Verification On The Impact Of Plant Cover Variability To The Anuran Diversity In Bohol, Philippines Using Fractal Analysis

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Abstract

This study attempted to analyse the impact of the diversity of plant covers of the different sites of Bohol, Philippines to the diversity of Anurans. The researchers utilized a novel method of analysis in the nature of geometrical fractal and statistical analysis where the following are computed: 1.) the number of species per site per cover (agricultural/ forest) 2.) the record of species of the respective covers 3.) the fractal dimension of the relationship that exists between 1 and 2 were calculated in five (5) trials. The centroid regression approach was used to determine the strength of relationship and the degree of impact of the variability in the plant covers to the diversity of Anurans in the area. The fitted regression line (with R-sp. of 91.9%) states that Anuran species' diversity increased the number of the plant covers in both agricultural and forest increased. In fact, for every unit increased the number of species they cover increased the Anuran species' diversity to approximate 46%. Moreover, fractal correlation in terms of the diversity of plant covers explained the increase in the diversity of Anurans' species where implication for policies on greening tree planting and environmental protection could be advanced.

Keywords: Anurans, fractal correlation, plant covers, fractal dimension, novel method

1.0 Introduction

Determining a biodiversity of a certain species in an area would allow us to know whether that area is diverse enough to fit-in in the ecosystem. Every species in an ecosystem has its importance in accomplishing its niche. Relationships between species and its habitat will give us an idea how does these species would vary and sustain its nourishment. Preserving species and their habitats is important for ecosystems to self-sustain themselves. Yet, the pressures to destroy habitat for logging, illegal hunting, and other challenges are making conservation a struggle (Shah,2014). There are many methods used in determining the biodiversity and the most commonly used is the Shannon index.

Anurans are under amphibians, which is mostly displaying a biphasic life history meaning they live in two areas: the aquatic breeding habitat and terrestrial habitats (Chambers, 2008). Eterovick (2002) stated that the distribution of few anurans species could be clearly related to particular physical and biotic variables. He found out that the behavioural flexibility of anurans and the similarity among streams contributed to its pattern. Some other researchers said that with analysing diversity using fractal analysis gives an accurate result. Fractal dimension results accurately reflect its vegetation transition shift, providing a powerful analytical framework for simplifying ecological complexity and understanding its dynamics (Alados, C. L. et al, 2005).

Biodiversity has significant implication for functioning of ecosystem. Biodiversity boosts ecosystem productivity where each species, no matter how small, all have an important role to play. Since anuran species diversity recognized a favourable effect towards plant species, thus, it must have to be determined. Through fractal analysis, analysing the diversity would be easy and less time-consuming.

This paper aimed to analyse the plant covers and the diversity of anurans using fractal analysis in the Rajah Sikatuna Protected Landscape (RSPL) Bohol, Philippines.

2.0 REVIEW OF RELATED LITERATURE

Anuran Diversity

Anurans represent as the most specious and widespread of the three amphibian orders. Anuran diversity is greatest in the tropics. There are twenty-five families currently recognized, representing more than 4000 species, with more than being discovered regularly (Heying, 2003). Anurans represent a ubiquitous group of organisms that play a pivotal role in aquatic food webs but may also be used for observing long-term trends in community change in wetland ecosystems (Adamus, 1996). In the book of Duellman (1999), diversity of anurans is greatest in the lowlands compared to other amphibians like salamanders which are most diverse in highlands. Their diversity increases as the mountains became humid. He also states that the greatest number of Bufo is in the southwestern part of the USA and adjacent Mexico. In contrast, greatest diversity of Rana is in the Southeastern lowlands.

