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Genetic Variety Serves as a Buffer in Biodiversity: The Loss of Biodiversity Can Exacerbate the Spread of Infectious Diseases

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ABSTRACT

Almost every ecosystem maintains its own ecological insurance scheme. In order to maintain this system, an ecosystem needs three forms of diversity: biological, genetic, and functional. Biological diversity refers to the richness of species in a given area; genetic diversity denotes a way for a particular species to adapt itself to changing circumstances while functional diversity relates to the biophysical processes that happen within the area. One of the most important benefits of genetic variation is that it functions as a buffer against the variability of environmental conditions, particularly in the medium and long durations. Biodiversity or biological diversity refers to the variety of life on Earth, including plants, animals, micro-organisms, and the genes they contain. It simply means the existence of a broad variety of plants and animal species in their natural settings or the diversity of plant and animal life in a particular habitat.

1. Introduction

Biological diversity is defined as the relative abundance of organisms in various habitats. Variation among species as well as among habitats is considered diversity in this definition. The 'totality of genes, species, and ecosystems in a region' definition of biodiversity can also be used. As defined by the Convention on Biological Diversity (Glowka et al, 1994), biodiversity is the variation among living organisms from all sources, including, but not limited to, the ecosystems and ecological complexes in which they exist, such as terrestrial, marine, and other aquatic ecosystems. This includes variation within and between species as well as variation within and between ecosystems.

An examination of the available literature found that several scientists have made significant contributions to the field of biodiversity conservation. Three degrees of biodiversity are commonly used to characterize it, and it has a variety of purposes and values. Attempts are being made here by the author to discuss genetic diversity as a buffer and shock absorber for contemporary biodiversity.

2. Biodiversity

On a general note, diversity means the variety of individuals among a group or community. Biodiversity is one of the most complicated terms in the natural world that have a significant impact on the ecological system to sustain lives. Biodiversity refers to all living things on Earth, from the largest mammals to the tiniest insects, including plants and microbes. The fact that we are surrounded by such a diverse spectrum of biodiversity is a blessing. However, some of the creatures have already been lost in this web, while some are in danger of extinction.

3. Genetic Diversity

We all know that every living being from his own community is different from each other yet has some traits of their family. Each species contains an individual set of genes. It is the 'gene' that an offspring inherits from parents and it runs from generation to generation. 'Gene' plays the main and the most significant role to distinguish features from different organisms between species or among species.

Following genes, genetic diversity refers to the huge range of characteristics that are from inherited genes between a species. It is likely to happen that within a species different individuals will have different characteristics. This is what genetic diversity is all

about. However, genetic diversity is different from genetic variation as genetic variation refers to different sequences of genes of an individual organism from the same community.

According to Rolf Holderegger, there are mainly two types of genetic diversity. They are

- Neutral Genetic Diversity.
- Adaptive genetic Diversity

3.1 Neutral Genetic Diversity

Neutral Genetic Diversity is the kind of genetic diversity that doesn't show us any growth and adjustable feature in body fitness. Hence, it is likely to call diversity neutral. But there is a lot of things to identify and study in neutral genetic diversity, such as gene flow and its migration. These factors enable us to assess the functional importance of spatial indicators employed in landscape ecology. (H. Rolf, 2006)

3.2 Adaptive Genetic Diversity

Adaptive genetic diversity is different from neural-genetic diversity. It is a study of quantitative genetic research. This research has occurred in a controlled and consistent environment. Adaptive genetic variation or variation among people at quantitative or adaptive characteristics is not directly linked with neutral genetic diversity.

4. Three Basic Biodiversity

The biodiversity is investigated and documented on three different levels, namely, ecological diversity, species diversity, and genetic diversity. The diversity of habitats (a site where an organism or a group of organisms naturally occurs) within an ecosystem, as well as the diversity of life forms within an ecosystem, is referred to as ecosystem diversity. There are three degrees of diversity at the level of the community and the ecosystem. Alpha diversity (diversity within communities), beta diversity (diversity between communities), and gamma diversity (diversity of habitats over the entire landscape or geographical area) are the three types of diversity.

