

The Baseline Study of the Existing Biodiversity in Ghaazee School, Hulhumale, Maldives

¹Aminath Shazra, ²Shimla Ibrahim, ³Aminath Nahudha Mauroof

^{1,2}Teacher, ³PhD Researcher
Department of science
Ghaazee School
Hulhumale, Maldives.

Abstract- The purpose of the baseline study is to investigate the existing biodiversity of Ghaazee school grounds and the surrounding premises to quantify and document the species diversity. The study also focuses on the different types of species, their frequencies, abundances and to evaluate the biodiversity index and to study the relationship between various ecosystem parameters and the species present. Line transects, list quadrat, direct counting, visual encounter survey (VES) and torch count were used as data collection methods. The result showed the presence of 6 types of vegetation, 27 types of plants, 28 types of herbs and shrubs. Moreover, there are 5 vertebrates and 4 invertebrates found in the school premise.

Keywords: Biodiversity, Flora, Fauna, Soil Analysis, Organic Content, pH, Vertebrate, Invertebrate, Vegetation, Biodiversity Index, frequency, abundance

INTRODUCTION

Biodiversity refers to the entire range of living species found in terrestrial, marine and aquatic ecosystems, the genetic variation among individual species and how they are associated with chemical and physical environment [1]. The study of terrestrial biodiversity is crucial as the dryland of the Maldives is very much limited when compared with area covered by the sea. According to the [2] the Maldives land area is estimated to be 300 km² out of the 90000 km² of the Exclusive Economic Zone (EEZ) highlighting the scarcity of the land and thereby the terrestrial biodiversity of the country. Therefore, the research was based on the baseline study of a terrestrial biodiversity and its interrelated components at Ghaazee School, Hulhumale', Maldives. The study not only provides insights relating to the existing biodiversity and species index, but it also further helps to raise awareness among school students, staff as well as the authorities on the importance of maintaining healthy ecosystems within the limited land area of the country. The study also assists to contribute to the limited available research-based knowledge in the area in the Maldives.

OBJECTIVES OF THE STUDY

The main objective of the research study is to carry out a baseline study on the existing biodiversity of Ghaazee school grounds and to quantify and document the species diversity. Moreover, the study is also utilised to examine the different types of species present, the frequency of them and to evaluate the biodiversity index and the abundance of species at the grounds of Ghaazee School, Hulhumale'. Furthermore, the study is also utilised to investigate the ecosystem parameters and its relationship with the biodiversity.

RESEARCH METHODOLOGY

The biodiversity baseline study has utilised various survey and monitoring methods for data collection. For vegetation survey, mainly line transect and list quadrat method was used. Standard line transect sampling method is efficient for plant population as this method has the ability to cover a large part of plant distribution [3]. For the vertebrates and the invertebrates, several applicable methods of survey were utilised. This includes the direct counting method (Visual survey), Visual Encounter Survey (VES) method, Torch count method was specifically used for reptiles and amphibians. Visual Encounter Survey allows the researcher to be present in the site and obtain records [4]. For birds mainly point count method and opportunistic sighting methods were utilised. Point count is one of the most common methods to collect data for relative abundance of birds [5]. In addition to the above survey techniques, random sampling methods were utilised to collect soil samples for physical and chemical analysis of various other parameters of the soil that are directly or indirectly related to the species. [4] [3] [2]

