Impact of Disaster on Wildlife and Biodiversity

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Abstract

Natural and anthropogenic disasters pose severe threats to wildlife and biodiversity, causing immediate mortality, habitat destruction, and long-term ecological disruptions. Natural catastrophes, including wildfires, floods, hurricanes, earthquakes, and droughts, can obliterate habitats, displace species, and reduce food and water availability, as exemplified by the 2016 New Zealand earthquake, 2019-2020 Australian bushfires, and Kerala floods. Anthropogenic disasters, such as oil spills, chemical accidents, nuclear events, deforestation, and urban expansion, further exacerbate biodiversity loss by contaminating ecosystems, altering species interactions, and reducing reproductive success. Climate change-driven events, including coral bleaching and marine heatwaves, amplify these impacts, destabilizing ecosystems and threatening species survival. Immediate effects include fatalities and injuries, medium-term effects involve resource scarcity, disease outbreaks, and behavioral changes, while long-term consequences manifest as reduced genetic diversity, trophic cascades, and altered ecosystem services. Globally, at least 10% of terrestrial vertebrates, including 5.7% of birds, 7% of mammals, 16% of amphibians, and 14.5% of reptiles, are at risk from natural hazards, with tropical and island species disproportionately affected. Disasters also compromise critical ecosystem services, including pollination, water purification, and soil fertility, which in turn impact human health and livelihoods. Understanding the scale, mechanisms, and cascading effects of disasters is essential for integrating conservation strategies with disaster risk reduction, enhancing ecosystem resilience, and ensuring species survival in increasingly disaster-prone regions.

Keywords

Natural disasters, Anthropogenic disasters, Biodiversity loss, Wildlife conservation, Habitat destruction, Climate change, Ecosystem services, Species extinction, Disaster management.

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Introduction

Natural and anthropogenic disasters have significant and in most cases devastating effects on wildlife and biodiversity affecting ecosystems and endangering the existence of many species. Natural catastrophes like floods, earthquakes, hurricanes, wild fires and droughts may cause instant destruction of habitats, it can result in loss of food sources and direct causes of death to plants and animals. An example of this is the destruction of vast forested regions by wildfires, which results in the displacement of the animals and the alteration of plant communities, or losses of nesting areas and freshwater habitats by floods. The anthropogenic disasters like the industrial accidents and chemical spills, deforestation and urban sprawl contribute to further vulnerability of the species by affecting the habitat and introducing contaminants to the species that impact reproductive health and food chains. The result of such events is loss of biodiversity that renders ecosystem less stable, less resilient to future environmental pressures and less sufficient in terms of delivering required ecological services including pollination, water purification and soil fertility. In addition, calamities can disrupt the relationships among the species as well, forcing them to alter their predator-prey behavior and lead to the establishment of invasive species. There is a cumulative effect of recurrent tragedies of repeated disasters, namely endemic and already threatened species, to the perceived risks of local extinctions, which destabilizes the genetic diversity and ecological balance. The description of the impact of disasters on wildlife and biodiversity is urgently required in the conservation planning and development of mitigation strategies that would make the ecosystem strong and recover the habitats and ensure the survival of the species in the world that is increasingly prone to disasters, in consideration of the dependence of human activities, climate change, and natural environmental processes.

Research Objectives

- To examine the immediate and long-term impacts of natural and anthropogenic disasters on wildlife populations and their habitats.
- To analyze how disasters disrupt ecosystems, alter species interactions, and contribute to biodiversity loss.
- To identify mitigation strategies and conservation approaches that enhance ecosystem resilience and species survival in disaster-prone areas.

Definition of Disasters: Natural vs Anthropogenic

A disaster is basically a disaster, which is so devastating and that the community in which it has occurred cannot manage it utilizing available resources.

Natural and anthropogenic (man-made) Disasters are widely categorized into the natural and anthropogenic type, based on their origin.

