ISSN- 2350-0530(O), ISSN- 2394-3629(P)
DOI: 10.5281/zenodo.2631388

INTERNATIONAL JOURNAL OF RESEARCH – GRANTHAALAYAH
A knowledge Repository

Science

DIVERSITY OF SHRUBS AND TREES IN THE ISLAND TOWNS OF NORTHERN SAMAR, PHILIPPINES

Divina Minguez-Galenzoga [*1]
[*1] College of Science, University of Eastern Philippines, Catarman, Northern Samar 6400 Philippines

Abstract

This study aimed to identify the shrubs and trees in the five island towns of Northern Samar, Philippines; determine their abundance, community structure; and economic uses to the locals. Four barangays in every island town represented the north, south, east, and west sides. Line Intercept Transect (LIT) at intervals of 100m and plot method with an area of 10m x 10m were used in gathering the data. Transect walks, field plots, and transects were also used in gathering data. There were 207 species of shrubs and trees belonging to 152 genera and 64 families. Shrubs constituted 55.33% and trees 44.67% of the total number of species. Mangifera indica (Anacardiaceae) ranked first in relative density (25.50%), relative frequency (25.30%), and importance value (59.15%). Plots in the island of Laoang were observed to have the highest Shannon Diversity Index (3.25%) and Simpson's Dominance Index (1.86%). The most abundant shrub and tree species in the island towns were Citrus microcarpa (Cucurbitaceae) and Mangifera indica (Anacardiaceae) respectively. The least abundant shrub and tree species were Gardenia jasminoides (Rubiaceae) and Cananga odorata (Annonaceae) respectively. There were more species of shrubs and trees in the island town of Laoang than in the other four island towns.

Keywords: Community Structure; Diversity; Island Towns; Shrubs; Trees.

Cite This Article: Divina Minguez-Galenzoga. (2019). "DIVERSITY OF SHRUBS AND TREES IN THE ISLAND TOWNS OF NORTHERN SAMAR, PHILIPPINES." *International Journal of Research - Granthaalayah*, 7(3), 208-216. https://doi.org/10.5281/zenodo.2631388.

1. Introduction

Shrubs are woody perennial plants that possess multiple stems arising from a common point known as the crown. Trees are woody perennial plants, such as shrubs, by the presence of usually but not always, a single woody stem known as the trunk. Both shrubs and trees inhabit virtually all climates and soil types, with a large variation in form, adaptability and stress tolerance from species to species [1].

The Philippines is one of the megadiversity countries of the world. It has also a large population, which exerts tremendous pressure to transform these biodiversity resources into material wealth

ISSN- 2350-0530(O), ISSN- 2394-3629(P)
DOI: 10.5281/zenodo.2631388

that will lift the people out of poverty [2], [3]. Awareness of the people about the rich biodiversity and the role of education should be emphasized. Attempts to identify methods of maintaining and using biodiversity in ways that can benefit the human population is the major role of conservation biology [4]. Systematics plays a vital role in conservation biology in determining the limits of species; only if these taxonomic entities are clearly defined can they be evaluated for rarity and the threat of extinction. In addition, floristic studies and phylogenetic analyses may have an impact on which species or biogeographic regions are most worthy of protection, given limited resources [5]. Naturalists, scientists, researchers, and conservationists predict that at 1% extinction rate, these resources will be gone by 2050 [6]. Organisms in small restricted areas, such as **islands**, are more prone to extinction because an environmental change in their locale can eliminate the entire species at once [7].

Living organisms provide us with many useful drugs. The United Nations Development Programme (UNDP) estimates the value of pharmaceutical products derived from developing world. Plants, animals, and microbes are estimated to be more than 30 billion dollars per year [8]. Because we don't fully understand the complex interrelationships between organisms, we often are surprised and dismayed at the effects of removing seemingly insignificant members of biological communities. Maintaining biodiversity is essential to preserving these biological and ecological services [9].

Thus, this study of shrubs and trees may open for more conservation and preservation practices for these woody plants for now and the future generations of island folks in the country.

2. Objectives

The objectives of this study are:

1) To identify the shrubs and trees in the island towns of Northern Samar, Philippines;
2) To determine their community structure; and
3) To determine the most abundant shrubs and trees in the island towns.

3. Methodology

The province of Northern Samar consists of 24 municipalities, i.e. 15 coastal towns, 5 island towns, and 4 interior towns. Catarman is the capital town of the province of Northern Samar.

