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Review

Levels of Natural and Anthropogenic Disturbances and Assessment of Their Impact on Plant Community Functional Diversity

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ABSTRACT

Plant disturbance regimes have intensified recently in many parts of the world, and future plant communities are expected to amplify this development further in the coming decades. The changes in forest disturbance are a major challenge to the forest structure. The main aim of this article is to identify the various plant disturbances and their presence in the plant community. These disturbances affect the plant growth and structure of the forest. The disturbance is the influence of the positive and negative impacts on the plant. The disturbance factors influence the colonization and persistence of plant species. They act as filters that regulate community structure. The structure and composition of plant communities are influenced by the disturbance regime, which includes the frequency, intensity, and severity of disturbances. In most cases, disturbances affect the various activities in a plant community, like plant regime, frequency, intensity, severity, and composition. Many plant disturbances are very helpful for the forest growth structure and are also important for the conservation planning of the plant. In the disturbance, variability and species diversity are strongly linked, necessitating adaptations that help boost plant fitness, which is required for survival. This article deals with how manmade and natural disturbances influence community structure and the required criteria for the development and growth of the plant.

Keywords: Community, disturbance, ecosystem, forest, plant

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Introduction

In recent decades, plant disturbance has played a key role in the plant community and function in many parts of the world (Gardiner et al., 2010). The disturbance is the occurrence that creates sudden changes in an ecosystem's physical and biotic properties, displacing or killing some or all of a species' individuals while generating new opportunities for others (Le Page et al., 2013). Plant disturbance is divided into two categories based on its source: natural and anthropogenic, as shown in Figure 1 (Turner, 2010). The disturbance factors impact the plant species, colonization, and persistence of the plant. They work as filters that control community structure. Generally, these types of disturbances are caused by natural site conditions and anthropogenic factors (Luzuriaga et al., 2012). Individually, these types of disturbance are addressed, but they can also interact to shape community structure (Pavoine et al., 2011). For example, the composition of the initial plant community has characteristics that are more likely to be affected by disturbances.

The various disturbance factors generally affect the plant composition, community, and structure. The changes in the disturbance regime depend on the frequency, intensity, and severity of disturbances (Davies et al., 2016). In some cases, the same disturbance regime may develop structures that are similar. For example, those that experienced different flooding regimes were more similar in composition. While characteristics such as the relative productivity of a vegetation community can influence the response to disturbance, more productive systems require more frequent disturbances.

Furthermore, understanding the types of plant disturbance (natural and anthropogenic) is helpful in many cases, and the potential impacts on plant growth and development are numerous. Many researchers are finding that plant disturbance is beneficial to the plant's growth and structure. They improve the ecological theory, ecosystem management, and restoration of the plant (Vandewalle et al., 2014). The disturbance of natural and anthropogenic factors impacts the resistance and resilience of plant communities. Different types of disturbances to community structure may be influenced by how that structure is expressed (Harpole et al., 2016).

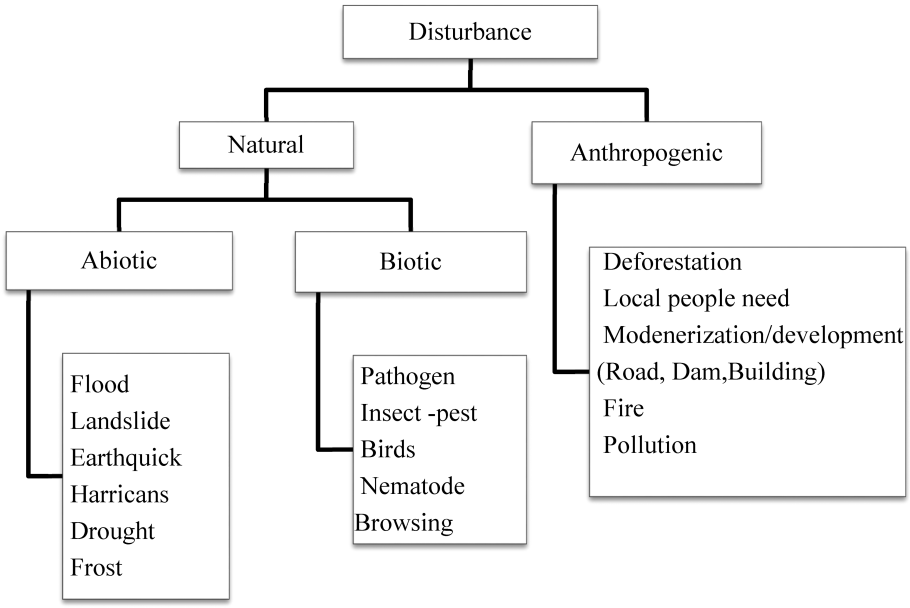

Figure 1.
Major Categories of Disturbance.