The species diversity of a region refers to the variety of species that can be found there. Within a species' population or between distinct species within a community, variability is defined as the difference between two or more individuals. It is the species that serves as the fundamental unit of classification for organisms, and it is its diversity that serves as the most often utilized level of description for biodiversity. It is a general representation of the number of species and their abundance in a community. Individual species are consequently separate units of diversity, each of which has an important role to perform in the ecosystem. In nature, the number and types of species, as well as the number of individuals per species, all change, resulting in increased diversity of organisms. The species are classified together into groups based on the qualities that they have in common. The genetic diversity of a species is defined as the variation in the number of fundamental units of hereditary information (genes) that are handed down from one generation to the next. As a result of genetic variation, there are variations, which are the fundamental source for biodiversity, and the quantity of genetic variation is, in turn, the basis for speciation. It is significant for natural selection because genetic variety helps a population to adapt to its environment and hence is crucial for natural selection. Genetic variety within a species is frequently increased as a result of environmental variability, but not all groups of animals have the same degree of genetic diversity. Therefore, distinct populations of a species must be protected in order to conserve genetic diversity.

5. The Values of Biodiversity in Existence

According to Richard (2015), genetic variety is critical to the survival and adaptability of a species's population and environment. Some of its many diverse values and applications include consumptive use; productive usage; social benefit; aesthetic benefit; scientific and evolutionary benefits; and so on.

The principle of "Live and Let Live" is also applied to biodiversity, which provides an ethical or existence value based on the concept of "Live and Let Live." In other words, biodiversity is valuable because, if we want our human race to live and thrive in the future, we must maintain and conserve all biodiversity, which means that, in essence, "all life must be preserved."

If we want to ensure the survival of the human race, we must safeguard all forms of biodiversity. This is because biodiversity has intrinsic worth from both a natural and an ecological standpoint. A recent study by Chris Maser (2009) found that nearly all ecosystems are capable of maintaining their own environmental insurance system, which requires three types of biodiversity: biological, genetic, and functional. The richness of species in a particular area is referred to as biological diversity; genetic diversity refers to the ability of a particular species to adapt to changing environments is referred to as genetic diversity, and functional diversity refers to the biophysical processes that take place in the area is referred to as functional diversity. When it comes to environmental unpredictability, one of the most significant effects of genetic variety is that it functions as a buffer, especially in the medium and long term.

The living world contains a wide diversity of animals, plants, and microorganisms, all of which appear to be well adapted to their surroundings. This rich and diverse diversity must be preserved in order for all living things to survive and thrive in harmony with one another. The presence of a large and diversified gene pool in a population of a species means that there will be greater variability in the qualities of individuals in that group, and consequently, more features on which natural selection can act in order to pick the fittest individuals to survive. It is becoming increasingly difficult to conserve biodiversity due to the loss and degradation of habitats, overexploitation of resources, unprecedented climatic changes, pollution, illnesses, agricultural shifting, hunting of wild animals, and other factors. Because human beings derive all of the benefits from biodiversity, they must take appropriate measures to ensure the preservation of biodiversity in all of its forms, as well as the health and safety of future generations, as well as the health and safety of themselves.

Existence value refers to the value and benefit, especially economic, that we receive from any environmental resource individually.

The existence of biodiversity explains the importance of economic benefits that we get from our natural resources, like- wildlife and marine biodiversity. The existence of biodiversity doesn't care whether we use the resource purposefully or not or whether the resource helps us provide goods or not. However, it is likely to say that it is a very controversial topic. Some study says that the existing value gets along with the financial value with its feasibility. Other studies say that existence value is over as the resource gets vanished or becomes of no use.

It can be connected to the Stern Review's (Stern, 2007) approach of discounting, in which it was suggested that the social discount rate's pure time preference component should be based on an (inherently arbitrary) assessment of the chance of humanity's disappearance. Similarly, existence value may be calculated using a (not intrinsically arbitrary) assessment of the likelihood that the land-use change in issue would result in the entire extinction of the ecosystem/species/service in question. If respondents in a stated preference survey are asked to rate a change in an ecosystem and the change can be related to a change in the likelihood of the ecosystem collapsing (i.e., the end of its existence), then the WTP for this might be understood as an expression of existence value. Apart from this probabilistic interpretation, existence value does not fit well into a welfare economic framework in which value can only be captured via change.

In our opinion, the present elements of biodiversity are important to us. Also, the resources that we have lost are important to us since they are benefiting us by decomposition. Nonetheless, we are not done with our natural resources yet, we have not seen all the benefits that we can get from these. For example, a lot of medicines are yet to discover. It is our responsibility to take good care of our biodiversity for our own good. Otherwise, we will be in huge threat to our own existence.

6. Loss of biodiversity

Loss of biodiversity refers to the loss of a variety of natural elements or living organisms from the nature and ecosystem. Loss of biodiversity doesn't only mean the loss of biological organisms of a species, but also refers to the loss in the ecosystem. According to Britanica (Rafferty. J. P, n.d.) "biodiversity loss describes the decline in the number, genetic variability, and variety of species, and the biological communities in a given area"

Biodiversity and species, these two terms are interconnected and interdependent with each other one way or other. As the loss the organisms of a particular species, we lose the organisms of biodiversity. The unwanted loss of organisms of a particular species negatively affects the species itself. Also, a negative alteration can be shown in the whole ecological community.

