Research Article

International Journal of Bioassays
ISSN: 2278-778X
www.ijbio.com

ESTIMATION OF FLORAL DIVERSITY AND POTENTIAL EFFECTS OF INTRODUCED SPECIES AT THE NATURE PRESERVE, UNIVERSITY OF EASTERN AFRICA, BARATON- KENYA

Ramesh F* and Kirui J
Department of Biological Sciences, University of Eastern Africa, Baraton, P.O. Box 2500, Eldoret-30100, Kenya

Received for publication: December 13, 2013; **Revised**: January 08, 2014; **Accepted**: January 17, 2014

Abstract: Biological diversity (Biodiversity) is the variety of life on earth. Measurement of biodiversity is one of the greatest scientific challenges of our time. It is also one of the most urgent because, we must address the problem soon or we will lose the chance forever since many species are becoming extinct without trace. Introduced species is among the factors that cause native species to go extinct. Biodiversity is normally considered at the species level, and that the species diversity of an area is a measure of both the number of species present and their relative abundance. In this study trees and shrubs were only considered. The objectives of the study was to determine the number of species of trees and shrubs and to compare the relative abundance of introduced species with the total floral biodiversity at the University of Eastern Africa, Baraton (UEAB) nature preserve. The purpose was to develop an inventory of trees and shrubs and to create a case for the potential effect of introduced species to native species and eventual loss of biodiversity. The study was conducted over a period of five weeks with sampling done twice every week. Data was collected by the Belt transect method and analyzed by descriptive statistics. The results indicated that nature preserve is rich in species diversity and native species diversity is lower compared to the relative abundance of introduced species.

Keywords: Biodiversity, Introduced species, species richness, relative abundance.

INTRODUCTION

Biodiversity is defined as variety and variability among the living organisms and the ecological complexes in which they occur. Measurement of biodiversity is one of the greatest scientific challenges of our time. The diversity of species, or species richness is the simplest aspect of biodiversity to understand and quantify but even this is fact far from easy to measure, because biologists have long debated what a 'species' actually is (Cilve Hambler, 2004).

A diversity of species may approximate to a diversity of genes, and genes are the most fundamental unit of both biodiversity and evolution (Bertie, 2002). Genes are even harder to count than species but measure of biodiversity must be known in order to protect genetic and species diversity for posterity. Species diversity, which consists both species richness and evenness, increases as the numbers of individuals in the total population are more equitably distributed among the species (Robert, 1996). Among the array of species that comprise a community, few are abundant.

During the 1970's estimates of the number of species were of the order of a few million (Clive Hambler, 2004). But it is estimated that naturally roughly 1.75 million species have been formally described but many more exist estimated at 10 million species (IUCN, 2000). We are unsure of the number of species on the earth because some areas remain little explored e.g. hydrothermal vents, rainforest canopies, tropical soils, etc. Many species are tiny and inconspicuous (microbes) to count and some species are very similar in appearance and it is hard to separate as distinct species.

A larger percentage of species that ever lived have gone extinct due to human activity and stochastic factors. It is estimated that 95-99% of species that ever existed are extinct (Clive Hambler, 2004). The background rate of extinction is 1 extinction per year, i.e. 1 extinction of species in 50 – 100 years. A combination of other human induced factors have caused species decline i.e. Habitat degradation and fragmentation, introduced species, pollution, population growth and over exploitation. Introduced species accounts for 50% of species loss while habitat destruction and fragmentation accounts for 85% of the decline (Smith & smith, 2001).

The great increase in the introduction of alien species is those that people are importing primarily for aesthetic reasons. Ornamentals to make their gardens more attractive often lead to a net increase in species richness in their destination. It is quite likely, for example, that many parts of the world have far more species now than ever before, though this great

***Corresponding Author:**
Dr. Ramesh Francis,
Chairperson,
Department of Biological Sciences,
University of Eastern Africa, Baraton
P.O. Box – 2500, Eldoret – 30100, Kenya.

increase of species numbers is usually at least partly at the expense of indigenous species (and thus reduces global species diversity) (Jeff, 2001).

An invasive (introduced) species is an exotic species that is spreading very fast (Bertie, 2002). Invasive species is one of the major causes of much extinction (either local, regional or global) of animals and plants. Introduction of these invasive species spread and breed beyond control causing a lot of harm as they compete with the natives depriving them the elements necessary for their growth and development (Clive Hambler, 2004).