The reaction of the plant population to disturbance would vary depending on the stability of the environment. For example, disturbances in riparian habitats may have an immediate impact on species diversity due to poorer habitat stability, but alterations in a comparably stable highland ecosystem may take longer. As a result, we believe that habitat stability may have an impact on the effects of disturbance on species diversity and functional diversity. It is often considered that disturbance causes changes in species diversity and functional diversity. This paper demonstrates how many plant disturbances are present in the plant ecosystem and how they impact plant growth and development.

Natural Disturbance

Natural disturbances are important drivers of forest ecosystem dynamics and strongly modulate the structure and functioning of forest communities (Kuuluvainen & Aakala, 2011). Natural disturbances impact many forms and are present on a broad scale. Generally, plant community interaction can be seen as a kind of disturbance. For example, the wind carrying a plant seed onto new ground, the movements of predators such as wolves causing their prey to run for safety, and the beak of a woodpecker making openings for fungi in a tree are all kinds of disturbances. The word tends to have negative connotations, so it is important to recognize that the right kinds of disturbance are beneficial and essential to the long-term health of all ecosystems. Some major natural causes of disturbance are wind, fire, water, insects, and disease.

For instance, the frequency of large wildfires in western North America has increased nearly four times in the period 1987–2003 compared to the average for 1970–1986, while at the same time, bark beetle damage has reached unprecedented levels (Meddens et al., 2012). A similar trend is evident for wildfire, windthrow, and bark beetles in Europe (Seidl et al., 2014). In many areas, changes in the disturbance regime (i.e., in the distinctive type, size, severity, and frequency of disturbances on overextended spatio-temporal scales) are expected to be among the most severe climate change impacts on forest ecosystems (Turner, 2010). The disturbances due to water (e.g., storms, floods, droughts, and freezes) affect estuarine biota. Disturbances by large storms can result in potentially massive sediment redistribution. However, storm events often have variable impacts on estuarine and coastal biodiversity communities. For example, Hurricane Andrew had no significant impact on seagrass beds in South Florida (Chris Dawes, University of South Florida, personal communication), but Hurricane Gilbert did impact turtle grass (*Thalassia testudinum*) communities in Puerto Morelos, Mexico (Weimin et al., 2019). Thus, the effects of large-scale disturbances on benthic and epibenthic plants and animals can be quite different depending on several factors, for example, storm frequency, intensity, and the local community present. Storms are also stochastic events that cannot be predicted, and a changing climate may also affect storm frequency and intensity.

Abiotic Disturbance

Abiotic disturbance is a non-living factor that is majorly caused by the natural and integral parts of the forest structure and community that have significant impacts, positive and negative. They primarily influence the forest's structure, composition, and functioning, and they can be essential for maintaining biological diversity and facilitating the regeneration of the forest.

The disturbance of the flooding has negative impacts on the plants. They are strongly related to the lack of access to oxygen, reduced cellular respiration, and an ATP crisis for the cell of the plant (Wright et al., 2015). It is a slow process that uses the oxygen exchange capacity of the plant. In the conditions of early summer flooding, less affected are the plants. Because plants grow later in the season, consequently, plant communities with a predominance of late-season species may be more resistant to disturbances (Striker, 2012).

The destruction of the forest by landslides is common in many parts of the world, particularly in tropical areas, due to the combination of intense rainfall and earthquakes (Schuster & Highland, 2007). A large earthquake in Chile in 1960 triggered landslides that destroyed more than 250 km^2 of forest. After the 1976 Panama earthquake, 54 km^2 of tropical forest was wiped out by landslides (Widjaja, 2019).