From the beginning of the earth, we have been used to seeing the loss of different species. For example, Dinosaurs. The reason for this kind of loss is not certain. There are numerous causes behind it, i.e, adapting to new species, hunting, air pollution, water pollution, disruption in habitat due to ravages of nature, and many more. However, it is likely to say that humans have a huge hand in the disruption of biodiversity. Human's self-centric activities impact in a not so pleasant way.

Let's look at some attributes that cause loss of biodiversity:

6.1 Adapting with new species

Often nature evolves with new exotic animals with whom the existing animals can't get mixed. For this reason, the food chain, production of species get hampered. Eventually, the whole system faces difficulty. If the difficulty gets serious, then the loss of any species may occur, as well as loss of biodiversity.

6.2 Hunting

Hunting is one the most brutal selfish activity that human finds do. Through hunting, people directly kill animals for their own interests without thinking about nature. because of hunting gradually, a major disruption in the ecology can be seen.

6.3 Pollution

Types of pollution can be air pollution and water pollution. Due to having unwanted life-risking particles in the air, like, CFC gas, the air gets polluted. Cutting down trees is one of the major reasons for environmental pollution. People throw wastages in water. The sea level gets risen. Many species of water animals and fishes find it difficult to breathe and get feed. Also, if giant animals consume small animals at an abnormal rate, the particular species get at risk. Using pesticides in farming lands is a man-made idea for the extinction of an entire species of insects. This idea may help the farmers to grow vegetables but in the long run, they will face the necessity of the insects or small biological elements that they exploited before.

6.4 Ravages of Nature

As the world is getting hot day by day, the animals staying in ice or cold lands are getting threats of life. In contrast, sudden lava can burn an entire jungle, following the biological elements that inhabit the jungle. Sudden tornado or extreme rainfall, a tsunami can take away a whole species of animal on its own. Mother nature can be exotic and hamper itself anytime without notifying.

Ecological communities are unable to perform a wide range of essential ecosystem services as a result of catastrophic biodiversity losses. The transmission of infectious diseases in humans, other animals, and plants can be affected by a decrease in biodiversity. In theory, a decline in biodiversity could lead to an increase or decrease in the spread of diseases. According to recent studies, the loss of biodiversity has been linked to an increase in the spread of infectious diseases. Areas with a high level of biodiversity, on the other hand, may act as a breeding ground for novel illnesses.

Many issues remain, but current data suggests that the preservation of intact ecosystems and their endemic biodiversity can minimize the incidence of infectious diseases.

7. The loss of biodiversity can exacerbate the spread of infectious diseases

According to common sense, the more diverse and abundant pathogens are, the more likely it is that diseases will be transmitted.

As a result, species-rich habitats may have a higher risk of infection than those that have been impacted by human activity. Research, on the other hand, suggests otherwise. Biodiversity loss has been linked to an increase in disease transmission, according to several studies (Keesing et al. 2010). Consequently, the loss of biodiversity results in a loss of a key ecosystem service: protecting humans, animals, and plants from infectious diseases (Pongsiri et al. 2009). It is possible that the loss of biodiversity could lead to an increase in the number of people infected with infectious diseases, such as the Hantavirus, which could infect a larger percentage of the population (Pongsir et al. 2009; Suzan et al. 2008; Peixoto and Abramson 2006). When it comes to Hantavirus disease, there are two distinct types: HFRS (hemorrhagic fever with renal syndrome) and HPS (Hantavirus pulmonary syndrome).

8. Are there any specific ecosystem services that were studied? How, exactly?

It has been found that all recent Hantavirus outbreaks, transmitted from animals to humans, so-called zoonoses, occurred in anthropogenic highly degraded ecosystems with reduced biodiversity (Suzan et al. 2008).

To spread Hantaviruses, rodent excreta is aerosolized or direct contact with the animals can be a risk factor. The virus spreads among rodents through means of physical contact (aggressive encounters). For each Hantavirus genotype, a certain rodent species (hos t) is connected. Because of this, the likelihood that a particular Hantavirus genotype will successfully infect other rodent species is quite low.