Sampling areas included the five island towns of the province; i.e. Laoang, Biri, Capul, San Antonio, and San Vicente. The study was conducted during the summer months of April and May 2012-2014. Four barangays in every island town represented the north, south, east, and west sides. Line Intercept Transect (LIT) at intervals of 100m and Plot Method with an area of 10m x 10m were used in gathering the data. The preliminary identification was done on-site in the study area through personal communication with the foresters and local residents (local names). Further identification and verification were done at the College of Science Laboratory. Simpson's Dominance and Shannon-Wiener indices were used to verify the diversity status of shrubs and trees.

ISSN- 2350-0530(O), ISSN- 2394-3629(P)
DOI: 10.5281/zenodo.2631388

4. Results and Discussion

4.1. Shrubs and Trees in the Island Towns of Northern Samar

There were 207 species of shrubs and trees belonging to 152 genera and 64 families. Trees constituted 55.33% of the total number of species; while the shrubs 44.67%.

Table 1: Shrubs and Trees in the Island Towns of Northern Samar, Philippines

1. Family Acanthaceae	**11. Family Bixaceae**	**25. Family Euphorbiaceae**
Barleria cristata	Bixa orellana	Macaranga tanarius
P. atropurpureum	**12. Family Bromeliaceae**	Melanolepis multiglandulosa
2. Family Agavaceae	Ananas comosus	Reutealis trisperma
Pleomele reflexa variegata	**13. Family Burseraceae**	Jatropha multifida
3. Family Anacardiaceae	Canarium ovatum	Euphorbia milii
Mangifera indica	**14. Family Caesalpiniaceae**	Jatropha curcas
Anacardium occidentale	Caesalpinia pulcherrima	Excoecaria agallocha
Buchanania arborescens	Leucaena leucocephala	**26. Family Gnetaceae**
Spondias pinnata	Erythrina orientalis	Gnetum gnemon
Spondias purpurea	Gliricidia sepium	**27. Family Goodeniaceae**
4. Family Annonaceae	Pterocarpus indicus	Scaevola taccada
Annona muricata	Acacia mangium	**28. Family Labiateae**
Annona squamosa	Albizia lebbeck	Gmelina arborea
Annona reticulata	Leucaena leucocephala	Premna odorata
Cananga odorata	Erythrina orientalis	Vitex parviflora
Polyalthia longifolia	Acacia auriculiformis	**29. Family Lauraceae**
5. Family Apocynaceae	**15. Family Casuarinaceae**	Persea americana
Nerium indicum	Casuarina equisetifolia	**30. Family Leguminosae**
Thevetia peruviana	**16. Family Caricaceae**	Tamarindus indica
Alstonia scholaris	Carica papaya	Osbornia octodonta
Plumeria rubra	**17. Family Clusiaceae**	Sesbania grandiflora
Ervatamia divaricate	Calophyllum inophyllum	Peltophorum pterocarpum
Adenium obesum	**18. Family Combretaceae**	Cassia bakeriana
Cerbera odollam	Lumnitzera littorea	Cassia fistula
Cerbera manghas	Terminalia catappa	Delonix regia
6. Family Araliaceae	Lumnitzera littorea	Saraca thaipingensis
Polyscias balfouriana	Lumnitzera racemosa	Cassia siamea
Polyscias guilfoylei	Terminalia catappa	Cassia alata
Trevesia palmata	**19. Family Cucurbitaceae**	Cassia auriculata
7. Family Araucariaceae	Citrullus lanatus	Adenanthera pavonina
Araucaria heterophylla	Citrullus vulgaris	**31. Family Liliaceae**
Pongamia pinnata	Citrus maxima	Asparagus setaceus
Aganope heptaphylla	Citrus microcarpa	Asparagus asparagoides
Derris trifoliate	Citrus medica	Asparagus densiflorus
8. Family Arecaceae	Citrus reticulate	Asparagus falcatus
Caryota mitis	Citrus japonica	Asparagus plomusos
Cyrtostachys renda	**20. Family Cycadaceae**	**32. Family Loganiaceae**
Cocos nucifera	Cycas rumphii	Fagraea fragrans
Areca catecu	**21. Family Dilleniaceae**	**33. Family Lythraceae**
9. Family Avicenniaceae	Dillenia suffruticosa	Lagerstroemia speciosa
Avicennia lanata	Dillenia philippinensis	Pemphis acidula
Avicennia officinalis	**22. Family Dipterocarpaceae**	**34. Family Magnoliaceae**
	Shorea macroptera	