Mostly, temperate forest windthrows are hypothesized to play a critical role in maintaining species diversity (Yang et al., 2017). Windthrows are caused by large hurricanes and other intense windstorms that profoundly impact forest structure, species composition, successional development, carbon storage, and emissions in temperate forests (Xi, 2015; Xi et al.,2019). Commonly, intensive windstorms directly impact the forest structure and the population rate (e.g., morality, growth rates, and biomass change), but their impacts on community attributes such as species diversity and long-term forest succession are more complex (Xi & Peet, 2011). Windstorms impact forest diversity and plant succession in both positive and negative ways, depending on the intensity, frequency, and characteristics of the pre-disturbance communities (Xi, 2015).

Drought disturbance creates physiological stress on the plants (e.g., water stress, photoinhibition, and reduced photosynthetic rates), and they cause a decrease in community biomass. The climatic change leads to the increase of frequent and extreme droughts in many arid and semiarid parts of the world (Williams et al., 2015). Plants require a lot of water and nutrients throughout their lives, and a decrease in soil water content impacts all areas of plant development. The physical environment is altered due to the decrease in soil moisture, which affects plant physiological and biochemical activities. Even in fertilized soils, drought can create nutritional deficits due to reduced mobility and absorbance of individual nutrients, resulting in a slower rate of mineral diffusion from the soil matrix to the roots (Hicke et al., 2012).

Biotic Disturbance

Forest structure and the ability of forests to offer ecosystem services can be altered by biotic disturbances (such as insects, diseases, and wildlife herbivory). However, the paucity of reliable and timely disturbance data at large spatial scales limits impact estimates.

At present, pathogens have significantly altered the structure of forests in the United States, Western Europe, Australia, and East Africa (Santini et al., 2013). They are primarily affected throughout the plant. Table 1 lists some of the most common pathogens found in plants at various locations. Fungal blights have wiped out chestnut trees from the eastern deciduous forests of the United States, elm trees from much of Western Europe, and various other species from Western Australia's eucalypt forests (Cooke et al., 2007). On the other hand, herbivore viral and bacterial diseases have caused alterations in herbivore populations in East Africa, dramatically altering the structure of plant communities. Pathogens can have direct effects on individual plants' fertility and viability and indirect effects on populations via herbivores, pollinators, and seed or fruit dispersers. The direct impact of plant diseases on their hosts is small compared to viability and fecundity.

Pests can have an enormous spatial and temporal influence on forests, as evidenced by multi-decadal, continental-scale bark beetle epidemics in North American and European conifer forests (Meentemeyer et al., 2012). Insect pests influence population structure, community composition, and ecological processes in forest systems through their effects on tree physiology, mortality, and morbidity (Cobb & Metz, 2017). Plants are primarily damaged by bark and fruit borers in all parts of the world. Table 2 lists some of the most common insect pests that harm plants in various locations. Insect pests are distinct kinds of creatures, and they are generally treated differently when it comes to diagnosing forest health issues. On the other hand, both insect pests have a detrimental impact on tree development, induce death, alter forest structure and composition, and disrupt ecological processes. Furthermore, both insect pests frequently attack individual trees simultaneously, causing host mortality (Ploetz et al., 2013), demanding research into how global change will affect the dynamics of both insect pests at the same time. Forest pests and pathogens have detrimental physiological effects on trees that are an emerging phenomenon that mostly depends on the three interacting factors: the virulence of the biotic agent, the susceptibility of the host, and the environmental context of their interaction.

Bird disturbance has a minor role play in the structure and diversity of plants. Approximately, 3% of birds from at least 14 bird families regularly feed on the leaves (Zmihorski, 2012). Only five of them are arboreal, and most are members of terrestrial or aquatic families. Only two species, the Hoatzin (*Opisthocomus hoazin*) and the Owl Parrot (*Strigops habroptilus*), get the majority of their energy from leaves among these five families. Green leaves, buds, flowers, and fruits are commonly eaten by them. Table 3 shows that some of the world's most important birds have been harmed in the plant section. Hoatzin is a South American bird that causes damage in large amounts to tree crops. The vertebrates' damage ranges from seed-eating and browsing of seedlings to damage to all parts of mature trees (Li et al., 2019). The species involved, sap suckers in North America, sometimes ring barked the stem of a favorite tree by repeated feeding; they drill a ring of holes through the bark around the stem and may eventually remove the bark between the holes. Galahs in Australia will bite through sprays (small shoots with several leaves attached) of eucalypts (Grzędzicka & Reif, 2020). The behavior of Galahs is that they usually nest in smooth-barked eucalypts, and they commonly chew and strip bark from an area on the trunk. An interesting case is that of a New Zealand parrot, the Kaka (*Nestor meridionalis*), that strips bark from branches or the trunk of trees. For some species, the purpose is to feed on insect larvae, while for other species, the purpose is sap-feeding (Godoi et al., 2018).

