

Physical Geography Essay

Structural features

Communication features

The significance of fire on the ecosystem, and its impact on soil and vegetation

Fire **plays** a significant role in affecting the Earth's ecosystem. Whether a human-instigated management tool or a natural wildfire, fire is important in the disturbance of landscapes, the progression of biodiversity-rich systems and the development and degradation of vegetation and soil itself. The process **influences** all temporal and geographical scales of the ecosystem, ranging from the development of biota to topography and climate, albeit at differing rates over a particular period. As stated by Sugihara et al (2010, p. 72) **'Fire is an important ecological process that occurs regularly and has predictable spatial, temporal, and magnitude patterns'**. Arguably, however, although fire may be predictable, it is still an inherently physical process that can cause mass damage over vast areas. Ultimately, fire is in the balance, it can be used as a management process but must be significantly monitored especially with the expected future increase in wildfires due to climate change (Davies et al, 2010). **In this essay, I will firstly discuss how human management of peatlands have both positive and negative effects. Secondly, I will explore the natural disturbance hypothesis, investigating the multi-scalar effects of wildfires. Lastly, I will argue how fires have an inherently important effect on global temperatures and therefore global flora and fauna biodiversity through the albedo effect.**

Fire can have positive and negative effects on both vegetation and soil when used as a management system. The human usage of peatland areas for the development of the habitats of the game bird, red grouse, has been used for over 200 years, with minimal environmental awareness (Davies et al, 2016). The rotational burning of this peatland has provided many positive outcomes, and these are outlined by Davies et al (2016) as benefits in:

'... facilitating plant regeneration, improving forage quality and productivity, defining vegetation community composition, controlling landscape-scale variation in habitat structure, and modulating subsequent wildfire behaviour and severity' (Davies et al, 2016, p.3)

Immediate link to the title in the first sentence.

Present simple for describing physical facts

Use of a quote from a significant source is acceptable in the introduction, although the choice to use a quote needs to be justified. See Ch 8 , Referencing with accuracy

Clear statement of purpose with a well stated thesis.

Opening sentence to set up the two sides to the argument.

Correct formatting for a longer quotation.

Arguably, as (Davies et al, 2016) postulate, prescribed fire is one of the most important tools used to manage the Earth's diverse ecosystems. Fires help to create a mosaic of diverse habitats for plants and animals, specifically red grouse in the UK peatlands. Fires can be responsible for the burning of excess vegetation and therefore a supply of ash to facilitate new plant growth as well as the development of new habitats through growth in different varieties of vegetation. Furthermore, prescribed fires can be vital to allow for seed germination and increased biodiversity, thereby providing food for the red grouse (Davies et al, 2016). Therefore, prescribed fires can be seen to have clear the short term benefits to vegetation, recreation and soils.

Paragraph giving further information on benefits of fire.

However, in the long term as well as some cases in the short term, it can often be seen as detrimental, due to the factors associated around peat erosion and prescribed fires escaping human control (Davies et al, 2008). Peatland erosion occurs due to limited vegetation growth over certain areas of bog, often due to the short-term effects of prescribed fires. This erosion occurs over long periods of time as rain and fires frequently persist in eroding soil structure and vegetation. Peat, is a sink for many chemicals and Persistent, Bioaccumulative and Toxic substances (PBTs) such as Mercury, Sulphur and most formidably, Carbon. Peatlands contain over half the 10 billion tonnes of carbon stored in UK soil, a vast amount overall (DEFRA, 2016). **Therefore**, when these areas are managed via prescribed fires, chemicals are accidentally released into different areas of the environment (Gorham, 1991). Mercury can detrimentally affect vegetation and soils once it has leached into hydrological systems, often reaching areas much further away from the initial point of pollution. **In addition**, once Carbon is combusted, it is released into the atmosphere and exacerbates dramatic climate change effects, such as heating of the atmosphere, often at global scales (Gorham, 1991). Hence, parties of interest can view fires differently; **on the one hand** gamekeepers may consider them beneficial, and **on the other hand**, environmental agencies may consider them as negative, albeit when perceived at different temporal and geographical scales.

Paragraph giving information on negative effects of fire.

Language to indicate a change in argument (However, ...) and to build the argument (therefore, in addition, ...)