ISSN- 2350-0530(O), ISSN- 2394-3629(P)
DOI: 10.5281/zenodo.2631388

Avicennia alba	**23. Family Ebenaceae**	Michelia champaca
Avicennia marina	Diospyrus philippenensis	**35. Family Malvaceae**
10. Family Bignoniaceae	**24. Family Ericaceae**	Hibiscus tiliaceus
Tecoma stans	Rhododendron obtusum	Hibiscus mutabilis
Cresentia cujete	Rhododendron simsii	Hibiscus rosa-sinensis
Jacaranda acutifolia		Ceiba pentandra
Dolichandrone spathacea		Pachira aquatic
		Kleinhovia hospital
		Theobroma cacao

36. Family Melastomataceae	**43. Family Myrsinaceae**	**54. Family Rosaceae**
Melastoma malabathricum	Aegiceras floridum	Rosa centifolia
Lantana camara	**44. Family Oleacea**	Rosa chinensis
37. Family Meliaceae	Osmanthus heterophyllus	**55. Family Rubiaceae**
Lansium aqueum	**45. Family Onagraceae**	Morinda citrifolia
Lansium domesticum	Fuchsia spp.	Gardenia jasminoides
Azadirachta indica	**46. Family Oxalidaceae**	Ixora javanica
Melia azedarach	Averrhoa bilimbi	Ixora coccinea
Sandoricum koetjape	Averrhoa carambola	Mussaenda glabrata
Swietenia macrophylla	**47. Family Palmae**	Coffea arabica
Swietenia mahogany	Rhapis excelsis	Scyphiphora hydrophyllacum
Artocarpus altilis	Phoenix canariensis	**56. Family Rutaceae**
Artocarpus blancoi	Microcoelom weddellianum	Citrus grandis
Artocarpus odoratissimus	Livistona chinensis	Citrus microcarpa
Artocarpus heterophyllus	Livistona australis	**57. Family Sapindaceae**
Xylocarpus granatum	Nypa fruticans	Nephelium lappaceum
Xylocarpus moluccensis	Chamaedorea elegans	**58. Family Sapotaceae**
38. Family Mimosaceae	Caryota mitis	Manilkara achras
Calliandra emarginata	Chamaerops humilis	Chrysophyllum cainito
Adenanthera pavonina	**48. Family Pandanaceae**	Pouteria campechiana
Samanea saman	Pandanus odoratissimus	Mimusops elengi
39. Family Moraceae	**49. Family Pittosporaceae**	**59. Family Solanaceae**
Ficus microcarpa	Pittosporum tobira	Capsicum annuum
Ficus variegate	**50. Family Podocarpaceae**	Vestia foetids
Ficus religiosa	Podocarpus wallichiana	Solanum melongena
Ficus elastica	**51. Family Pteridaceae**	**60. Family Sonneratiace**
Ficus lyrata	Acrostichum aureum	Sonnertia caseolaris
Ficus nota	Acrostichum speciosum	**61. Family Theaceae**
40. Family Moringaceae	**52. Family Proteaceae**	Camellia japonica
Moringa oleifera	Grevillea robusta	**62. Family Tiliaceae**
41. Family Muntingiaceae	**53. Family Rhizophoraceae**	Colona serratifolia
Muntingia calabura	Rhizophora mucronata	**63. Family Urticaceae**
42. Family Myrtaceae	Bruguiera gymnorrhiza	Leucosyke capitellata
Callistemon citrinus	Ceriops decandra	**64. Family Verbenaceae**
Syzygium samargense	Ceriops tagal	Clerodendrum paniculatum
Psidium guajava	Rhizophora apiculata	Tectona philippinensis
Eugenia cumini	Rhizophora stylosa	
Syzygium polycephalum	Rhizophora mucronata	
Eugenia javanica	Bruguiera cylindrical	
Eugenia malaccensis	Bruguiera gymnorrhiza	
Eugenia aquea	Bruguiera parviflora	
Syzygium jambos	Bruguiera sexangula	

ISSN- 2350-0530(O), ISSN- 2394-3629(P)
DOI: 10.5281/zenodo.2631388

4.2. Community Structure of Shrubs and Trees

There were 207 species of shrubs and trees with average DBH (Diameter Breast Height) of ≥ 10cm. The density, relative density, frequency, relative frequency, dominance in terms of basal area, relative dominance, and importance value were calculated for each of the species of shrubs and trees. The results were:

Relative Density (RD) – *Mangifera indica* (Anacardiaceae) had the highest relative density at 25.50%, followed by *Tamarindus indica* (Leguminosae) at
12.10%, and *Chrysophyllum cainito* (Sapotaceae) at 10.82%. The other shrub and tree species accounted for 51.58% total relative density.