1. Natural Disasters: Natural disasters are events of the large scale, destructive, with natural processes, such as, geological and meteorological events, leading to loss of life, injuries, property damage, and socio-economic disturbance. Geological disasters like earthquakes, volcanic eruption, tsunamis, and landslides are caused by the activities of the earth, whereas the causes of meteorological disasters, including hurricanes, tornadoes, floods, droughts, wildfires, and heat waves, are caused by atmospheric and climatic conditions. Such events can be defined by their natural nature, high consequences on the settlements and ecology, the possibility of deaths and injuries, as well as the ability to disturb the economic and social systems. Natural disasters depend on geographic placement, whereby some areas are more susceptible to certain accidents and on human vulnerability, where occupying dangerous land, poor infrastructure, and environmental destruction can complicate the situation even more. This knowledge is crucial to disaster preparedness, reduction of risks, and mitigation techniques to save the human communities, and the environment.

2. Anthropogenic (Man-made) Disasters: These disasters can be attributed to either human actions, errors or laxity. These reasons can be a failure to plan appropriately, laxity in the industry, or even environmental degradation or even intentional ill intent. It can be industrial accidents like explosions in chemical plants, nuclear disasters, massive pollution and urban fires. Human intervention is not a direct cause or even a significant contributor as the natural disasters. In a lot of cases, these disasters could have been prevented or mitigated by proper regulation and planning and safety measures.

Types of Disasters Affecting Wildlife and Biodiversity

Both natural and human-made disasters are threatening and in most cases disastrous to wildlife and biodiversity. These may cause instantaneous mass death, protracted habitat harm, and the disturbance of the complex ecological functions, compelling endangered species to extinction. These impacts are being aggravated all over the world by the escalating rate and severity of numerous calamities, especially those associated with climate change.

Until now, the disasters that can have an impact on biodiversity can be grouped in the following way:

1. Natural Disasters

These are sudden, severe events resulting from natural Earth processes.

- **Wildfires:** This is an uncontrolled fire, such as in the Australian bush (2019-2020) and the Amazon, which destroys enormous areas. It is approximated that the Australian fires have claimed the lives or displacement of close to 3 billion animals including koalas and other endemic species, and also destroyed vital forest habitats.
- **Hurricanes, Cyclones, and Floods:** Not only do these occurrences result in direct drowning and physical injury, but they also destroy landscapes, salinate freshwater ecosystems and eliminate food sources. An example would be Hurricane Maria in 2017, which wiped out the canopy of the rainforests in Puerto Rico, which severely affected the endemic populations of parrots.
- **Volcanic Eruptions:** Eruptions have the power to destroy all life around the area in the vicinity with lava flows and pyroclastic surges. The fall of ash could cover vegetation and pollute sources of water in a significantly larger region, which resulted in starvation and population decline.

2. Human-Induced (Anthropogenic) Disasters: Human activities cause them, either by accident or as a by-product of industrial processes.

- **Oil Spills:** Crude oil is very toxic, which coats fur and feathers of animals, causing drowning, hypothermia and poisoning. The 2010 Deepwater Horizon spill at the Gulf of Mexico caused the death of over 1 million seabirds and tens of thousands of sea turtles and marine mammals, and had long-term effects on the health of fish and corals.
- **Industrial and Agricultural Chemical Spills:** The dumping of pesticides, fertilizers and heavy metals into rivers and oceans may result in instant mass killings and cause a dead zone to appear where oxygen does not exist. Direct effects of pesticides such as neonicotinoids are the loss of pollinator insects, which are vital in the functionality of the ecosystem and food security.
- **Nuclear Disasters:** Incidents such as Chernobyl (1986) and Fukushima (2011) made huge portions of land inhabited by various species uninhabitable through radioactive contamination leading to genetic mutations, cancer and population reductions.

3. Climate Change-Driven Disasters

Although climate change is a slow event, it leads to acute events of disasters.

- **Coral Bleaching:** Coral bleaching is a process that is caused by prolonged high temperatures in the sea and it happens when the corals in the water expel the symbiotic algae making it white, and dying off. Since 1998 the Great Barrier Reef has endured 6 mass bleaching events with the 2016 event alone killing 29-50 of its shallow-water corals, decimating the incredible biodiversity sustained by these ecosystems.
- **Marine Heatwaves:** These extended bouts of unusually hot ocean water can destroy kelp forests, destroy shellfish populations and result in large scale deaths of sea birds and seabird mammals caused by changes in prey levels.