The plant-parasitic nematodes are found in all regions of the forest area. At present, plant parasites are mostly damaging nursery seedlings and trees, causing a reduction in plant growth (Khan, 2012). This parasite

Table 1.
Occurrence of Major Diseases and Their Location

S. No	Disease	Plant	Location	Damaging Parts	References
1.	*Peronophythora litchii*	*Dimocarpuslonga*, lychee,	China, Thailand, India	Leaves and panicles and fruit	Ann et al. (2012), Anupunt and Sukhvibul (2005)
2.	*Phytophthora*, *Pythium*, and *Fusarium*	All trees	China, Vietnam, and Australia	Whole tree or just one or two branches	Brasier and Jung (2006), Lazreg et al. (2013), and Brett (2011)
3.	Anthracnose	Ash and oak	All over the country	Leaves	Terry (1989)
4.	Canker	Pine, poplars, spruce, and willows	China Thailand, India, Australia	Bark or sapwood, leaves, and fruit	Terhem et al. (2021)

Table 2.
Occurrence of Major Insect Pest and Their Location

S.No	Insect Pest	Plant	Location	Damaging Parts	References
1.	Fruit borer	Lychee, Apple Pear, Oak, Maple, Poplar, Elm, Sycamore, Walnut, and Hickory.	United States, Canada, and China	Fruit	Srivastava et al. (2018); FAO (2009)
2.	Fruit-piercing moths (*Eudocimafullonia)*	Coral tree (Erythrinavariegate)	Asia, Australia, and South Pacific	Fruit	Leong and Kueh (2011)
3.	Oxyodes scrobiculata	*O. tricolor*	Thailand and Australia	Leaves	FAO (2009)
4.	*Achaea janata*	*O. tricolor*	Australia	Leaves	FAO (2009)
6.	*Aristobia testudo*	Lychee	Guangdong	Bark	Shylesha et al. (2000)
7.	*Xylotrupes gideon*	Coconut, Cacao, Flame tree, Ash, Jacaranda, Raintree, and Mahogany,	Australia	Root	Griffiths (2004)
8.	*Pulvinaria psidii*	Broad leaves plant	China, Australia, and India	Leaves and twigs	Griffiths (2004)
9.	*Tessaritoma papillosa*	Lychee	China, Vietnam, Thailand, Myanmar, the Philippines, and India	Flowers and shoots	Meng et al. (2007)
10.	*Aceria litchii*	Lychee	China, Taiwan Province of China, India, Pakistan, and Australia	Leaves	Carrillo et al. (2020) Castro et al. (2018)
11.	*Dasyneura* spp.	Lychee	China	Leaves	Zhang et al. (1997)
12.	*Bactrocera tryoni*	Lychee	Queensland, Africa, and Hawaii	Fruit	Vargas et al. (2015)

contributes significantly to the difficulties in accurately measuring growth loss in trees caused by feeder root damage (Mujeebur, 2012).

However, knowledge of nematode–tree–root host–parasite relationships is critical for disease detection and diagnosis. Accurate estimates of tree yield losses from nematodes will be unavailable until such information becomes accessible. Plant-parasitic nematodes have recently been identified as causal culprits in tree nursery losses. Because the same or closely related plant species are grown continuously in the same region, irrigation maintains soil moisture levels for optimum plant growth and high soil fertility levels, and nursery seedlings are prone to nematode damage. All of these things contribute to the growth of nematodes. Most plant-parasitic nematodes found in plantations and natural stands have little evidence of pathogenicity (Khan & Khan, 2011). The majority of these nematodes were discovered during routine assessments of tree stands showing simply signs of general decline, a situation that may have been caused by anything other than nematodes.

Additionally, browsing significantly affects plant structure and causes disturbance in the community. Although goat and deer owners may cut twigs or branches to feed their animals, "browse" is a type of plant that is taken straight from the plant in nature (Szwagrzyk, 2020). Individual, population, and community levels are all affected by overbrowsing. Intolerant species, such as members of the *Trillium* genus, which have all photosynthetic tissues and reproductive systems at the apex of a single stem, are more susceptible to browsing's deleterious consequences (Ameztegui & Coll, 2015). It means that a deer could devour all reproductive and photosynthetic tissues at once, causing the plant's height, photosynthetic capacity, and reproductive production to be reduced. Overbrowsing can result in the loss of reproductive individuals in a population and a lack of young plant recruitment (Gerhardt, 2013). The palatability of plants to herbivores differs as well. Plants that are highly selected as browse in populations with high herbivore densities may be missing small and large individuals.