Relative Frequency (RF) – Among the shrubs and trees, the most frequently seen in all of the five island towns is the presence of *Mangifera indica,* (Anacardiaceae) which is a fruit tree, and favorite fruit among the islander folks since the fruit tree is seen everywhere, i.e. in the farms, at house front and back yards, in schools, churches, markets, and seashores. *Mangifera indica* (Anacardiaceae) had the highest relative frequency at 25.30%, followed by *Tamarindus indica* (Leguminosae) at 12.78%, and *Chrysophyllum cainito* (Sapotaceae) at 10.36. The other shrub and tree species accounted for 51.56% total relative frequency.

Relative Dominance (RD) – *Mangifera indica* (Anacardiaceae) dominated
the shrubs and trees in terms of basal area with 8.35%, followed by *Canarium ovatum* (Burseraceae) with 7.89%, and **Chrysophyllum** *cainito* (Sapotaceae) with 6.41%. Other shrub and tree species accounted for a total of 77.35%.

Importance Value (IV) – For the 207species of shrubs and trees, importance value was calculated by adding the relative density (RD), relative frequency (RF), and relative dominance (RD). The species with the highest importance value was the fruit tree *Mangifera indica*, (Anacardiaceae) with 59.15%.

Diversity Status – Among the five island towns being surveyed, Laoang had the most number of species. This was also reflected by Shannon Index of 4.75 and Simpson's Dominance of 1.86. The high value for the island town of Laoang was attributed to its favorable location - it is near the mainland; i.e. Samar Island-considered as third largest island in the Philippines; only 5-10 minutes motorboat ride compared to the other island towns whereby, they can be reached from 30-90 minutes motorboat ride.

4.3. Abundant Shrubs and Trees

The most abundant shrub and tree species in the island towns were *Citrus microcarpa* (Cucurbitaceae) and *Mangifera indica* (Anacardiaceae) respectively. The least abundant shrub and tree species were *Gardenia jasminoides* (Rubiaceae) and *Cananga odorata* (Annonaceae) respectively. There were more species of shrubs and trees in the island town of Laoang than in the other four island towns; i.e. Biri, Capul, San Antonio, and San Vicente. Plots in the island of Laoang was observed to have the highest Shannon Diversity Index (3.25%) and Simpson's

ISSN- 2350-0530(O), ISSN- 2394-3629(P)
DOI: 10.5281/zenodo.2631388

Dominance Index (1.86%). Fifty-three percent (53%) of the species were endemic to the island towns.

Families Caesalpiniaceae and Meliaceae respectively had the largest number of species which is 13; followed by Family Leguminosae which had 12 species; followed by Family Rhizophoraceae which had 11 species; and Families Palmae and Myrtaceae had both 9 species.

Other abundant species of shrubs in the island towns were: *Avicennia marina* (Avicenniaceae), *Rhizophora mucronata* (Rhizophoraceae), *Nypa fruticans* (Palmae), *Psidium guajava* (Myrtaceae), and *Hibiscus rosa-sinensis* (Malvaceae). Other abundant species of trees were: *Cocos nucifera* (Arecaceae), *Canarium ovatum* (Burseraceae), *Hibiscus tiliaceus* (Malvaceae), *Artocarpus blancoi* (Meliaceae), and *Tamarindus indica* (Leguminosae).

Other least abundant species of shrubs in the island towns were: *Rosa centifolia* (Rosaceae), Eugenia *aquea* (Myrtaceae), *Nephelium lappaceum* (Sapindaceae), *Manilkara achras* (Sapotaceae), and *Annona squamosa* (Annonaceae). Other least abundant species of trees were: *Eugenia javanica* (Myrtaceae), *Ficus elastica* (Moraceae), *Syzygium samargense* (Myrtaceae), *Lansium domesticum* (Meliaceae), and *Bixa orellana* (Bixaceae).