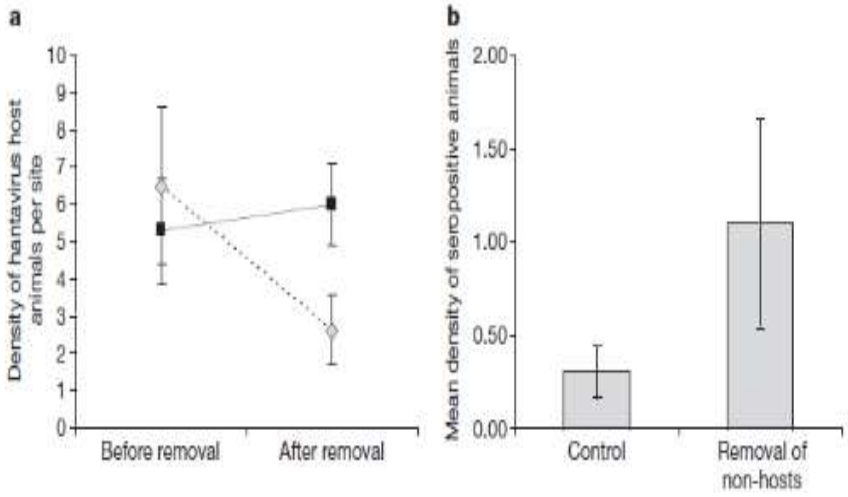
It has been discovered that a decrease in small-mammal diversity is associated with an increase in deer mouse infection prevalence of the Sin Nombre Hantavirus (SNV) (Clay et al. 2009).

By reducing the number of intraspecific interactions rather than decreasing host density, a high diversity of mammalian species reduced the frequency of infection significantly. Experiments also corroborate this conclusion. No correlation was found between the density of deer mouse populations and the incidence of SNV infection. In other words, rather than host abundance reducing intraspecific interactions, high genetic diversity did so (Clay et al. 2009).

A generalist rodent species may have been the source of recent epidemics, according to available information (Suzan et al. 2008). Generalist species may thrive in a wide variety of settings and feed on an array of different foods. According to Keesing et al. (2010), pathogen-amplification species have lower immune defense investments, making them more susceptible to infection. Specialist species, on the other hand, are highly adapted to a single ecosystem and require only a few unique food resources, and may spend more in immune defense and so buffer diseases from infection (Keesing et al. 2010). When humans interfere with natural ecosystems, they often cause the environment to be greatly simplified. Due to their greater ability to adapt to a changing environment and less competitive pressure, many opportunistic species' population densities can rise substantially.

As a result, the virus spreads more quickly since there are fewer opportunities for other species to come into contact with the rodents infected. As a result, it can be assumed that Hantaviruses are most effectively transmitted and propagated in groups with limited diversity. When species variety is reduced in highly disturbed areas, a generalist species' population tends to expand, which increases the danger of disease transmission to people. (Suzan et al. 2008).

As a result, if there is a decline in biodiversity, transmission events increase because of an increase in encounters between infected and vulnerable hosts. It is more likely for a rodent to spread the virus if the small-mammal diversity is minimal because aggressive interactions occur in groups of similar species more frequently. Research on wild rodent populations in Panama's southern region supports this conclusion. Small-mammal species diversification was found to have a negative effect on Hantavirus host abundance (See figure below from Keesing et al. 2010). As a result, the danger of human infection is increased (Pongsiri et al. 2009, Suzan et al. 2008).



Source: Keesing et al. 2010

Following these findings, Montira et al (2009) propose adopting policies that sustain or promote biodiversity instead of seeking to support or eradicate a specific species.

Focusing on a single species may have unanticipated consequences, such as increasing further biodiversity loss when eliminating a rodent species that can act as a food source or a buffer for illnesses. Adding a species (i.e. a natural enemy or rival) to control the disease's host can be considered by Keesing et al. (2010) for specific diseases. Adaptation and resistance to infections can occur if antibiotics are overused. Identifying possible emerging hotspots is also critical.

Protecting biodiversity and reducing human-wildlife contact can help prevent the spread of new diseases. Domestic animals and wildlife should also be kept apart. However, eliminating disease hotspots has the potential to "backfire" and result in the spread of pathogens (Keesing et al. 2010).

Understanding how global trends, such as climate change or nutrient pollution, are linked to biodiversity loss and disease systems necessitates additional research on various diseases (Keesing et al. 2010).

Economic decision-making tools are also necessary. CEA and BCA can be applied to human health protection measures, although further research is needed here (Pongsiri et al. 2009).