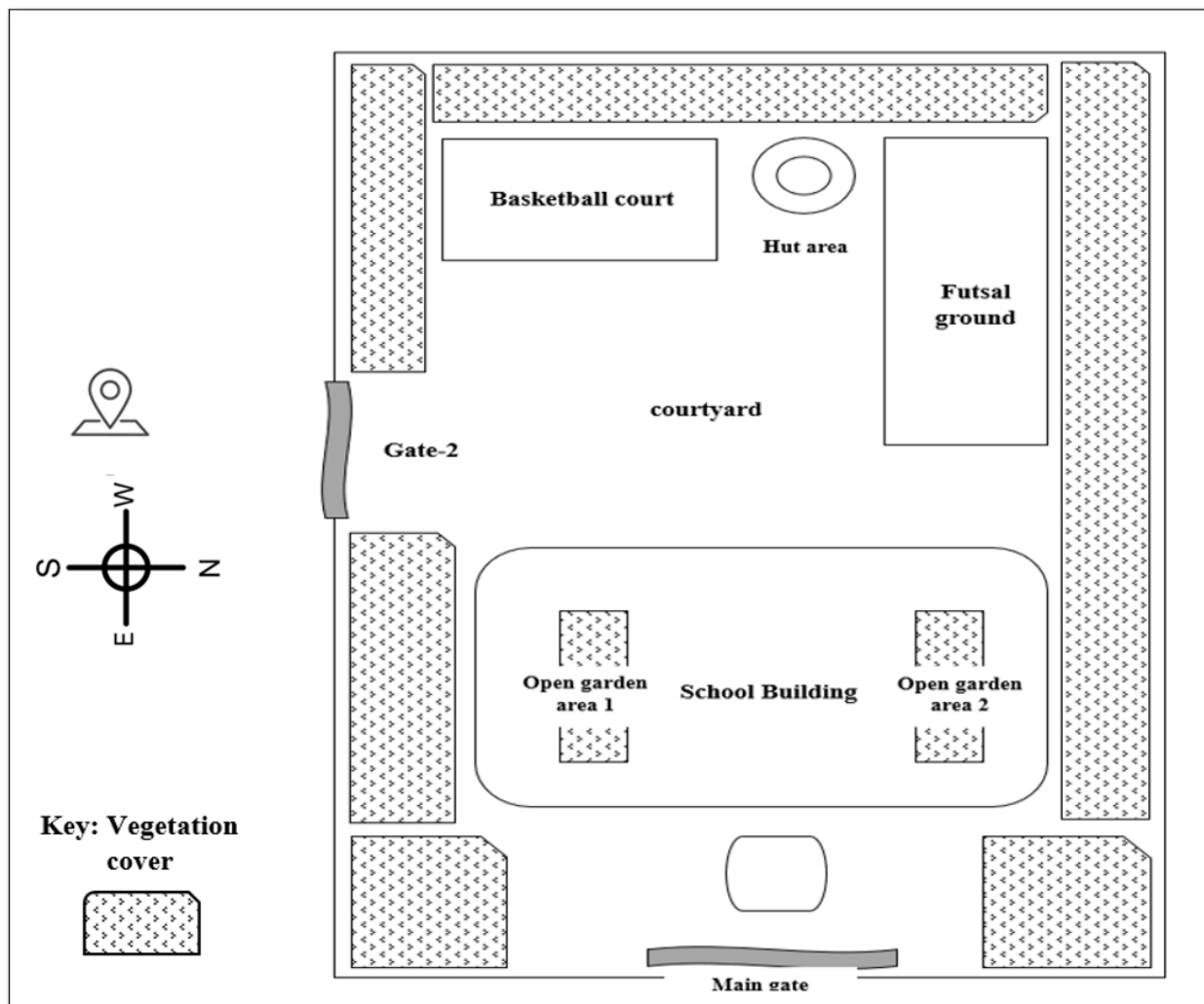
PERIOD OF THE STUDY

The study was conducted from 10th January 2024 to 24th January 2024.

LOCATION AND AREA OF THE STUDY

The study was conducted at Ghaazee School, located in Hulhumale', Maldives, Latitude 4° 12' 48.4524" N and Longitude 73° 32' 29.1012" E with a total area of 8800 m². Biodiversity within the school grounds and premises were studied for the research. Vegetation cover is approximately 40% of the school yard.

