred, sometimes en masse, and new species came about through allopatric and sympatric speciation.

When *Homo sapiens* first appeared, societies initially existed as hunter-gatherers. It wasn't until agriculture and permanent settlements arrived that the face of Earth became forever altered. Land

was tilled, forests were felled, villages became towns, towns became cities, human populations grew, and wildlife that posed a nuisance to these new ways of life was either dealt with punitively, or became collateral damage as a result of immense habitat destruction. It should, however, be noted that prior to large-scale industrial agriculture, a good portion of farming was primarily self-sufficient with a significantly lower carbon footprint, some of which still exists today. But fast forward from the emerging years of agriculture to the 20th century and a new type of practice that incorporated larger business ventures and industrial-scale farming was born: agribusiness.

Now into the 21st century, agribusiness (also known as corporate farming) is one of the more dominant components of the global economic industry (Schwartz, 2019). One specific form of agribusiness - palm oil production - has seen a particularly dramatic increase in recent years, largely as a result of a growing human population and the demands required to sustain it. Currently, palm oil is a major import in countries such as China and India, which puts significant pressure on natural ecosystems that have suitable climates for palm oil growth (Swarna Nantha & Tisdell, 2008).

The Southeast Asian islands of Borneo and Sumatra boast an incredibly high amount of biodiversity, most of which is located in tropical rainforest ecosystems. The three extant species of orangutans found there are tree-dwelling (arboreal) species that spend almost their entire lives above the forest floor. According to Spehar et al. (2018), more than 75 percent of Bornean orangutans currently live in areas that are available for development, which includes populations of thousands living in areas that are being allocated to palm oil agriculture. Moreover, roughly 35 percent of forest cover that remains in Indonesia is located in agriculture industry concessions (Spehar et al., 2018).

Orangutans are known as a keystone species, promoting the dissemination of seeds via defecation and the regeneration of forests (Spehar et al., 2018). Furthermore, their arboreal lifestyles means they are dependent on tree abundance to move from location to location. Given that the lives of orangutans and that of rainforest ecosystems are symbiotically entwined, it would appear that an increase in en masse palm oil production will negatively alter this ecologically mutualistic relationship, not to mention the livelihoods of local human communities that depend on sustainable forestry initiatives as a part of ecosystem services.

Literature Analysis

Orangutans populations cannot survive if there is no suitable habitat. However, Spehar et al. (2018) found that orangutans are slightly more flexible in their abundance, distribution, and ecology when it comes to human influence such as palm oil plantations than originally thought.

Their study into how orangutans respond to lengthy exposure to anthropogenic activities

like palm oil production helped offer new insights into just how vulnerable they are to such threats (Spehar et al., 2018). By looking at a comprehensive historical decline in orangutan populations, they postulate that their low reproduction rates means that any further uptick in organism mortality would have a negative impact on range expansion and population density.

While some of this has been due to historical and present-day poaching by humans, Spehar et al. do not rule out environmental factors, arguing that such pressures might have also had a hand in reducing remaining populations of orangutans in Borneo and Sumatra, thereby resulting in geographically isolated and lower-density populations seen today (Spehar et al., 2018).

All told, the Spehar et al. (2018) study benefits the conservation of keystone species by increasing key stakeholders' understanding of just how adaptability and current threats are interacting in order to determine the vulnerability of a taxon. For orangutans, Spehar et al. posit that their history reflects two selective pressures: human activities and environmental factors, both of which are interrelated.

Where oil palm production comes into play, Spehar et al. (2018) do observe that orangutan populations have shown some degree of adaptation to plantations, though they point out that orangutans still rely heavily on, "remnant natural forest for resting, nesting, and feeding." They also add that the ability or such plantations to support viable populations remains largely unknown, and that orangutans must be able to successfully navigate through monoculture plots to maintain genetic diversity.

What is arguably most telling is that Spehar and colleagues admit knowledge gaps pertaining to actively maintaining healthy populations of orangutans throughout anthropogenically altered landscapes. Spehar et al. (2018) acknowledge this in the following statement:

> Finally, we must also address current knowledge gaps that constrain our ability to effectively manage orangutan populations in modified landscapes. We have limited understanding of several key variables crucial to conservation planning, including what factors determine how orangutans use and move through different land-use types and the impact of population fragmentation, altered diets, changes in social structure, and increased human contact on orangutan reproduction and health. We must also assess variation in the ability of the different orangutan species and subspecies to adapt to human activities to determine how conservation strategies might differ for these populations.