It is observed that food requirement is the main reason of the abundance of trees in the island towns. Island folks plant them to provide nourishment, and store/preserve them during times of need. On the other hand, the abundant shrubs are used for construction purposes, for fuel, and for other uses. Some are ornamental flowering plants, which provide aesthetic value to the surroundings, especially for island people seeking for inspiration and adventure.

Table 2: Families with Number of Species and Genera

Family	No. of Species	No. of Genera
1.Family Acanthaceae	2	2
2.Family Agavaceae	1	1
3.Family Anacardiaceae	5	4
4.Family Annonaceae	5	3
5.Family Apocynaceae	8	7
6. Family Araliaceae	3	2
7.Family Araucariaceae	1	1
8.Family Arecaceae	4	4
9.Family Avicenniaceae	4	1
10.Family Bignoniaceae	4	4
11.Family Bixaceae	1	1
12.Family Bromeliaceae	1	1
13.Family Burseraceae	1	1
14.Family Caesalpiniaceae	13	10
15.Family Casuarinaceae	1	1
16.Family Caricaceae	1	1
17.Family Clusiaceae	1	1
18.Family Combretaceae	5	2
19.Family Cucurbitaceae	7	2
20.Family Cycadaceae	1	1
21.Family Dilleniaceae	2	1
22.Family Dipterocarpaceae	1	1
23.Family Ebenaceae	1	1

ISSN- 2350-0530(O), ISSN- 2394-3629(P)
DOI: 10.5281/zenodo.2631388

24.Family Ericaceae	2	1
25.Family Euphorbiaceae	7	6
26.Family Gnetaceae	1	1
27.Family Goodeniaceae	1	1
28.Family Labiateae	3	3
29.Family Lauraceae	1	1
30.Family Leguminosae	12	11
31.Family Liliaceae	5	1
32.Family Loganiaceae	1	1
33.Family Lythraceae	2	2
34.Family Magnoliaceae	1	1
35.Family Malvaceae	7	5
36.Family Melastomataceae	2	2
37.Family Meliaceae	13	8
38.Family Mimosaceae	3	3
39.Family Moraceae	6	1
40.Family Moringaceae	1	1
41.Family Muntingiaceae	1	1
42.Family Myrtaceae	9	5
43.Family Myrsinaceae	1	1
44.Family Oleacea	1	1
45.Family Onagraceae	1	1
46.Family Oxalidaceae	2	1
47.Family Palmae	9	8
48.Family Pandanaceae	1	1
49.Family Pittosporaceae	1	1
50.Family Podocarpaceae	1	1
51.Family Pteridaceae	2	1
52.Family Proteaceae	1	1
53.Family Rhizophoraceae	11	4
54. Family Rosaceae	2	2
55.Family Rubiaceae	7	6
56.Family Rutaceae	2	1
57.Family Sapindaceae	1	1
58.Family Sapotaceae	4	4
59.Family Solanaceae	3	3
60.Family Sonneratiace	1	1
61.Family Theaceae	1	1
62.Family Tiliaceae	1	1
61.Family Theaceaez	1	1
62.Fa62.	2	2
63.Fa	207	152
63, Family Urticaceae		
64.Family Verbenaceae		

5. Conclusions

1) There were 207 species of shrubs and trees belonging to 152 genera and 64 families. Shrubs constituted 55.33% and trees 44.67% of the total number of species.
2) Mangifera indica (Anacardiaceae) had the highest relative density at 25.50%, followed by Tamarindus indica (Leguminosae) at 12.10%, and Chrysophyllum cainito (Sapotaceae) at 10.82%. The other shrub and tree species accounted for 51.58% total relative density. Mangifera indica (Anacardiaceae) had the highest relative frequency at 25.30%, followed by Tamarindus indica (Leguminosae) at 12.78%, and Chrysophyllum cainito (Sapotaceae)

ISSN- 2350-0530(O), ISSN- 2394-3629(P)
DOI: 10.5281/zenodo.2631388

at 10.36. The other shrub and tree species accounted for 51.56% total relative frequency. Mangifera indica (Anacardiaceae) dominated the shrubs and trees in terms of basal area with 8.35%, followed by Canarium ovatum (Burseraceae) with 7.89%, and Persea americana (Lauraceae) with 6.41%. Other shrub and tree species accounted for a total of 77.35%. The species with the highest importance value was the fruit tree Mangifera indica, (Anacardiaceae) with 59.15%.

