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Biodiversity Information for Oil Palm

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ABSTRACT

The Roundtable on Sustainable Palm Oil's Principles and Criteria (RSPO P&C) relating to biodiversity have been highlighted by members as one of the most challenging aspects of the P&C to comply with. Whilst scientists are learning more and more about the effect that oil palm has on different species and the wider landscape, this information is rarely accessible to those in a position to mitigate the impact of plantations on biodiversity. The Zoological Society of London is a conservation charity that is working to overcome this by providing improved access to research and resources through our new Biodiversity Information for Oil Palm website, as well as developing additional guidance to assist RSPO members to implement the Biodiversity P&C more effectively. Here we summarise the impact of oil palm on biodiversity, based on a thorough review of the research published on this topic. We then introduce the features of our recently launched Biodiversity Information for Oil Palm website (www.oilpalm-biodiversity.info).

INTRODUCTION

There has been much debate about the impact of oil palm on biodiversity, with the facts often overshadowed by provocative NGO campaigns and misleading industry claims. Although only a small proportion of the published research relating to oil palm has focused on the impact this crop has on biodiversity and the wider environment (Turner et al. 2008), the information available is sufficient to highlight the serious nature of this impact and the urgent need to mitigate it. This falls within the remit of the RSPO, largely through the implementation of Criteria 5.2 and 7.3, which require that species and areas of High Conservation Value that are affected by existing plantations or remain within areas allocated for new developments are identified and conserved. This daunting task falls largely to palm oil producers and HCV consultants, but efforts to implement these criteria effectively are currently hampered by limited accessibility to objective scientific data about the impact of oil palm on biodiversity and insufficient guidance on how this can be mitigated. Given the growing realisation that efforts to conserve biodiversity are increasingly dependent on the way in which production landscapes are managed, it is crucial that members of the palm oil industry and conservation practitioners work together to ensure that the impact of palm oil production on biodiversity is reduced as far as possible.

What is Biodiversity and Why is it Important?

Biodiversity is the variety of all life on earth, including within species, between species and of ecosystems. High biodiversity gives ecosystems the flexibility to adapt and survive in a continually changing world. Therefore, addressing biodiversity loss is crucial to ensure the continued existence of these ecosystems, which human society depends on for vital services and resources, such as climate regulation, pollination and food.

How do Oil Palm Plantations Affect Biodiversity?

The most biodiverse terrestrial ecosystems are located in the tropics, where conditions are optimal for cultivating oil palm and consequently the majority of expansion has taken place. In order to determine the impact this has had on biodiversity it is necessary to determine the extent to which species present prior to expansion are able to adapt and survive in a landscape dominated by oil palm. In general, the biodiversity value of oil palm plantations is severely depleted in comparison to natural forest and is also frequently lower than disturbed forest and other plantation crops (Fitzherbert et al. 2008; Danielsen et al. 2009). This is indicated by a significant decrease in total number of species present (species richness) and changes in the community composition. This is due to the absence of the majority of forest specialists, which tend to be species of greatest conservation concern, and the increased dominance of a few generalists, which tend to be common, non-forest species of low conservation concern (Danielsen et al. 1995; Fitzherbert et al. 2008).

A key reason for the lower biodiversity value of oil palm monocultures is the absence of the major components of forest vegetation, including forest trees, lianas and epiphytic orchids (Danielsen et al. 2009). These structurally less complex habitats consistently support less than half as many vertebrate species as natural forest and on average only 23% of the forest species are recorded in the oil palm (Fitzherbert et al. 2008; Danielsen et al. 2009). However, this varies between taxa.

Mammals appear to react particularly adversely to oil palm monocultures, with research conducted in Sumatra reporting that only 10% of the medium to large mammal species present in the wider landscape regularly entered the oil palm monoculture and these were species of least conservation concern (Maddox et al. 2007). The most endangered species tended to be the most sensitive, such as the Critically Endangered Sumatran tiger, which almost never entered the oil palm monoculture. Although some species of conservation importance will frequent the oil palm monoculture to some extent, such as sunbears (Normua et al. 2004) and pangolins, they appear to favour non-oil palm habitats (Maddox et al. 2007). Therefore, it is clearly apparent that only common mammal species of least conservation concern are able to thrive within the oil palm monoculture, such as the wild pig, bearded pig, leopard cats and common palm civets (Ickes 2001; Koh et al. 2007; Maddox et al. 2007; Rajaratnam et al. 2007). The dramatic change in the species composition of medium to large mammals present in the oil palm monoculture is also seen in the small mammal community, with a study of the response of primates, squirrels and tree shrews to conversion to oil palm plantations reporting the absence of the species found in nearby primary forest (Danielsen et al. 1995) and a further study demonstrating an 88% difference in the community composition of non-volant small mammals in comparison to natural forest (Bernard et al. 2009). Similarly, bat species richness and diversity has been shown to be significantly lower in oil palm plantations than in nearby forest, with the population that persists being dominated by a few species that may be able to feed on the oil palm fruit (Danielsen et al. 1995; Fukuda et al. 2009).