9. Conclusion

An ecosystem is a collection of living organisms (biotic components) that interact with one another as well as with the non-living elements (abiotic components) of their environment to maintain their existence. In this way, the ecosystem is defined as a community of creatures and their physical surroundings that are in constant communication with one another. As species disappear from the face of the earth, whether locally, globally, or glocally, we lose not just the diversity of their form and function, but also the genetic diversity that they possess. The loss of genetic diversity eventually results in the reduction of complex ecosystems to a level of simplicity that makes them incapable of providing the productivity and resilience necessary to support us as a society.

As a result, biological diversity is transmitted to future generations through genetic variation, which efficiently preserves functional diversity. Environmental variability, particularly in the medium and long term, is mitigated by genetic variety, which serves as a protective buffer.

An ecosystem may be stable and capable of responding positively to disruptions in its own habitat if it has adapted to the conditions of that environment. As a result, healthy settings can operate as a shock absorber in the face of a variety of different disturbances.

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References

[1] Clay, C. A., Lehmer, E. M., Jeor, S. S., & Dearing, M. D. (2009). Testing mechanisms of the dilution effect: deer mice encounter rates, Sin Nombre virus prevalence and species

[2] Glowka L. (1994) IUCN Gland and Cambridge. 12:161. *A Guide to the Convention on Biological Diversity Environmental Policy and Law Paper No. 30 IUCN Gland and Cambridge*.

[3] Kaushik A.,Kaushik C.P. (2008). Environmental Studies, New Age International Publishers, *New Delhi, Kaushik A. and Kaushik C.P*.

[4] Chris M. (2009) Every forest and every city has a design interface for social-environmental planning. *Taylor & Francis Group, CRC Press, London, New York,*328.

[5] Nair, S.M (1992). National Book Trust, New Delhi, *Endangered Animals of India and Their Conservation*

[6] Odum. E.P (1971). Fundamentals of Ecology, 3rd edition, *W.B. Saunders Company, Japan.*

[7] Prakash S. &Verma A.K. (2015) Studies on various fish genera in Kaushambi's Alwara Lake;): *An International Journal of Biodiversity & Environment. 5*(1-2):

[8] Prakash S. & Verma A.K. (2015) Studies on various fish genera in Kaushambi's Alwara Lake.; in Bioherald: *An International Journal of Biodiversity & Environment.*

[9] Prakash S.& Verma A.K. The effect of a public awareness campaign on the growth and conservation of the vulnerable bird species Grus Antigone antigone in and around Alwara Lake in the District Kaushambi (Uttar Pradesh), India. *The Journal of Zoology Studies, vol. 3,* no. 2,. 1–5.

[10] Prakash & A.K. Verma. (2016b) Conservation Status of Freshwater Fishes in Alwara Lake, District Kaushambi (U.P.). *International Journal of Zoology Studies.*

[11] Richard F. (2005) Biological Conservation.; 126(2):1–140. 10. *Richard F.* "*Genetics and Extinction.*"

[12] Verma, A.K and Sunil K. The status and ecology of the Sarus Crane, Grus antigone antigone, in and around District Kaushambi's Alwara Lake (U.P.). *International Journal of Environmental Sciences, vol. 6,* no. 2. 331-335, 2015.

[13] Verma A.K and Prakash. S (2016a). Fish biodiversity in Alwara lake in District Kaushambi, Uttar Pradesh, India, in *Research Journal of Animal, Veterinary, and Fishery Sciences.*

[14] A.K. Verma and S. Prakash. Population dynamics of the Indian Sarus Crane, Grus antigone antigone (Linnaeus, 1758), in and around the Alwara Lake in the Kaushambi area of Uttar Pradesh, India.

[15] Verma, A. K. (2016). Biodiversity: Its different levels and values. *International Journal on Environmental Sciences*, *7*(2), 143-145.

[16] Verma, A. K. (2016). A preliminary survey of fresh water fishes in Muntjibpur pond of Allahabad (UP). *Indian Journal of Biology. 2016d*, *3*(2), 99-101.

[17] Reaka-Kudla, M. L., Wilson, D. E., & Wilson, E. O. (Eds.). (1996). *Biodiversity II: understanding and protecting our biological resources*. Joseph Henry Press.

[18] Mace, G. M., Masundire, H., & Baillie, J. E. M. (2005). Biodiversity. Chapter 4 Current state and trends: *Findings of the condition and trends working group. Ecosystems and human well-being, vol. 1.* inMillennium ecosystem assessment, 2005.

[19] Pongsiri, M. J., Roman, J., Ezenwa, V. O., Goldberg, T. L., Koren, H. S., Newbold, S. C., ... & Salkeld, D. J. (2009). Biodiversity loss affects global disease ecology. *Bioscience*, *59*(11), 945-954.