Species are introduced into new habitats by people for three general reasons: (i) accidental introductions (often invertebrates and pathogens); (ii) species imported for a limited purpose which then escape; and (iii) deliberate introductions (usually plants and vertebrates) (Levin, 1989). Many of the deliberate introductions relate to the human interest in nurturing species that are helpful to people. This is particularly true of agricultural, forestry, and ornamental species. Indeed, in most parts of the world, the great bulk of human dietary needs are met by species that have been introduced from elsewhere (Hoyt, 1992); it is difficult to imagine an Africa without cattle, goats, maize, and cassavaó all introduced species. Species introductions in this sense, therefore, are an essential part of human welfare in virtually all parts of the world. Further, maintaining the health of these introduced species of undoubted net benefit to humans may require the introduction of additional species for use in biological control programmes which import natural enemies of, for example, agricultural pests (Waage, 1991; Thomas and Willis, 1998). Some of these invasive species have caused considerable disasters in East African dry forests and rangelands. The United Nation Environmental Programme (UNEP) estimates that alien invasive species cost the global economy an annual US $1.4 trillion. In Africa limited studies have been done to quantify the cost of invasive plants species. However, studies in South Africa alone show the country spends over $60 million annually to eradicate invasive plants (Obiri, 2011).

The introduced species have high reproductive rates, are generalists with broad habitat requirements and are good dispersers that enter into new areas. These characteristics make them outcompete the native species. According to Ganzhorn *et al*., (2007) studies carried out in Madagascar showed that the survival and growth rate of native tree species were reduced significantly when they were planted in combination with exotic tree species. The most vulnerable (to invasive species) are early successional areas or disturbed areas with empty niches tend to have resources that are unexploited with little or no competition (Smith & Smith, 2001).

UEAB nature preserve was subjected to different intensities of disturbances in the last decade that created a mosaic of conditions from destruction of natural habitat, brick making to complete clearing of vegetation for dam construction. The objective of this study was to estimate floral species diversity at UEAB nature preserve and to compare it with the relative abundance of introduced species. The purpose was to create a case for the potential effect of introduced species in natural habitats.

MATERIALS AND METHODS

UEAB nature preserve with an area of approximate area of 5 ha located in Rift valley, Nandi County and is largely composed of ever green vegetation that receives approximately 1800 mm of rain annually. Almost 60% of the reserve is characterized by tall trees and shrubs and the remainder is comprised of a wetland and shrub thickets. Our study focused on species diversity of trees and shrubs. We compared the relative abundance of the native species with the introduced species.

The line intercept or line transect is one-dimensional and the method consists of taking observations on a line or lines laid out randomly or systematically over the study area (Smith & Smith, 2001). The total area of the site to be sampled was determined. A sisal thread was stretched between stakes 20 m apart. The line was subdivided into 2m intervals. We moved along the line and for each interval the plant species found and the distance they cover along the portion of the line intercept were recorded. Only those plants that touched the line or lay under it or over it were considered. Each stratum of vegetation (Shrubs and trees) was treated separately. Five such lines were repeated on the study area.

RESULTS

Table 1: Mean distribution of Species

Statistics		Type of species	Number of species
N	Valid	41	41
	Missing	0	0
Mean		21.0000	83.3902
Median		21.0000	72.0000

Table 2: Relative abundance of types of species at the nature preserve, University of Eastern Africa, Baraton
Frequency Table

	Type of species	No. of species	Relative abundance	Valid Percent (%)	Cumulative Percent (%)
Valid	*Prunus africana*	71	2.02	2.4	2.4
	Grevillia robusta	43	1.23	2.4	4.9
	Calistemon spendens	68	1.94	2.4	7.3
	Syzygium cortadum	79	2.25	2.4	9.8
	Croton megalocarpus	159	4.53	2.4	12.2
	Polyscias fulva	32	2.62	2.4	14.6
	Casuarina equisetifola	47	1.34	2.4	17.1
	Bersaina abyssinica	59	1.68	2.4	19.5
	Cyperus lusitanica	34	0.90	2.4	22.0
	Sapium elliptiuum	201	5.73	2.4	24.4
	Solonum mauritanum	72	2.05	2.4	26.8
	Olea africana	67	1.91	2.4	29.3
	Fraxinus perisylvanica	66	1.88	2.4	31.7
	Markhamia lutea	71	2.02	2.4	34.1
	Brillantaisia riten	74	2.11	2.4	36.6
	Albisia gummifera	100	2.85	2.4	39.0
	Vangueria infuusta	73	2.08	2.4	41.5
	Trimeria grandifolia	142	4.05	2.4	43.9
	Neboutonia macrolix	109	3.11	2.4	46.3
	Ekebergia capensis	76	2.17	2.4	48.8
	Spathodea campanula	89	2.54	2.4	51.2
	Flacourtia caffra	74	2.11	2.4	53.7
	Eucalyptus saligua	248	7.07	2.4	56.1
	Erithrococca bongensis	47	1.34	2.4	58.5
	Macaranga capensis	64	1.82	2.4	61.0
	Ricinus communis	81	2.31	2.4	63.4
	Sennadidi mobotrye	58	1.65	2.4	65.9
	Caesalpinia dicapitala	49	1.40	2.4	68.3
	Vernonia auralifera	74	2.11	2.4	70.7
	Solanum aculeastrum	56	1.60	2.4	73.2
	Toddalia asiatica	69	1.97	2.4	75.6
	Rhus vulgari	47	1.34	2.4	78.0
	Vernoni abiafrae	77	2.19	2.4	80.5
	Brilantia nitens	189	5.37	2.4	82.9
	Solanecio manii	91	2.59	2.4	85.4
	Sesbania sesban	72	2.05	2.4	87.8
	Dombeya torrida	84	2.39	2.4	90.2
	Lantana camara	96	2.74	2.4	92.7
	Psidium guajava	71	2.02	2.4	95.1
	Abutilon mauntanum	101	2.88	2.4	97.6
	Daturas uaveolens	69	1.97	2.4	100.0
	Total	3509	100	100.0	