Anthropogenic Disturbance

Anthropogenic disturbances significantly affect the plant community's structure and function. Floristic composition is considered one of the major distinguishing characteristics of a community, and, therefore, any depletion of biodiversity is bound to alter the community's attributes. Because of the growing threat to biodiversity, it is important to see how natural communities and their structural attributes are affected by the progressive erosion of biodiversity caused by anthropogenic disturbances. Some major anthropogenic disturbances are clear-cutting, forest clearing, and invasive species into plant communities. Some major anthropogenic activities in the last 10 years have been large tree cover decades all over the world, as shown in Table 4 (GFW, 2020). Human settlement is disturbing a large amount of the forest. Due to the increase in the rate of population growth and migration, there is a dramatic increase in the population. Tremendous pressure has been exerted on the country's natural resources due to the population expansion rate and agroforestry practices. In general, farmers' use of the plants for green fodder, fuel wood, leaf litter, timber, and pole wood had significant influences on decreasing biomass and plant diversity and changing the species distribution pattern. In the middle hilly region, plants, green foliage, and fodder are used for large-scale fodder purposes for cattle, goats, and sheep, especially during the winter season (November–March). When the biomass removal is too severe, the trees' morphology, health, and regeneration ability are seriously compromised, resulting in a severely altered forest structure (Måren & Vetaas, 2007).

Furthermore, some natural disasters, such as hurricanes, floods, and extreme temperature occurrences, are becoming more frequent and severe due to anthropogenic disruptions that are changing the ecosystem (Altman et al., 2016). Disturbances are also thought to be important factors in communities becoming vulnerable to alien (i.e., non-native, non-indigenous, or exotic) species colonization. The introduction of alien species, on the other hand, is one of the most important factors in reducing community biodiversity (Cameron et al., 2016). When alien species become so numerous in a community that they drive out native species or disrupt the ecosystem's normal functioning, they are

Table 3.
Effect of Birds on the Plant Community

S.No	Birds	Trees	Damage Parts	References
1.	Blackgame (*Lyrurustetrix*)	*Pinussylvestris*, *Pinuscontorta*	Destroy lead shoots and buds	Forcina et al. (2018)
2.	Capercaillie (*Tetra ourogallus*)	*Pinussylvestris*	Destroy tops	Saniga (2003)
3.	Cockatoos Red-tailed-Black (*Calyptorhynchus banksii*) and Yellow-tailed-Black (*Zanda funerea*)	*Eucalyptus* spp.	Bark removal	Ritson (1995), Mcinnes and Carne (1978)
4.	Cockatoo White (*Cacatua alba*)	*Eucalyptus* spp., *Pinusradiata*	Strip bark and wood (eucalypts); Ringbark upper branches (eucalypts); Break/bend lead shoot (Pines)	Rowley (1997) and Cameron (2006)
5.	Galah (*Eolophus roseicapilla*)	*Eucalyptus* spp.	Remove sprays (small shoots). Scarring (bark removal from the trunk)	Engelhard et al. (2015)
6.	Grouse Black (*Lyrurus tetrix*)	*Pinus sylvestris, Pinus nigra*	Destroy terminal shoots	Merta et al. (2009)
7.	Grouse Blue (*Dendragrapus obscures*)	*Pinus ponderosa*	Destroy buds and young leaders of seedlings	Banner (2002), Frankis (1998)
8.	Grosbeak (*Pinicolaenucleator*)	*Pinus sylvestris, Pinus stobus*	Destroys terminal shoots Destroys apical buds	Dorworth (1977)
9.	Kaka (*Nestor meridionalis*)	*Dacrydiumcupressinurn, Nothofagusmenziesii, Metrosiderosumbellata*	Remove bark	Kerry and Wayne (2014)
10.	Sapsuckers	*Picea abies*	Remove bark	St-Amand et al. (2018)
11.	Sapsuckers, Red-naped (*Sphvrapicus nuchalis*) and (*Sphyrapicusthyroideus nataliae*) Woodpeckers	*Populus tremuoides*	Remove bark	Lindroth and St. Clair (2013)
12.	Sapsuckers, Red-breasted (*Sphyrapicusvari usdaggetti*)	*Pinus ponderosa*	Bark and cambium removal	Kozma (2010)
13.	Yellow-bellied sapsucker (*Sphyrapicusvarius*)	*Betula* spp., *Piceapungens*, *Pinussylvestris*, *Uhnuspulmia*	Bark and sapwood removal	Marsh (1994); Rushmore (1969)