Language showing the two sides to the argument

Wildfires are unlike prescribed fires, in a sense that they are natural and often out of our control. In most cases, wildfires are physical in origin, derived from lightning strikes or magma flows. However, in some cases they can be caused by human activity such as barbecues, cigarettes and arson. As stated by Sugihara et al (2010), wildfires are numerous, and often

very destructive in regions with frequent dry thunderstorms. Therefore, in these locations they are heavily associated with natural disturbance regimes or 'perturbations'. If fires occur at regular intervals and at similar scales then vegetation, soils and wildlife benefit greatly (Sugihara et al, 2010). With less competition from other species and more sunlight, seedlings grow quickly and quickly rejuvenate areas of land. As well as this, via the natural disturbance hypothesis, biodiversity is seen to greatly increase compared to if the environment was left untouched (Sugihara et al, 2010).

Furthermore, it can be seen that frequent wildfires can reduce and prevent the chances of a large fire occurring that could detrimentally affect the ecosystem as well as human and environmental life (Levin et al, 2012). This is due to the fact that frequent small fires kill weeds and essentially limit growth of flora to a certain stage. If fires were not to limit this growth, then the possibility of a stage where the fuel load is drastically higher than it should be will occur, often ending in vast wildfires that can persist for days, sterilising soil bacteria and leading the destruction of seed banks (Minnich, 1983). Minnich argues the benefits of setting 'small, controllable fires to prevent excessive fuel accumulation and catastrophic blazes' (Minnich, 1983, p.1). Therefore, although there may be negative effects on vegetation and soil, it is often more beneficial to have frequent prescribed fires, than large wildfires less frequently.

Fire is an incredibly important ecosystem process, increasingly affecting the global biospheres. As Bowman et al (2009) suggest, in a world without fire most carbon would be stored in woody vegetation. However, in our world this is not the case. Currently, fire derived from biomass burning, deforestation and wildfires releases CO₂ equal to that produced from fossil fuel combustion (Bowman et al, 2009). Hence, due to this combustion from fire, atmospheric aerosols are released which dramatically reflect the sun's solar radiation, leading to the cooling of the atmosphere and global temperature decreases. Therefore, ecosystems are affected due to the varied knock-on effects of these derived temperature changes. However, it is possible, as Bowman et al (2009) suggest, that this can be offset by the black carbon covering of snow and ice. This decreases the Earth's reflective albedo, and therefore increases the absorption from solar radiation, increasing global temperatures. This can lead to the destruction of ecosystems relying on cold temperatures in the northern and southern latitudes (Bowman et al, 2009). Furthermore, a 'feedback' system can be seen to take place. As temperatures increase, so does global warming and the chance for natural wildfires

to take place that will ultimately further exacerbate the effects of global warming overall. In addition, due to these increases in temperatures rapid snow melt can occur, leading to new ecosystems and habitats in boreal regions that may only have been habitable for short periods of the year (Bowman et al, 2009). However, as Bowman et al (2009) indicate:

“... albedo may increase over longer time periods owing to larger exposure of snow following boreal fires, or replacement of dark forests with brighter pastures and croplands following deforestation. Indeed, aerosol and surface albedo effects could even cancel each other out” (Bowman et al, 2009, p. 483)

Therefore as suggested by Bowman et al (2009), factors derived from fire combustion, both anthropogenic and natural, may cancel each other out. Yet, it is still a very important ecosystem process, changing the biodiversity of vast areas and substantially affecting where flora and fauna develop globally (Bowman et al, 2009).

Ultimately, fire is a key ecosystem process, affecting a diverse range of multi-scalar factors. As Bowman et al (2009) argue, ‘progress in understanding fire on Earth has been hampered by cultural aversions to accepting fire as a fundamental global feature’ (p. 484). Therefore, fire is conflicted by social and geographic perceptions of whether it is truly beneficial or negative to vegetation and soil systems, and these perceptions of the value of fires appear to depend on the following variables: the organisation viewing the case, where the fire may be and what purpose it takes. This view is reinforced by Davies et al (2016), who suggests that fire is capable of being used in different ways, advocating the fact that fire can be both positive and negative depending on perspectives. **Overall, however, this essay has shown that** fire is an extremely important ecosystem process; without fire, flora and fauna would suffer greatly, and biodiversity would be detrimentally impacted at an exponential scale. Fire needs to be researched and managed into the future so that the negative effects of global warming do not vastly exacerbate detrimental effects of wildfires at a global scale (Moritz et al, 2014).

Concluding paragraph bringing the arguments together and summarising the main points

Clear link to the title set and thesis statement.

Language showing the link to the introduction

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Diana and Tom's comments

This essay is well structured and shows evidence of good research. There is a clear statement of purpose and thesis statement. There are links to the title at every stage to maintain flow and relevance, and sources are used as evidence to provide credibility to the line of reasoning. There are logical and well-argued conclusions drawn. Improvements could be made by using fewer direct quotations, so that the the 'voice' of the writer of the essay is more prominent.