Figure 1: School yard map



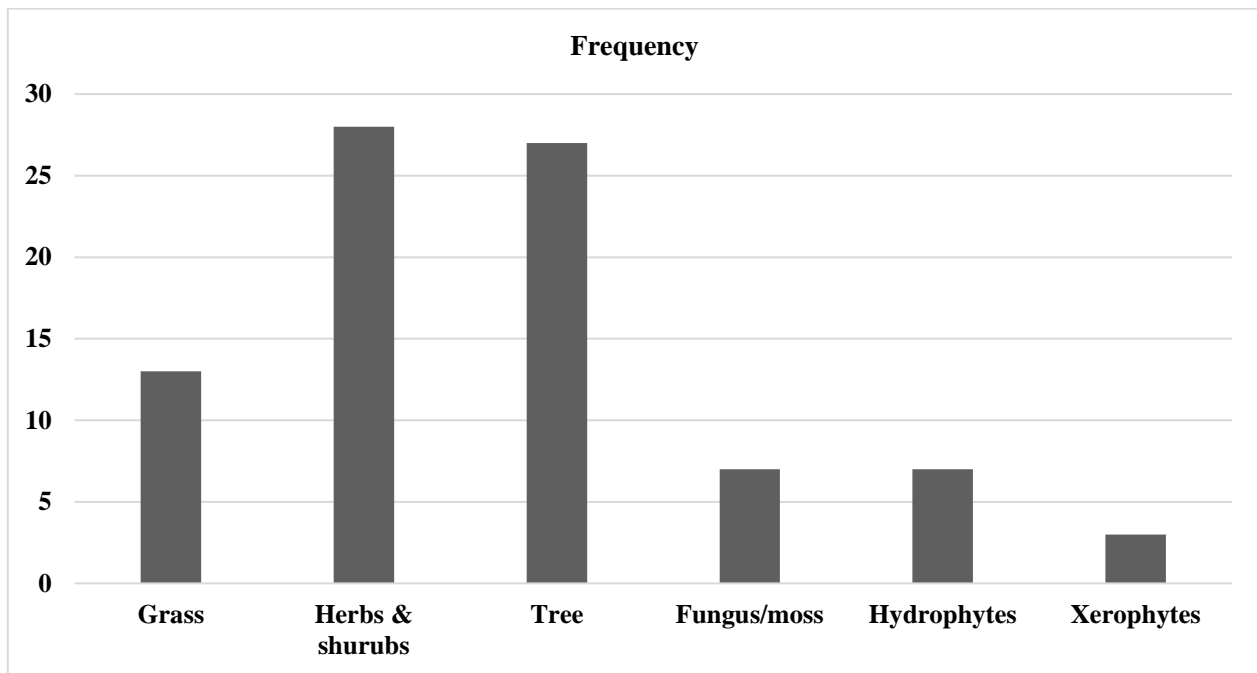
LIMITATIONS OF THE STUDY

The research has provided valuable insights into the biodiversity of the school yard and its immediate surrounding. However, the information may not be generalised to the broader surrounding and this could be a limitation of the study. Furthermore, school land use plan, habitat fragmentation, cleaning practices, movement of large number of students and staff within the area all may affect the species composition, habitat, and the ecosystem. Besides that, there may be some limitation during the data collection duration as weather and the time may affect the species presence and their visibility etc.

DATA ANALYSIS AND DISCUSSION

Vegetation

The analysis of vegetation within the study site has illustrated the presence of major types of vegetation within the school premises. Figure 1.0 illustrates the composition and frequency of vegetation cover. The result indicates herbs and shrubs and trees are the dominant species across the study area, followed by the different types of grasses. Total 6 separate types of vegetation are present in the study area, reflecting the ecological diversity and habitat divergency within the study area. Each vegetation type will provide unique ecosystem and supports specific plant and animal as well as other living organisms.

Figure 2: Frequency of vegetation

It is worth considering that the school grounds and premises have a lot of human influence and activities which will ultimately affect the distribution and abundance of vegetation. The specific land use plan, maintenance procedures, introduction of non-native vegetation and all other such anthropogenic activities may have affected both composition and frequency of the vegetation. Regular cleaning and maintenance can cause habitat destruction and environmental deterioration which cause elimination and alteration of natural conditions for plants to survive [6].

It may also affect ecosystem's natural functioning as well as its resilience to environmental and climate change.

The research has illustrated the school yard is rich with many of the native plants and trees that are widely available in the Maldives. A total of 27 different plants were identified along with 28 different types of herbs and shrubs were also identified in the school premises. For the identification process of plants, Soneva Fushi plant guide [7] and a book of Common plants of Maldives [8] were utilised as the main reference resource.

The table 1.0 gives the specific details of the different types of trees found at the school yard.