referred to as "invasive" species. Invasive species have been found to have negative impacts on a variety of ecosystems, as well as substantial economic losses (Simberloff, 2011). (Marbuah et al., 2014). The nature of the relationship between invasive species and community biodiversity is not always clear-cut, as it is with the disturbance diversity relationship (Radford, 2013).

Table 4.
Impact of Anthropogenic Disturbance on Tree Covers

	Tree Cover Loss (Mha)					
S. No	Wildfire (Mha)	Shifting Cultivation (Mha)	Forestry (Mha)	Urbanization (Kha)	Deforestation(Mha)	Total (Mha)
2010	3.13	4.03	5.81	163	5.22	18.4
2011	3.42	3.15	5.76	147	4.92	17.4
2012	6.08	3.97	6.55	172	6.47	23.2
2013	6.55	4.15	5.15	135	4.06	20.5
2014	5.75	5.94	5.97	164	5.72	23.5
2015	4.41	4.55	5.47	154	4.94	19.5
2016	5.70	7.51	7.57	202	8.52	29.5
2017	6.30	8.06	7.81	239	6.78	29.2
2018	6.34	6.26	6.75	188	5.05	24.6
2019	4.13	5.65	6.86	170	5.19	22.0

Source: GFW (2020).

Moreover, fires have directly impacted species richness by killing individual plants and encouraging seed germination. Through competitive exclusion and recruitment limitations, understory plant abundance can influence richness (Hart & Chen, 2008). Moore et al. (2006) found that overstory tree basal area can be a crucial driver of understory production, influencing richness patterns indirectly. Due to high tree densities and a long time since the last fire, deep duff layers may stifle plant growth and diminish species diversity. Natural and anthropogenically caused fires exist, with anthropogenically induced fires accounting for roughly 98% of all fires and natural fires accounting for about 2%. The pattern, frequency, and intensity of the fire, vegetation type, terrain or soil structure, climate, and physical environment are all elements that influence the impact of fire on plant communities.

Pollution from a variety of sources has an impact on plants. It could be contamination of the air, water, land, soil, or even light, which negatively impacts plants (Bach, 1998). It is a comprehensive overview of how various contaminants damage plants. Plant pollution is defined as when contaminants and compounds that do not occur naturally in the environment come into contact with or are absorbed by plants (Lukina & Nikonov, 1999). For example, plant contamination can occur from the air, water, or soil. Plant pollution has numerous effects on plants: ozone and other ground-level pollutants physically injure plant leaves, causing chlorosis or unnatural yellowing. It causes a chlorophyll shortage, and the plants perish due to too much exposure.

Furthermore, the stressed plant will not flower since it will devote all of its energies to fighting and surviving the attack. Most plants exposed to car exhaust, for example, postpone flowering in order to combat the emissions. A variety of factors causes water pollution. Whether caused by pollution or acid rain, acidic soils provide a complicated environment for plants, preventing them from thriving (Zvereva & Kozlov, 2001). Acidic soil accumulates a lot of aluminum ions, which kills root systems and inhibits critical nutrients and ions from being absorbed. Stomata are small pores on leaves that serve as gas exchange sites between the plant and the environment. When a plant's structure is impacted by pollution, the size of the stomata is reduced, and photosynthesis decreases as gas exchange is impaired.

Criteria of the Disturbance in Plant Community and Structure

In most cases, conditions in which natural disturbances occur are commonly influenced by the climate, weather, and location. For example, natural fire disturbance has been more common in locations where lightning and combustible biomass is more prevalent, such as the long-leaf pine ecosystem in the southeast United States (Noss, 2018). These circumstances are frequently part of a cycle, and disruptions can occur on a regular basis. Disturbances caused by humans, invasive species, and impact events, for example, can happen anywhere and are not always cyclic. As a result, the extinction vortices may cause multiple disturbances at a greater frequency than a single disturbance. After the disturbance has subsided, in the absence of competition for space or other resources, there is a flurry of recruitment or regrowth (Herben et al., 2018). After the initial surge, recruitment slows because it is difficult to displace a single plant once established. The presence of various types of disturbance impacts the plant community, which will take advantage of the disruption of the diversity function in plants. Due to scale-dependent connections that are seen throughout nature, the effect of disturbance on natural plant communities varies depending on the geographical scale. Seed dispersal and herbivory, for example, may decrease as you get further away from a burn's edge.