Similarly, studies have reported that only between 5% and 53% of the bird species recorded in the primary forest were also present in the oil palm plantations, but in every case these forest species were outnumbered by a few common, generalist species of lower conservation concern (Danielsen et al. 1995; Aratrakorn et al. 2006; Sheldon et al. 2010). It would appear that very few of the species of high conservation concern or with specialised frugivorous or insectivorous diets are able to adapt when natural forests are converted to oil palm (Danielsen et al. 1995; Aratrakorn et al. 2006; Sheldon et al. 2010). This could have both ecological and

economic implications as it has been shown that the absence of insectivorous birds that provide important pest control could result in around 28% higher leaf damage over the lifetime of an oil palm leaf, which could translate to between 9% and 26% lower fruit yields (Koh 2008). This emphasises the importance of maintaining bird diversity within the oil palm estate. Whilst it has been shown that retaining undergrowth and epiphytes within the oil palm plantation could result in slight increases in bird species richness (Aratrakorn et al. 2006; Peh et al. 2006; Koh 2008), conserving natural forest cover, both primary and secondary, within and around the estate is a much more effective way of encouraging higher levels of bird diversity within the plantation (Koh 2008).

Invertebrates are also involved in important ecosystem functions such as nutrient cycling and pollination, but they are often overlooked in biodiversity assessments (Turner et al. 2008). The difference in species richness between primary forest and oil palm plantations was more variable for studies that focused on invertebrates than vertebrates (Fitzherbert et al. 2008; Danielsen et al. 2009), with much lower numbers of beetle, ant and moth species reported in oil palm plantations but no difference in terrestrial isopods and higher numbers of bee species (Chung et al. 2000; Liow et al. 2001; Davis et al. 2005; Chey 2006; Hassall et al. 2006; Brühl et al. 2009; Fayle et al. In press). A more consistent trend across studies was that forest species were frequently replaced by a few non-forest species that favour open and disturbed habitats, resulting in significant differences in community composition within the oil palm plantation (Chey 2006; Pfeiffer et al. 2008; Brühl and Eltz 2009; Fayle et al. In press). This could have important implications for pest control, for example a study of beetles reported an increased prevalence of herbivores and a loss of predators within the oil palm plantation (Chung et al. 2000). Changes in community composition within different species groups could also have important implications for other ecosystem services, including pollination. For example, although bee diversity was actually found to be higher in the oil palm than in the natural forest, the absence of honey bees *(Apidae)* could have serious implications for forest regeneration and restoration in the surrounding area as this is largely reliant on pollination by these species (Liow et al. 2001).

Invasive species belonging to various groups of invertebrates appear to be highly successful in the oil palm habitat, frequently becoming highly abundant (Pfeiffer et al. 2008). For example, in Ghana the scarab beetle community was dominated by high densities of invasive savanna species (Davis and Philips 2005). Bruhl et al 2009 also reported that the invasive Yellow crazy ant (*Anoplolepis gracilipes*) was the most dominant species at 70% of all baits placed within the oil palm plantations in Sabah, Malaysia. The high abundance of this species is concerning as it has been reported to have negative impacts on a wide range of taxa and ecological processes, which can result in 'ecological meltdowns'(Brühl and Eltz 2009). Conserving biodiversity within and around the oil palm plantation can help to ensure that the checks and balances that would normally regulate invasive species and pest outbreaks in natural habitats continue to function (Chung et al. 2000; Pfeiffer et al. 2008). The level of undergrowth, proximity to natural forest and the age of the oil palm stand are all factors which had little influence on the species richness of ground dwelling ants within the oil palm monoculture (Brühl and Eltz 2009). However, since ant species that are able to inhabit bird nest ferns are least affected by conversion to oil palm it has been suggested that maintaining a high prevalence of birds nest ferns could increase the species richness in oil palm plantations by 15%, but that the majority of these would be non-forest species meaning the contribution to maintaining ant biodiversity may be minimal (Fayle et al. In press). A study of scarab beetles in Ghana showed that in order to maintain specialist forest dung beetle species it is crucial to maintain areas of natural forest (Davis and Philips 2005). Similarly, it has been shown that the species richness of forest butterflies within oil palm plantations tends to be

higher when more extensive old growth forest cover remains in the surrounding area (Koh 2008). Given the general trend towards the loss of forest species when natural forest is converted to oil palm plantations and their important role in many essential ecosystem functions it is important to conserve as much natural forest as possible within and in the area surrounding oil palm plantations.