#	Scientific Name	Common Name	Local Name
1	<i>Cocos nucifera</i>	Coconut Palm	Dhivehi ruh
2	<i>Cordia</i>	Sea Trumpet	Kaani
3	<i>Casuarina equisetifolia</i>	Beefwood Tree	Fithuroanu
4	<i>Calophyllum inophyllum</i>	Alexandrian Laurel	Funa
5	<i>Muntingia calabura</i>	Japanese Cherry	Jeymu
6	<i>Scaevola taccada</i>	Sea Lettuce	Magoo
7	<i>Azadirachta indica</i>	Neem	Hithigas
8	<i>Moringa oleifera</i>	Moringa	Muranga gas
9	<i>Morinda citrifolia</i>	Indian Mulberry	Ahi
10	<i>Ziziphus mauritiana</i>	Indian Jujube	Kunnaaru
11	<i>Eugenia jambolana Lam.</i>	Black plum,	Dhanbu gas
12	<i>Agati coccinea</i>	Humming bird tree	Feerumuranga
13	<i>Lingoum indicum</i>	Amboyna wood	Ofi ealy gas
14	<i>Guajava pumila</i>	Guava	Feyru
15	<i>Plumeria caracasana</i>	Fiddle leaf plumeria	Bodu gulchampaa
16	<i>Jatropha manihot</i>	Cassava	Dhandi aluvi

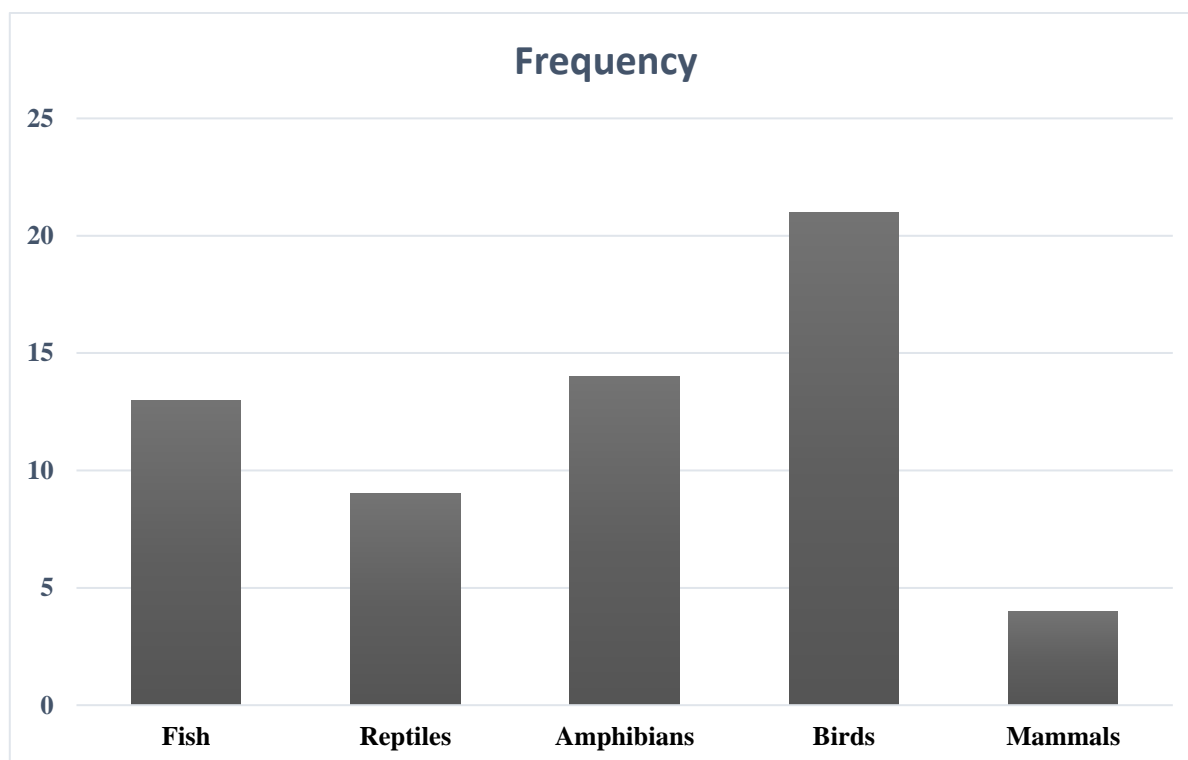
17	<i>Mangifera austroyunnanensis</i>	Mango tree	Anbu
18	<i>Ficus skytinodermis</i>	Indian rubber tree	Rabarugas
19	<i>Limonia aurantifolia</i>	Country lime	Lunboa
20	<i>Cassia rhombifolia</i>	Indian laburnum	Anmalthassh
21	<i>Papaya carica</i>	Papaya	Falhoa
22	<i>Phanera purpurea</i>	Butterfly tree	Javvahiru
23	<i>Averrhoa acutangula</i>	Star fruit tree	Kaamaranga
24	<i>Averrhoa abtusangulata</i>	Bilimbi	Bilamagu
25	<i>Annona hexapetala</i>	Climbing ylang-ylang	Champaapool
26	<i>Araucaria excelsa</i>	Christmas tree	Th urravaas gas
27	<i>Mimosa saman</i>	Rain tree	Reethigas