Consequently, the plant communities in large fires in interior areas react differently from smaller fires (Mason & Lashley, 2021). Because species differ in dispersion and mobility capacities, spatial size likely affects ecological interactions and community recovery in all circumstances, despite the fact that disturbance types vary in ecosystems (Herben et al., 2017).

Cyclic Disturbance of the Plant Community and Structure

Furthermore, natural disturbances provide circumstances that let certain species survive longer than pre-disturbance creatures. Physical changes in an ecosystem's biotic and abiotic circumstances might be blamed for it. As a result, a disturbance force might completely replace an ecosystem for much longer than the acute impacts last (Buma, 2015). Shifts in dominance may occur over time following a disturbance, with transitory herbaceous life forms gradually being overtopped by longer perennial herbs, shrubs, and trees (Bottero et al., 2013). Some ecosystems, however, tend to return to pre-disturbance conditions in the absence of new disturbance pressures. Species with long lifespans and the ability to regenerate in the presence of their adults become dominant over time. Many changes, as well as variations in the abundance of diverse species through time, are referred to as ecological succession (Laurance & Curran, 2008). Succession frequently results in conditions that predispose an ecosystem to disturbance once more. Insect outbreaks in western North American pine forests are a better example of this cycle. The mountain pine beetle (*Dendroctonus ponderosae*) serves a useful function in restricting lodgepole pine trees in western North American woods (Jenkins et al., 2008). In 2004, the beetles invaded about 90 000 km^2. Both endemic and epidemic phases of the beetles can be encountered. During epidemic episodes, swarms of beetles destroy a greater number of ancient pines. New plants can sprout in the forest as a result of this death. Because the beetles don't bother spruce, fir, and younger pines, they thrive in canopy gaps. Pines gradually grow toward the canopy and take the place of dying trees. Pines that are younger can typically fend off beetle assaults, but as they age, they become less robust and more vulnerable to infestation (Davis et al., 2012). The forest's temporal mosaic of pines is created by this cycle of death and regrowth (Forest Practices Board, 2007). Similar cycles can be found in the aftermath of other disturbances like fires and windstorms. A "compound disturbance" occurs when several disturbance events occur in rapid succession, resulting in a new condition that is greater than the sum of its parts due to the interaction of forces. For example, windstorms followed by fire can produce fire temperatures and durations not seen in even the most severe wildfires, with unexpected consequences for post-fire succession (Buma & Wessman, 2011). Environmental stresses are pressures on the environment that are compounded by variables such as extreme temperature or precipitation changes, all of which play a role in an ecosystem's diversity and succession (Johnstone et al., 2016). Diversity increases due to the intermediate-disturbance effect, decreases due to the competitive-exclusion effect, increases due to the avoidance of competitive exclusion through moderate predation, and decreases due to the local extinction of prey due to severe predation with environmental moderation (Kane et al., 2017). Some of the environmental stressors are decreases in recruitment density and the relevance of competition (Kane et al., 2017).

Plant Adaptation to the Disturbance

A disturbance has the potential to replace the forest completely. Following that the forest floor is frequently littered with dead leaf material (Atkins et al., 2020). The disturbance of new growth in plants is aided by decomposed matter and disrupted sunlight. As plant biomass burns in a forest fire, some nutrients previously collected in the biomass are