While such an admission does not directly point to palm oil plantations as being a key

component of orangutan population declines, the very mention of knowledge gaps concerning orangutan conservation among dramatically altered ecosystems highlights the role that such an environmentally degrading activity is playing in population reductions, not to mention that the study already confirmed as much (in addition to hunting, which was found to be the most significant historical factor). Thus, one can conclude a correlation between an increase in palm oil plantations and a decrease in *Pongo* populations, both in its emergence, and in its continued cultivation by industrial agribusiness corporations.

Consider also the requirement of orangutans as an arboreal species. Simply put, the more an ecosystem is modified to serve agribusiness needs, the less any species can utilize it as a means of maintaining and sustaining fitness. While orangutans may, indeed, be able to adapt to these changes by certain degrees, such adaptations may not be sufficient enough to maintain a healthy carrying capacity within such heavily degraded environments.

Looking at rainforest ecosystems in more detail, Gaveau et al. (2009) studied *Pongo abelii* (the Sumatran orangutan) and their homes on the island of Sumatra. Remembering that orangutans are almost entirely dependent on adequate rainforest cover to survive, Gaveau et al. were interested to see how, "payments for reduced carbon emissions from deforestation (RED)," would bolster forest protection when weighed against the growing threat of the palm oil industry.

While their, "satellite-based spatially explicit deforestation model," predicted that the RED initiative would certainly save about 1313 km2 of rainforest by 2030, it also predicted that forest cover from the year 2006 would shrink by roughly 7913 km2 in landscapes outside of protected areas (PA), and that actual orangutan habitats would undergo a reduction of 1137 km2, resulting in a loss of, "1384 orangutans, or 25% of the current total population with or without RED intervention" (Gaveau et al., 2009). The following statement by Gaveau et al. (2009) details their final prediction with regard to rainforest ecosystems and Sumatran orangutans:

> Our predictions suggest that Indonesia's first RED initiative in an upland PA may not significantly reduce deforestation in northern Sumatra and would have little impact on orangutan conservation because a large amount of forest inside the project area is protected de facto by being inaccessible, while lowland forests will remain exposed to the combined expansion of high-revenue plantations and road networks.

Such a prediction strikes at the very heart of the uphill nature of rainforest ecosystem conservation efforts in regions heavily favored by the agribusiness industry for palm oil cultivation. Note that the geographic locale of lowland forests on the island of Sumatra are especially vulnerable to insatiable agribusiness appetites. Note also how certain portions of

the forests would only be saved by virtue of their own inaccessibility, which cannot be considered a part of the RED initiative. It is these combined factors, then, that conclude the defenseless status of much of Sumatra's remaining tropical forests and that of current Sumatran orangutan populations.

Gaveau et al. (2009) do, however, recommend that a significant portion of forests might be saved from palm oil deforestation if RED initiatives would be implemented throughout remaining forests that are outside of PAs. Part of this means that RED payments could be utilized to compensate land users for any opportunity costs incurred by not allowing unprotected forests to be converted into palm oil, along with halting road construction to aid palm oil marketing (Gaveau et al., 2009).

Turning to Borneo, Labrière et al. (2015) were keenly interested in the rainforest ecosystem, specifically as it relates to monoculture impacts versus more traditional methods that serve as ecosystem services for human communities.

Their study compared the diversity of trees, control of soil erosion, and carbon storage as an ecosystem service in natural forest ecosystems and variations of anthropogenically altered forest ecosystems of northern Borneo to determine ecosystem services production (Labrière et al., 2015).

Unsurprisingly, the results of the study showed that the diversity of tree species and ecosystem services were the highest in natural forests, as was carbon storage and low rates of soil erosion. What was interesting, however, is that areas of forest that were logged selectively showed the same diversity levels for tree species and ecosystem services as that of natural forests (Labrière et al., 2015). (These areas were primarily logged-over via traditional swidden agriculture for community food production. It should also be noted that these are sustainable, selective swidden methods.)

The results also showed that swidden agriculture dominated palm oil monocultures when it came to maintaining ecosystem service production and tree diversity, leading Labrière et al. to conclude that traditional multifunctionality of landscapes should be encouraged as sustainable alternatives to palm oil (Labrière et al., 2015). They warn, however, that the temptation of earning a bigger income from monocultures threatens ecosystem services such as carbon stock and sustainable forestry.