Table 1.0: Types of trees found at the school yard.

Vertebrates & Invertebrates

In this study it has shown that all the major types of vertebrate species are present within the school ground and premises. That includes fish, reptiles, amphibians, birds, and mammals. The frequency of vertebrate fauna illustrates that birds are among the highest followed by amphibians. Pigeons and crows are the two main types of birds that are commonly found at the school yard and besides that other different bird species are also seen at times. However, during the data collection process no other types of birds were sighted.

Figure 2: Frequency chart of vertebrate fauna

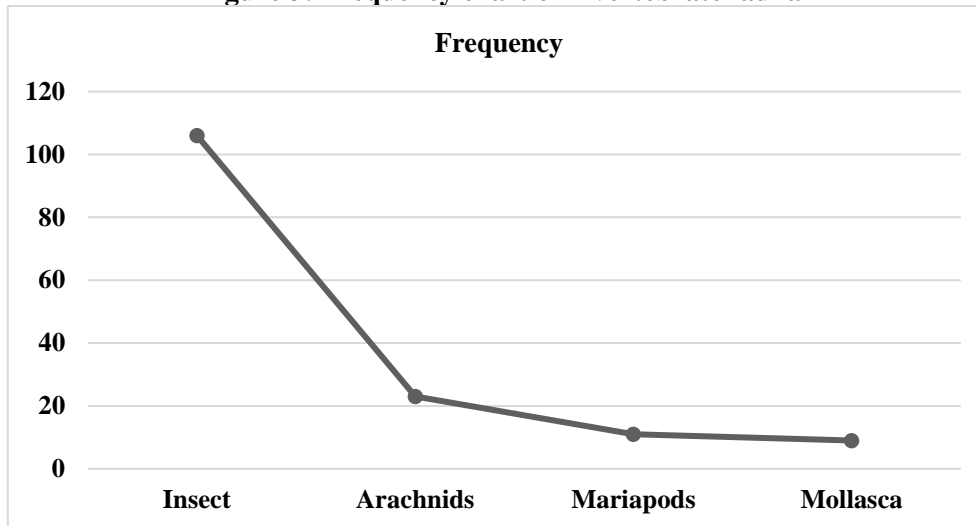


Pigeons a nuisance to Ghaazee School!

Presence of pigeons at Ghaazee School is a common scene and in fact it has widely regarded as a menace by the school community. For the last several years, it has been noticed that an unusual number of pigeons shelter, lodge, and lives at the school yard. Their ideal location within the school is the roof of the building and the pigeons has been using the roof and the ceiling area as their ideal breeding and nesting ground. This has created a whole lot of mess and expensive damages to the roof. The droppings and faeces all around the school has created a lot of difficulties in cleaning and providing a safer environment to students and staff in a daily basis.

The study has also demonstrated the presence of major types of invertebrates within the school ground and premises. This includes insects, arachnids, myriapods and Mollusca. However, during the data collection period, no species from the class Annelida was able to spot. Among the invertebrates, insects were found to be the highest frequency species.