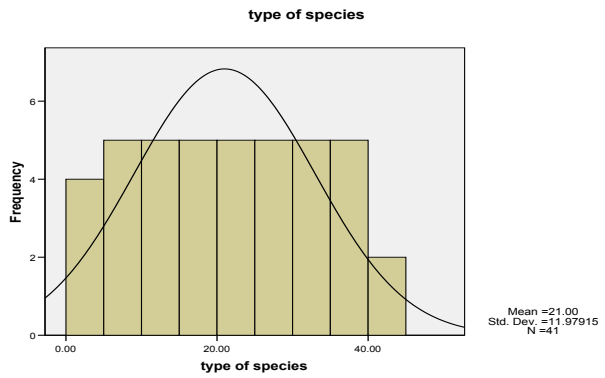

Fig.1: Graphical distribution of types of species at the nature preserve, University of Eastern Africa, Baraton

From the graph above the type of species are normally distributed around the mean

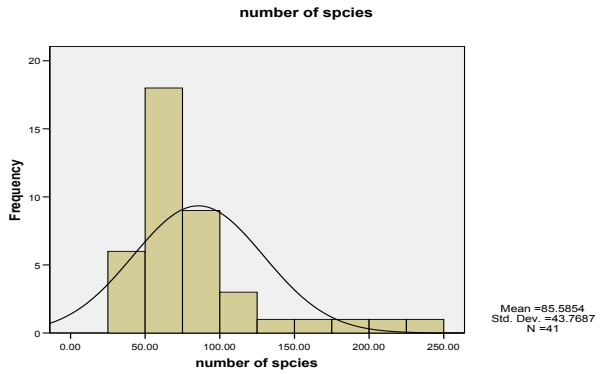

Fig.2: Graphical distribution of number of species at the nature preserve, University of Eastern Africa, Baraton

The above graph show that most of the species have species number is ranging between 50 – 100 and just a few of them have numbers beyond 100. The means species number for the 41 types of species is 85.58 i.e. 85 species

DISCUSSION

According to the United Nations Environmental Program (UNEP), biodiversity is the variety of all forms of life, including genes, species, populations and ecosystems (Kasten Liu *et al.* 2013). Biodiversity contains every living thing, including humans. It works in an interdependent system, a web of sorts. Every being depends on each other to survive. If one being disappears, the web is weakened, but because there is balance, it remains in place (Williams Scott *et al*., 2010).

Biological diversity is a characteristic of each and every biological community. Habitat destruction and introduced species are the current greatest threat to biological diversity. Already, tropical forests are more than half gone and almost none of the great grasslands (Prairies) of Northern America remain (Riordan, 2002). Biological invasions generate changes in composition and competition of species and have the potential to completely eradicate the native species of a particular area (Banerjee *et al.*, 2008). Species introduced from outside their natural range can be an economic boon, because they often seem to do better in their new home than in their place of origin (Jeff, 2001).

The number of species invasions has been on the rise at least since the beginning of the 1900s. Species are increasingly being moved by humans (on purpose and accidentally). In some cases the invaders are causing drastic changes and damage to their new habitats (e.g.: zebra mussels and the emerald ash borer in the Great Lakes region and the lion fish along the North American Atlantic coast). Some evidence suggests that invasive species are competitive in their new habitats because they are subject to less pathogen disturbance (Torchin *et al*., 2003). As per the results we obtained, the introduced species is relatively abundant compared to other plant species relative to the study area size. This has implications on species diversity at the nature preserve. It is not surprising that invasive plants cause larger declines in diversity at smaller spatial scales, as plant competition is a local, ecological process (Powell *et al*., 2011).

The analysis result shows that 7.07% of trees and shrubs are represented by introduced species (*Eucalyptus saliva*). The next most abundant species is a native species representing 5.73% of floral biodiversity. The UEAB natures preserve is rich in trees and shrub biodiversity with a total species richness of 3509 species relative to an area of about 5 ha.