Labrière et al. (2015) also go one step further by arguing that utilizing traditional landscape methods will not only save forest ecosystems, but will likewise offset the market volatility of goods that are traded - such as palm oil - which the economic model of monocropping is

significantly more dependent on than traditional systems.

While the Labrière et al. study did not look at orangutans as in the aforementioned studies, it provides ample evidence that forest ecosystems cannot provide beneficial ecosystem services unless it is utilized sustainably. Furthermore, it can be inferred that orangutans cannot be ecosystem service providers unless rainforest ecosystems are harvested through traditional means. In other words, orangutan populations will continue declining in the absence of natural and traditional land-use forest ecosystems.

By calculating plant biomass within different plot selections of natural and land-use forest ecosystems to estimate the diversity of tree species, and by monitoring loss of soil and estimating the carbon stock of topsoil (Labrière et al., 2015), the case can be made that monocrop systems will not permit adequate ecosystem service production to occur, resulting in a loss of service benefits by local communities. It is also noteworthy to add that the abiotic analysis of soil is a clear indicator in terms of which anthropogenic method correlates with a healthier ecosystem.

Looking once more at orangutan populations (Bornean orangutans) Swarna Nantha and Tisdell (2008) demonstrate that the opportunity cost of conserving orangutans is high when taking into account the fact that individuals of populations require an extensive range. When weighing this against palm oil's high economic value and monoculture space required resulting from a high global demand, they argue that strategies favoring, "carbon financing and payments for biodiversity," would help keep the retention of habitat as a financially competitive and viable alternative (Swarna Nantha & Tisdell, 2008).

While this particular study does not address population ecology specifically, it lays the groundwork for conservationists to engage palm oil producers directly. This, they argue, is best done at the institutional level in addition to on-the-ground efforts. To reiterate, the bulk of benefits comes through ecosystem service payments, which directly and indirectly benefit orangutan populations by safeguarding their rainforest habitats (Swarna Nantha & Tisdell, 2008).

Swarna Nantha and Tisdesll (2008) point out that the forestry sector and biodiversity and carbon markets offer potential returns that may well match the production of oil palm. However, the fact that this study is slightly dated, coupled with increasing deforestation rates since its publication, illustrates the importance of orangutans as ecosystem service providers, which the study did not touch upon.

Recall that orangutans aid in forest regeneration that humans indirectly benefit from.

Despite the fact that the report stresses that conservationists should be seeking out a diverse number of solutions to counteract the economic pressures of palm oil on the conversion of orangutan habitat (Swarna Nantha & Tisdell, 2008), it does not take into account the role that orangutans play within an ecological context. In short, the returns that orangutans can provide might be proven as economically invaluable, which additional studies might well be able to confirm.

Sustainable solutions come in a multitude of different forms, yet the lives of animal species as an economic service - apart from being hunted, trafficked, illegally sold in the black market pet trade, and utilized as food - often go overlooked (The economic emphasis here is on living animals in their natural habitats, not on animals that are hunted, trafficked, or processed for food.) It is safe to assume, then, that the potential value that living wildlife brings, apart from tourism, has not been fully realized. In the case of orangutans, the Spehar et al. (2018) study offered this value by outlining their role as three extant, keystone species.

Conclusion

Orangutans living in their natural habitats are, in essence, integral forest caretakers (Schwartz, 2019). Without an adequate carrying capacity of orangutan populations, the rainforest ecosystems will not survive. At the same time, remaining orangutans will suffer additional population losses if more rainforest disappears at the whim and will of agribusiness. Finally, local communities will suffer from the loss of both of these components by losing access to benefits from payments through ecosystem services. The literature stresses that one of the leading causes of orangutan population declines and deforestation is palm oil monocropping which, if allowed to continue unabated, will all but permanently destroy these two important resources. The onus is on researchers to quantify the economic benefits of rainforest ecosystems and orangutans as separate and interrelated ecosystem service providers. This is especially true of orangutans as a keystone species. If additional studies validate their economic worth, there is hope that a future for orangutans and their forest homes will be secure, and that an increase in public education about the dangers of palm oil use will cement this security.

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environmental damage to ecosystems. I could think of no better example than what is being done to orangutan populations, and I continue to hold onto hope that conservationists in that part of the world will save rainforest ecosystems and orangutans from this irreparably damaging practice.

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