Figure 3: Frequency chart of invertebrate fauna



The results have uncovered a diverse collection of both vertebrates and invertebrate species inhabiting the study area of Ghaazee School grounds and premises. Invertebrate species richness was particularly high, with over 15 different species recorded across the various taxa that includes insects, arachnids, myriapods and molluscs. Similarly, 12 different species of vertebrates are also recorded within the study area. The distribution of vertebrate and invertebrate species was greatly influenced by habitat and the environmental features, characteristics, and related parameters within the ecosystem.

Biodiversity Index

The Shannon Diversity Index, also known as Shannon-Wiener index and Shannon Equitability Index is an effective system of measurement for the evaluation of biodiversity across the three taxonomic groups that were particularly studied in this research. Hence statistical analysis was carried out using the given formula below to calculate the indices [9]. [9]

Shannon Diversity Index; $H = -\sum p_i * \ln(p_i)$

Shannon Equitability Index; $EH = H / \ln(S)$

The result has illustrated that the Shannon Diversity Index was highest for vegetation with a value of 1.53, followed by 1.43 for vertebrates and the lowest was for invertebrates with a value of 0.90. However, Shannon Equitability Index illustrated that the highest value is for the vertebrates followed by the vegetation and lowest for the invertebrates as given in Table 2.0.

Subgroup species	of	Shannon Diversity Index	Shannon Equitability Index
Vertebrate		1.43	0.89
Invertebrate		0.90	0.65
Vegetation		1.53	0.85

Table 2.0: Shannon Diversity Index and Shannon Equitability Index

The statistical analysis shows that vegetation has the highest biodiversity with the highest species richness as well as more evenly distributed species abundances among the three subgroups followed by the vertebrates. The lowest biodiversity index represents the invertebrates within the study area, suggesting skewed distribution of species abundances compared to the other two groups.

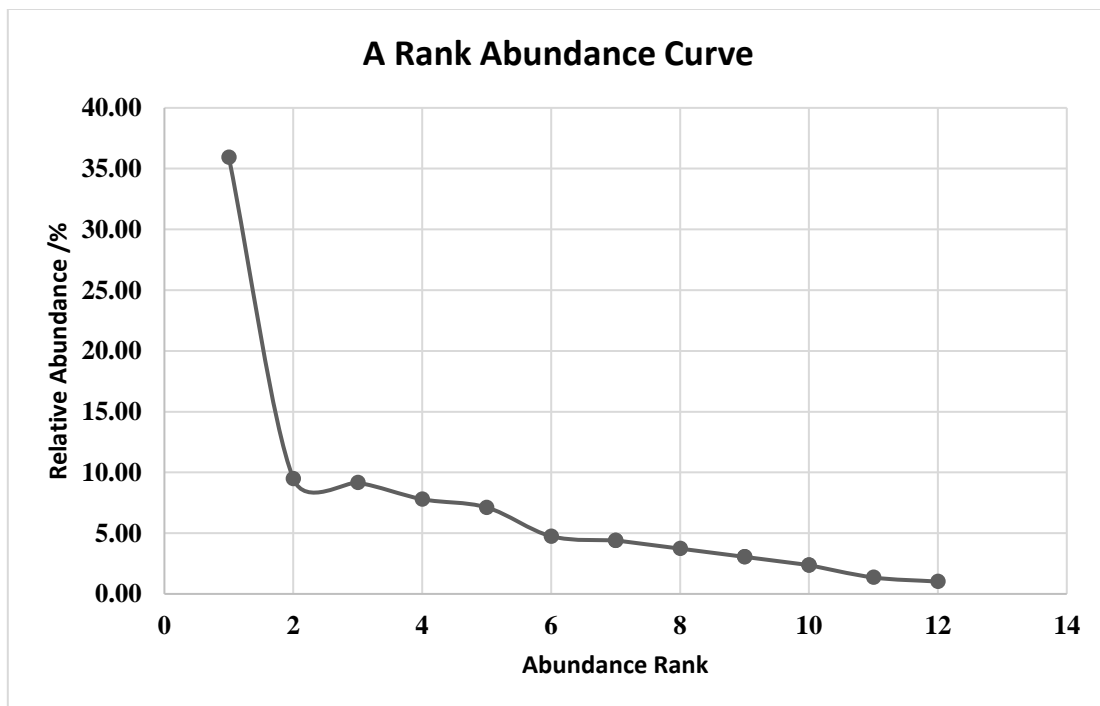
Furthermore, according to the Shannon Equitability Index data for the three subgroups of vertebrates, invertebrates, and vegetation; it has demonstrated that the vertebrates are in greater evenness in species abundance followed by the vegetation subgroup. The highest unevenness in species abundance within the study area was found to be the