quickly returned to the soil. The disturbance is beneficial to some plants and animals. A few species are particularly suited to exploiting currently disturbed sites. Plants having the ability to grow quickly might soon take advantage of the minor of competition (Kaushal et al., 2021). In the northeastern United States, shade-intolerant trees like pin cherry and aspen thrive in forest gaps left by fire, wind, or human disturbance. Silver maple and eastern sycamore have comparable floodplain adaptations (Fahey et al., 2015). They tolerate standing water well and typically dominate floodplains, where diverse species are wiped off on a regular basis. When a tree is blown over, the holes are usually filled with tiny herbaceous seedlings, but this isn't always the case; fallen tree branches may sprout and fill the space (Bond, 2011). Sprouting ability can have a significant impact on the plant population. Plant populations that exploit the tree fall gap get overwhelmed by the shoots of the fallen tree. Species adaptation to disturbances is species-specific, but how a single organism adapts affects all the species. Another species that has adapted to a particular disturbance in boreal forests exposed to crown fires is the jackpine. They, along with a number of other pine species, have specialized serotinous cones that only open and disperse seeds when heated by fire. As a result, this species often dominates in areas where competition has been low due to fire. Pioneers of early successional species have evolved to take advantage of disturbed areas. These shade-tolerant plants may photosynthesize at a faster pace, allowing them to grow quickly. Their short lifespans usually counteract their rapid development.

Furthermore, while these species usually take over quickly after a disturbance, they are unable to compete with shade-tolerant plants later on and are displaced by these species through succession. These adjustments, however, may not represent the gradual rise and dominance of species that were available but inconspicuous immediately after the disturbance, but rather the gradual emergence and dominance of species that were previously unknown. Disturbances have also been shown to aid non-native plant invasions (Lembrechts, 2016). While plants are directly affected by disturbances, some animals are not. Most are able to avoid fires, and some even thrive afterward, thanks to copious new growth on the forest floor. New circumstances support a broader range of plants, which are frequently more nutrient-dense than pre-disruption vegetation. The plants, in turn, sustain a wide range of species, temporarily enhancing the forest's ecological richness.

Importance of the Disturbance in Plant Community and Structure and Conclusion

Natural disturbance has the most significant impact on plant communities and function. Natural disturbance events like flooding, fire, and windstorms are linked to the survival of a diverse range of plant species across all taxonomic groups (Thom and Seidl, 2016). For example, many shade-intolerant plants use disturbances to establish themselves and keep competitors at bay. Without this perpetual thinning, the diversity of the forest flora can decline, which affects the animals dependent on those plants as well (Bogle & Van Kooten, 2013). For a better understanding of the function of disturbance in the ponderosa pine (*Pinus ponderosa*) forests of the western United States, surface fires frequently reduce existing vegetation, allowing for new growth, development, and look of the ponderosa pine (*P. ponderosa*) forests of the western United States. If fires are suppressed, the shade-tolerant Douglas fir (*Pseudotsuga menziesii*) eventually replaces the pines. The dense crowns of Douglas firs significantly limit the quantity of sunlight reaching the forest floor. New growth is greatly hindered in the absence of enough light. The diversity of animal species that rely on surface plants decreases as the diversity of surface plants. In this case, fire is beneficial not only to the species that have been directly harmed but also to a variety of other creatures that rely on those key plants for survival. Plant diversity is limited in hostile environments because of the intolerance of all species except opportunistic and larger resistant species to specific conditions (Carnus et al., 2009). The interaction between disturbance and these biological processes is responsible for much of the structure and spatial patterning of natural ecosystems. Variability in disturbance and species variety is intertwined, necessitating adaptations that aid in increasing plant fitness, which is required for survival (Franklin et al., 2002).

In this article, disturbance plays a major role in the influence of the plant's structure, community, and diversity. Most disturbances impact species and functional diversity, which are fundamental to conservation planning but remain elusive. Both disturbances have a long-term influence on the plant community and structure. Natural disturbances affect some natural phenomena that affect the plant community and decrease the plant's survivability, but they affect a limited amount of the plant structure and are less affected by anthropogenic disturbances. Anthropogenic disturbances have no limit to disturbances, and they are also generated by human activity. This disturbance is primarily a disturbance in the present time, and it has had a significant impact on the structure, community, and diversity of the plant. The fire significantly impacts the plant community, among other disturbances. At present, prescribed fire has damaged a large portion of the forest and killed many plant species. At this time, the major problem is the increase in the human population and their demand. These activities are the major disturbances to the plant. People have deforested the forest area for human development, like plants used for medicinal purposes, mining, roads, factories, and building making. This activity causes water, air, and soil pollution, significantly impacting the plant community and structure and reducing diversity. However, some disturbances help plant community survival and the formation of vegetation. Birds help in pollination and seed formation, while the wind is beneficial in seed dispersal. In addition, forest fires facilitate new sprouting and regeneration of some plants.

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