The primary consequence of the inability of most forest species to survive in oil palm monocultures is the reduction in overall habitat left to support them. It is indisputable that rapid oil palm expansion since the mid 1980s in Indonesia and Malaysia has been accompanied by accelerating rates of deforestation (Sheil et al. 2009), with the combined annual forest loss of these countries now standing at around 2 million ha (Danielsen et al. 2009). However, complex interactions with other land use change and the lack of reliable data documenting this means it is often difficult to determine when deforestation is directly attributable to oil palm (Fitzherbert et al. 2008). Where intact forests are logged or cleared for the primary purpose of financing or establishing oil palm plantations this crop is clearly responsible for the biodiversity loss that ensues (Fitzherbert et al. 2008). Similarly, replacing secondary or degraded forests, which can frequently retain high biodiversity value, with oil palm plantations will result in the loss of a large proportion of the primary forest species that these habitats often continue to sustain (Sheil et al. 2009). A recent study of land-cover data estimated that between 1990 and 2005, between 55% and 59% of oil palm expansion in Malaysia and at least 56% of oil palm expansion in Indonesia had occurred on land categorised as forest (Koh et al. 2008). However, some claim that oil palm is rarely directly responsible for deforestation, but instead utilises land that has already been degraded by other activities or cultivated with another agricultural crop. Even where this is the case, converting this land to oil palm may displace previous activities or agriculture to forested areas and would be indirectly responsible for the deforestation that results (Fitzherbert et al. 2008). Furthermore, if fire is used to clear land for oil palm development the impact of this may extend beyond the concession boundary and result in further habitat loss in the surrounding landscape (Nantha and Tisdell 2009).

In addition to the contribution of oil palm expansion to habitat loss, it has also contributed to the increasing fragmentation of forest landscapes (Abdullah et al. 2007), which is a major threat to biodiversity (Bickel et al. 2006). Since many forest species are intolerant of oil palm, extensive monocultures of this crop can represent major movement barriers, preventing dispersal and causing populations to become isolated (Bickel et al. 2006; Maddox et al. 2007; Bernard et al. 2009; Brühl and Eltz 2009). The theory of island biogeography predicts that species richness will decrease as forest fragments become smaller and increasingly isolated (MacArthur et al. 1967). This pattern was seen in a study of forest butterflies within forest fragments that remained within an oil palm dominated landscape in Sabah, Malaysia (Benedick et al. 2006). However, a study of the response of bat species to forest fragmentation found that isolation had little influence on variation between patches and that species with specific habitat requirements were more severely affected by declining patch size than species with more general habitat requirements (Struebig et al. 2008). Shifts in community composition in leaf litter ants were also reported as a result of forest fragmentation, with an increased presence of tramp species reported in the smaller fragments (Bruhl et al. 2003). A further consequence of fragmentation is the increased exposure of the natural forest to both harmful edge effects, such as micro-climatic changes that increase the risk of fire and increased sapling mortality (Fitzherbert et al. 2008), as well as intensified human disturbance as a result of increased accessibility to the forest.

How the 'Biodiversity Information for Oil Palm' Website can help?

The published research summarised above gives an important and impartial insight into how oil palm plantations affect biodiversity. However, this research is usually published in journals that those outside of the academic community rarely have access to. Yet it is only those involved in deciding how oil palm plantations are managed that have the ability to act on information gained through existing and new scientific research in order to mitigate the impact of palm oil production. In order to make this information more accessible to all those involved in the palm oil industry the Zoological Society of London, supported by a grant from the Biodiversity and Agricultural Commodities Programme (BACP) with matched funding from Wilmar International, have developed the 'Biodiversity Information for Oil Palm' website (www.oilpalm-biodiversity.info). This website is in English and Bahasa Indonesia and hosts a searchable library, containing both simple summaries and more detailed information about research that has focused on the impact of oil palm on biodiversity. In addition to this we have identified key resources that can assist all those involved in efforts to reduce the environmental impact of palm oil production.

CONCLUSION

It is clear that palm oil production can have serious consequences for biodiversity, with continuing expansion meaning that there is a limited timeframe in which to act if we are to stand a chance of mitigating this impact. It is therefore crucial that scientists and conservation practitioners work closely with the palm oil industry to ensure that the information and resources needed to increase the compatibility of palm oil production and biodiversity conservation are made available.

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