invertebrate subgroup. This could be due to the dominance of one species particularly the insects and the other three taxa were rare, and scarce compared to the insects.

Rank Abundance Curve

A rank abundance curve is a graphical representation that are frequently used in ecology to picture out the relative abundance and distribution of species within an ecosystem. It plots the abundance of each species in a community against its rank order, with the most abundant species ranked first, followed by the next [10]. In this study a similar rank abundance curve was plotted based on the data obtained and figure 4 illustrates the species abundance curve of the study area. The curve shows that the slope is steeper at the beginning and then it decreases and remains more of a constant line. The shape of the graph therefore depicts that there is lower species evenness, and few species are dominant over the other species. This can be seen from the data as there is 37% relative abundance of insect taxa which is quite higher compared to all other species of different subgroups. Moreover, other than insects all other species are more of the same relative abundance giving a flatter curve after the insect species. [5]

Figure 4: Rank Abundance Curve



The data above has illustrated an overall species presence at Ghaazee School grounds and premises that gives a visual picture of the dominant species and the rank of all other species in the study area. This information will be vital for future studies of the same area since it can be useful to compare the changes in diversity over time.

Soil Analysis

The table 2.0 illustrates the results of soil analysis of the three different sites with different soil profiles. The result shows that the soil moisture percentage is highest at site 3 (24%) followed by site 2 (20.5%). Similar pattern can also be seen in organic matter content, with the highest percentage present in site 3 (2.09%) followed by site 2 (1.2%) and the lowest percentage is present in site 1 (0.56). the pH is found to be lowest in site 3 (7.8) followed by site 2 (8.1) and the highest pH is found in site 1 (8.5).

Parameters	Site 1 (sandy soil)	Site 2 (clay type soil)	Site 3 (silt)
Soil moisture %	13	20.5	24
Soil pH	8.5	8.1	7.8
Organic content %	0.56	1.2	2.09

Table 2.0: Soil Analysis

At Ghaazee school, you will be able to see different types of soil at different locations, hence in this study the major different types of soil were analysed by collecting samples from different sites for comparison. Site 3 has mainly silt. The soil has smooth texture with fine particles and the colour is more of black. Water content is high due to poor drainage within fine particles and can hold water for a longer period. The soil is also having the lowest pH among the

three sites depicting the presence of higher organic content which is at 2.09%. On the other hand, site 1 is having sandy soil with the lowest in water and organic matter content. Since sandy soil has better drainage of water as its coarse particle causes lower water holding capacity and causes poor nutrient retention capacity [11] The result of soil analysis also illustrates that all the soil samples analysed from the study area is alkaline having a pH greater than 7. This could be due to several factors. One major reason is due to the geological composition. Hulhumale' island itself is an island created by sand reclamation. The Maldives is an island archipelago made up of coral islands hence the calcium carbonate content is very high in the soil [12] Hence, the school compound consists of some of the plants commonly found in beach area which are considered as high salt tolerant plants. For instance, Sea Lettuce which is a common beach shrub that grows close to sea exposed to the salt spray [13]. In addition to that, low organic matter content also leads to higher pH. Furthermore, anthropogenic activities also contribute to this as daily land clearing practices prevents litter and leaves natural decomposition process which in turn can reduce organic matter content present in the soil. [5] [1]

RECOMMENDATION

- Establish native plant gardens including different types of vegetables, fruits or flowering plant gardens that can in turn provide habitat for native wildlife such as butterflies and other pollinators.
- Adopt sustainable soil management practices such as preparing own compost using organic waste collected from the school yard which can then be used to grow plants and to keep the soil fertile so that organisms can thrive and promote biodiversity.
- Engage students more in biodiversity initiatives such as monitoring, maintaining plant gardens, and further research projects to enhance their scientific understanding as well as to aware the importance of conservation of biodiversity.
- The school needs professional as well as financial assistance from concerned authorities to keep the pigeon's population away from the school roof and ceiling area thereby keeping the school yard and premises free of mess and damage. For that a special pigeon shelter can be put up to handle them efficiently. This can be a great initiative to showcase the pigeons to students and create learning opportunities, especially for lessons which requires to study about bird species.