3) The most abundant shrub and tree species in the island towns were Citrus microcarpa (Cucurbitaceae) and Mangifera indica (Anacardiaceae) respectively. The least abundant shrub and tree species were Gardenia jasminoides (Rubiaceae) and Cananga odorata (Annonaceae) respectively. There were more species of shrubs and trees in the island town of Laoang than in the other four island towns; i.e. Biri, Capul, San Antonio, and San Vicente. Plots in the island of Laoang was observed to have the highest Shannon Diversity Index (4.75%) and Simpson's Dominance Index (1.075%). Fifty-three percent (53%) of the species were endemic to the island towns.

Families Caesalpiniaceae and Meliaceae respectively had the largest number of species which is 13; followed by Family Leguminosae which had 12 species; followed by Family Rhizophoraceae which had 11 species; and Families Palmae and Myrtaceae had both 9 species.

6. Recommendations

1) Conserve and preserve the economically and ethnobotanically important shrubs and trees; and other plant life.
2) Greening of the island towns by assigning botanical gardens and parks to central site locations in the community.
3) Evaluate shrubs and trees, as well as other plant life in the island, using the IUCN Red List Categories Version 3.1, series 2001, or the latest reference.

Acknowledgment

The author would like to thank the following: Rolando A. Delorino Ph.D., President, University of Eastern Philippines; Dr. Pio P. Tuan, Research Director, UEP; Dr. Karina Milagros R. Cui-Lim, Dean, College of Science, UEP; Municipal Mayors of the five island towns;and Mr. Ranulfo A. Arbiol, former PGENRO, DENR, Northern Samar.

References

[1] W. Cunningham and M. Cunningham, Principles of Environmental Science: Inquiry and Applications, 3rd ed., New York:McGraw-Hill Book Co., 2006.
[2] Dogma, G. Trono, and R. del Rosario, Guide to Philippine Flora and Fauna, Quezon City: Goodwill Bookstore, Ministry of Natural Resources, UP-Diliman, 1986.
[3] E. Enger and B. Smith, Environmental Science: A Study of Interrelationships, 11th ed., New York: McGraw-Hill Book Co., 2008.
[4] M.G.Simpson, Plant Systematics, 2nd ed., London, England: Elsevier, Inc., 2010.
[5] J. Ghazoul and D. Sheil, Tropical Rainforest Ecology, Diversity and Conservation, Great Britain: Oxford University Press, 2010.

ISSN- 2350-0530(O), ISSN- 2394-3629(P)
DOI: 10.5281/zenodo.2631388

[6] T. Millerand S. Spoolman, Environmental Science, 13th ed., USA: Brooks/Cole, Cengage Learning, 2010.
[7] Polunin, Plants and Flowers of Singapore, Malaysia: Times Offset, 2010.
[8] C. Starr, C. Evers and L. Starr, Basic Concepts in Biology, 6th ed., USA:Thomson Brooks/ Cole Corp., 2006.
[9] Philippine Biodiversity: An Assessment and Plan of Action. Makati: UNEP, DENR, Bookmark Inc., 1997.
[10] Trees and Shrubs: A Gardener's Encyclopedia, USA: Firefly Books Inc., 2011.
[11] J.C. Kurian, Amazing Healing Plants, Vols. I and II, Saraburi, Thailand, Reprinted by Philippine Publishing House, Manila, Philippines, 2010.
[12] Reader's Digest Success With House Plants, Italy: The Reader's Digest Association Inc., 1986.
[13] R. Garcia, Guide to Philippine Flora and Fauna, Vol.VI Philippines: Natural Resources Management Center, Ministry of Natural Resources and University of the Philippines, 1986.
[14] M. Caldas, V. Cuevas, C. Cervantes, and Z. Sierra, Laboratory Guide in Ecology, IBS, CAS, UP at Los Banos, Laguna, Philippines, 1990.
[15] P. Stiling, Ecology: Theories and Applications, 2nd ed., Singapore: Prentice Hall International, Inc., 1998.
[16] A. Tomera, Understanding Basic Ecological Concepts, Portland, Maine: J. Weston Walch Publications, 1989.

*Corresponding author.
E-mail address: galenzoga@ yahoo.com