Comparison of a numerical abundance of one species with the total abundance of all species for obtain the relative abundance of each species. The mean species number is 85.

Among the many species that make up a community, few are abundant. Consider these results at the UEAB nature preserve of the 41 species over six make up nearly 26% of the stand. The next most abundant trees and shrubs were *Spathodea campanula, Solanecia semanii, Sesbania sesban, Dombeya torrida and Lantana camara*. Each makesup from under 3% to just over 2.4%.

CONCLUSION

Humans have spread across the globe and have, either deliberately or accidentally, carried with them a wide range of species. Introducing new species often leaves endemic and other local species unable to compete with the exotic species and unable to survive. The introduction of exotic species into some areas has had a devastating impact on the native biodiversity (IUCN, 2001). The exotic organisms may be predators,

parasites, or may simply outcompete indigenous species for nutrients, water and light. UEAB nature preserve is not an exception. The dominance of introduced species will eventually drive out the native species to extinction. Native species are most vulnerable to the impact of introduced species.

RECOMMENDATIONS

1. Further research to be done to re-examine the regional and local patterns of species extinction due to introduced species.
2. Advice institutions to protect and restore natural habitats as possible in order to preserve biodiversity.

REFERENCES

1. Banerjee T, Srivastava RK and Melkania U (2008). Floral distribution pattern in surroundings of SIDCUL IIE-Pantnagar. (In J. Singh (Eds.), Biodiversity, Environment & Sustainability (pp: 181-189). New Delhi: MD Publications Pvt. Ltd.)

2. Bertie J Weddell (2002). Conserving Living Natural Resources in the context of a changing world. Cambridge University Press. Cambridge.

3. Clive Hambler (2004). Conservation. Cambridge University Press. Cambridge

4. GanzhornJorgu, Steven M. Goodman and ManonVincelette (2007). Biodiversity, Ecology and Conservation of Littoral Ecosystems in southern Madagascar, Tolagnaro. Smithsonian Institution, Washington DC USA.

5. Hoyt E. (1992). Conserving the Wild Relatives of Crops IBPGR, IUCN and WWF. Second Edition

6. IUCN (2001). International Union for the conservation of nature red list categories, version 3.1. Gland, Switzerland: IUCN.

7. Jeff Mc Neely (2001) Invasive species: a costly catastrophe for native biodiversity Land Use and Water Resources Research 1, 2, 1–1

8. Kasten, Liu et al., "Integrated Solutions for Biodiversity, Climate Change and Poverty." *United Nations Environmental Program (UNEP).* Jan. 2010. 6 Feb. 2013. http://www.unep.org/policyseries/Sustainable_integrated_Solutions.pdf

9. Levin, S.A. (1989). Analysis of risk for invasions and control programmes, 425ñ432. In: J.A. Drake, H.A. Mooney, F. di Castri, R.H. Groves, F.J. Kruger, M. Rejm·nek and M. Williamson (eds.). Biological Invasions: A Global Perspective. Scope 37. John Wiley and Sons

10. Riordan, O. and Stoll – Kleemann (2002). Biodiversity, sustainability and Human Communities. Cambridge University Press. Cambridge.

11. Robert Leo Smith (1996). Ecology and Field Biology. HarperCollinsCollege publishers. Virginia.

12. Smith and Smith (2001). Ecology & Field Biology. Benjamin Cummings. New York.

13. Thomas MB and AJ Willis. 1998. Biocontrol: Risky but necessary? TREE 13(8): 325-329

14. Obiri F, John (2011). *Invasive plant species and their disaster-effects in dry tropical forests and rangelands of Kenya and Tanzania.* JAMBA: Journal of Disaster Risk Studies, Vol. 3, No.2, May 2011

15. Torchin, Mark E., Lafferty, Kevin D., Dobson, Andrew P., McKenzie, Valerie J., Kuris, Armand M. (2003). Introduced species and their missing parasites. *Nature*421 (6923): 628–630. Bibcode:2003Natur.421..628T. doi:10.1038/nature01346

16. Waage JK (1991). Biodiversity as a resource for biological control, 149ñ163. In: Hawksworth, D.L. (ed.). The Biodiversity of Microorganisms and Invertebrates: Its Role in Sustainable Agriculture. CAB International, Oxford, UK

17. Williams, Scott, et al. "Biodiversity Loss." *Biodiversity and Economics* Apr. 2010. 6 Feb. 2013.
18. http://www.mtholyoke.edu/~willi29m/classweb/econ/biodiversity.htm

19. KI Powell, JM Chase, TM Knight (2011). A synthesis of plant invasion effects on biodiversity across spatial scales**.** *American Journal of Botany*, 98 (3): 539 DOI: 10.3732/ajb.1000402

Source of support: University of Eastern Africa, Baraton
Conflict of interest: None Declared