CONCLUSION

The baseline study of the existing biodiversity at Ghaazee School grounds and premises has illustrated that the school grounds and premises serve more than just an educational facility rather it is a home for major taxa of vegetation, vertebrates, and invertebrate subgroups. According to the result, there are total 6 different types of vegetation growing inside school yard. In addition, a total of 27 different plants were identified which includes many native plants that can be found across the Maldives. The frequency of fauna concluded that birds are most commonly found among the vertebrates followed by amphibians, fish, reptiles and mammals. Invertebrates includes insects, arachnids, myriapods and Mollusca. The research has provided valuable information on the flora and fauna and the species richness as well as the other ecological parameters of the ecosystem that support several different species. The rich ecosystem will provide valuable learning opportunities to our students and would help to develop deeper appreciation in environmental conservation and the love for nature.

ACKNOWLEDGMENT

The authors would like to thank Ghaazee School management for the encouragement and support given to the research study. We also would like to express our sincere gratitude to the STEM and Coding club member students, teachers, and leading teachers for their valuable contribution in the data collection process for the research study.

REFERENCES:

1. Wilson, J. W., & Primack, R. B. (2019). What is Biodiversity? In *Conservation Biology in Sub-Saharan Africa* (pp. 61-90). Cambridge: Open Book Publishers.
2. (2006). *Country Report*. Male'Maldives: Ministry of Fisheries, Agriculture and Marine Resources.
3. Buckland, S. T., Borchers, D. L., Johnston, A., Henrys, P. A., & Marques, T. A. (2007). Line Transect Methods for Plant Surveys. *The International Biometric Society*, 63(4), 989-998.
4. Boullhesen, M., Vaira, M., Barquez, R. M., & Akmentins, M. S. (2021). Evaluating the efficacy of visual encounter and automated acoustic survey methods in anuran assemblages of the Yungas Andean forests of Argentina. *Ecological Indicators*, 127, 1-11.
5. Yip, D. A., Bayne, E. M., S'olymos, P., Campbell, J., & Proppe, D. (2017). Sound attenuation in forest and roadside environments: Implications for avian point-count surveys. *American Ornithological Society*, 119, 73-84.

6. National Geographic. (2019, September 25). *The Global Impacts of Habitat Destruction*. Retrieved from news.nationalgeographic.org
7. *Biodiversity survey*. (2017, may). Retrieved from soneva.com
8. Sujanapal, P. . (2016). *Common plants of Maldives*. Retrieved from www.apfism.net
9. Bobbitt, Z. (2021). *Shannon Diversity Index: Definition & Example*. Retrieved from Statology: <https://www.statology.org/shannon-diversity-index/>
10. Meghan L. Avolio, I. T. (2019). *A comprehensive approach to analyzing community dynamics using rank abundance curves*. Retrieved from <https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/ecs2.2881>
11. Mario Feifel, W. D. (2023). *Effects of improved water retention by increased soil organic matter on the water balance of arable soils: A numerical analysis*. Retrieved from <https://access.onlinelibrary.wiley.com/doi/full/10.1002/vzj2.20302>
12. AutoPot In The Maldives . (2022). *AutoPot In The Maldives – With Prime Maldives*. Retrieved from <https://primemaldives.com/news/detail/25>
13. AutoPot In The Maldives . (2022). *AutoPot In The Maldives – With Prime Maldives*. Retrieved from <https://primemaldives.com/news/detail/25>
14. G., S. N., Kulkarni, A., & B., A. K. (2017). Literature Review of Scavola Taccada. *World Journal of Pharmaceutical Research*, 6(11), 251-258.