Disasters and Their Impacts on Wildlife: An Analysis

The impact of disasters on wildlife is disastrous, not only in the direct sense of their death but also in the indirect ecological impact. Wildfires, floods, earthquakes, and storms pose direct injuries to animals, and lead to longer-term effects of habitat, food, and disease vulnerability. The effects tend to take years of influence on species population patterns and stability of the ecosystem. As the example of 2016 earthquake in New Zealand, which killed a quarter of the local population of the shearwater of Hutton, when burying their breeding colony, or floods in India, which endangered

45.25 percent of livestock, shows. Wildfires, such as the ones in Greece in 2023 caused immense destruction of habitat resulting in the enormous loss of biodiversity. The other ways in which disasters change the ecosystems include modifying landscapes and water systems, which leave some species with an inappropriate environment. **Direct Impacts**

- **Fatalities:** Animals are killed directly by floods, fires, earthquakes, or storms.
- **Injuries:** Survivors may suffer burns, cuts, broken limbs, respiratory problems, or severe damage to wings or gills.

Examples

- 2016 New Zealand earthquake: ~25% of Hutton's shearwaters killed.
- 2019 Montana storm: Thousands of birds injured or killed by hailstones.
- 2023 Greece wildfires: Massive loss of animal life and habitat destruction.

Indirect Impacts

- **Habitat Loss:** Fires, floods, and landslides reduce available shelter and territory.
- **Food and Water Scarcity:** Vegetation destruction and water contamination reduce resources.
- **Disease Outbreaks:** Malnourished and stressed animals become more susceptible to infections and parasites.
- **Behavioral Changes:** Animals may show disorientation, nervousness, and altered feeding behaviors.

Ecosystem Disruption

- **Landscape Alteration:** Earthquakes, volcanic eruptions, and fires permanently modify habitats, making adaptation difficult.
- **Pollination Disruption:** Loss of pollinators like bees impacts forest regeneration and food production.

Long-Term Effects

- **Slow Recovery:** Habitats may take years or decades to recover, prolonging stress on wildlife.
- **Decreased Fertility and Population Size:** Reduced resources and stress lower reproduction rates, decreasing population sizes over time.

Table: Examples of Disasters and Their Wildlife Impacts

Disaster Type	Location & Year	Direct Impacts	Indirect Impacts	Species Affected
Earthquake	New Zealand, 2016	~25% Hutton's shearwater population killed	Burial of breeding grounds; loss of habitat	Hutton's shearwater
Storm	Montana,	Thousands of birds	Stress and	Various bird
Disaster Type	Location & Year	Direct Impacts	Indirect Impacts	Species Affected
(Hail)	USA, 2019	killed/injured	displacement	species
Wildfire	Greece, 2023	Extensive mortality, burns	Habitat destruction, food scarcity	Mammals, birds, reptiles
Flood	India, 2020	Direct drowning	Loss of grazing land, water contamination	Livestock (45.25% vulnerable)

Impact of Disasters on Biodiversity: Global Insights

The threat posed by disasters to biodiversity is growing, through habitat loss, displacement of wildlife, and loss in food and water, and direct mortality, increasing extinction vulnerability, especially in biodiversity hotspots and island ecosystems. At the global level, natural hazards are threatening at least 10 percent of terrestrial vertebrates, with tropical and island species being over-represented. Human-made threats to biodiversity are usually made more severe by disasters, which destroy key ecosystem services to the well-being of wildlife and humans. Integrated approaches combining conservation strategies and disaster risk reduction are essential to mitigate these impacts.

Examples of Data and Findings

- **Scale of Impact:** Global analyses indicate that 10% of terrestrial vertebrates are at risk from at least one natural hazard, including 5.7% of birds, 7% of mammals, 16% of amphibians, and 14.5% of reptiles.

Specific Events

- 2019-2020 Australian Bushfires: Nearly 19 million hectares burned, impacting ~3 billion animals, including koalas, wombats, kangaroos, and wallabies.
- Kerala, India (Floods & Landslides): Aquatic birds, insects (like butterflies and moths), and freshwater habitats were disrupted, reducing population sizes and altering ecosystems.
- High-Risk Species: Species in tropical regions and on islands are more vulnerable to natural hazards.

- Interconnectedness: Biodiversity loss caused by disasters also affects human health by reducing ecosystem services such as clean air, water, and food (WHO).

Mechanisms of Impact

- **Habitat Loss:** Direct destruction or alteration of habitats leads to wildlife displacement and increased mortality.
- **Resource Scarcity:** Diminished water availability and food sources stress populations.
- **Direct Mortality:** Individuals are killed immediately during events like wildfires, floods, or landslides.
- **Reduced Fertility:** Stress and habitat loss decrease reproductive success in surviving populations.
- **Invasive Species:** Disturbed environments provide opportunities for invasive species to establish, further harming native biodiversity.
- **Altered Ecosystem Services:** Degraded ecosystems reduce services such as water purification and soil fertility, impacting both wildlife and humans.

Table: Disasters and Their Impacts on Biodiversity

Disaster/Event	Location & Year	Scale/Extent	Direct Impacts	Indirect Impacts	Species Affected
Wildfires	Australia, 2019-2020	~19 million hectares burned	Immediate mortality (~3 billion animals)	Habitat destruction, food scarcity, displacement	Koalas, wombats, kangaroos, wallabies, birds
Floods & Landslides	Kerala, India, 2018-2020	Widespread river & habitat disruption	Some immediate deaths in aquatic birds & insects	Habitat alteration, reduced water quality, food scarcity	Aquatic birds, butterflies, moths
Global Natural Hazards	Worldwide	10% of terrestrial vertebrates at risk	Direct mortality during disasters	Habitat loss, resource scarcity, altered ecosystem services	Birds (5.7%), Mammals (7%), Amphibians (16%), Reptiles (14.5%)
Tropical & Island Species	Global	Higher vulnerability	Increased mortality and displacement	Higher risk of invasive species, reduced fertility	Endemic species on islands and tropical regions

Results and Discussion

Disaster analysis of its effects on wildlife and biodiversity indicates that there are both short-term and long-term impacts, which differ depending on the area, species and type of event. Natural disasters like wildfires, floods, earthquakes, and hurricanes have widespread direct deaths, injuries, and displacements, as witnessed by the 2016 New Zealand earthquake (around a quarter of shearwaters of Hutton killed), the 2019-2020 Australian bushfires (around 3 billion animals affected), and the 2023 Greece wildfires. The anthropogenic catastrophes such as oil spills, chemical contamination, and nuclear accidents aggravate the destruction of the habitats and have long-term effects on reproduction, genetic health and population sustainability. The events related to climate change, including coral bleaching and marine heatwaves, contribute to the increase in the instability of the ecosystem, including keystone and endemic species. Ecological functions are undermined by these indirect effects including habitat loss, shortage of resources, outbreaks of diseases and predator-prey interactions, which have cascading effects on food webs and ecosystem services. International evaluations have suggested that people face a threat of about 10% of terrestrial vertebrates at risk due to natural hazards with more susceptibility being in tropical and island species. These imbalances show how the loss of biodiversity is interrelated with human welfare because the ecosystem services are impaired, e.g. pollination, water purification, and soil fertility. As the results reveal, repeated disasters and compounded disasters further stress already endangered species and require integrated solutions that combine conservation planning, habitat restoration, and disaster risk reduction to increase the resilience of the ecosystem and ensure the survival of species living in the disaster-prone areas.

Conclusion

Natural, anthropogenic, and climate change-induced disasters have far-reaching and complex effects on wildlife and biodiversity causing mortality, habitat destruction, and ecosystems disruption. The susceptibility of vulnerable species, mainly in tropical and island habitats, is highly exposed to the threat of population decline and extinction. Cascading impacts of repetitive disasters and anthropogenic stresses impair genetic diversity, ecological stability, and provision of critical ecosystem services, to both wild and human societies. The mitigation needs to be an in-depth effort that involves conservation measures and habitat restoration and disaster risk management. To preserve the biodiversity and secure the long-term survival of species in disaster more prone environments, ecosystem improvement and proactive planning are important in protecting the ecosystem.

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