Faruk et.al (2013) concluded to their studies about the effect of oil-palm plantations on diversity of tropical anurans that not all measures of biological diversity differed between oil-palm plantation and secondary forest sites. They also believe that with the number of management interventions, oil-palm plantations can provide habitat for species that dwell in secondary forest. In the study of Vasudevan et.al (2008), a quadrat search method was used to estimate species richness and density of the forest floor anuran community in the rain forest of Southern Western Ghat, India. In here they found high levels of species turnover among watershed, which is comparable to the other study conducted in South East Asian forest.

Methods in Determining Diversity

A diversity index is the measure of species diversity in a given community. It is different from species richness in that unlike richness it also shows community composition and takes into account the relative abundance of species that are present in the community. Shannon Index is a commonly used diversity index that takes into accounts both abundance and evenness of species present in the community. In plant ecology, I(e) has been used to measure species diversity (Shannon and Weaver 1949), and is more often written as H, where pi is the probability of the frequency of the i-th species, and N is the number of species (all the species grouped in a single transect of a particular size). The maximum value of H occurs when all species are equally represented,Hmax=ln(N). The ratio H/Hmax=J is then the Evenness index. In the case of the researcher, she used the fractal dimension in determining the species diversity.

Furthermore, a complete definition of diversity needs to include patch richness (e.g., number of different patches) and patch evenness (distribution of patches across the landscape) as well (Shannon and Weaver,1962).

Plant Cover Effects to Species Diversity

Amphibians thrive in a variety of habitats, ranging from relatively pristine sites in forested areas to areas close to anthropogenic activities including water puddles, ditches, canals near houses and rice fields (International Union for the Conservation of Nature Global Amphibian Assessment 2004). The variability of habitats utilized by amphibian species is greatly influenced by their physiological needs. Due to their cutaneous respiration, a diet composed mainly of insects, the non-direct development of the young (for the majority of Philippine frogs), the need for a humid environment, water bodies and vegetation is quite necessary (Sexton et al. 1964). Forest dwellers were observed in closed canopy areas, relatively wet forest floor, moderately thick leaf litter and quite humid sites. Another factor that directs habitat preferences of amphibians is disturbance. Majority of the Philippine frog species were documented on less disturbed or undisturbed sites (Alcala 1986; Alcala and Brown 1998; Diesmos et al. 2003; Brown et al.1996).

Various studies attest that each amphibian species occupy certain habitat type, some species are highly confined to forested areas while others are easily sighted near human domiciles (as cited in Alcala & Brown, 1998 , Inger 1954; Diesmoset et al., 2006.

Current Philippine Anuran Diversity

About 85% of the anurans inhabit forested areas. Endemism of Philippine amphibians is high, (ca 78.5%), but is likely to increase to about 80% when more new species are described formally, following the lineage species concept (Brown et al. 2008).

Concept of a Fractal and Fractal Dimensions

Classical geometry considers objects that have integral dimensions: points have zero dimensions, lines have one dimension, planes have two dimensions and cubes have three dimensions. Within a plane, one can represent points and straight lines and other geometric objects as shown below:

Figure 1 A fractal object in a plane

It is possible to represent geometric objects within a plane that are neither points nor lines like the squiggly line above. This squiggly geometric object cannot have a dimension equal to 1 because it fills up more space than a line; it cannot have a dimension equals to 2 because it does not form an area. Hence, its dimension λ has to be between 1 and 2 like $\lambda = 1.63$. We will say that the squiggly line is a fractal (a geometric object having fractional dimension).

The fractal dimension of an object defines its roughness, ruggedness or fragmentation. The higher the fractal dimension, the more rugged and irregular-looking is the object. Thus, although fractals are rough and irregular objects, the pattern of irregularities are repeated over and over again. This is called the self-similarity property of fractal. Benoit Mandelbrot (1967) is acknowledged as the mathematician who opened roughness as a legitimate topic for investigation in modern science. He claimed that nature and natural processes are fractals, while uniform, smooth and continuous patterns are man-made concepts and pervade mathematical analysis. He also said that by introducing "randomness" into the situation, one gets more realistic fractal representations.

After the publication of Mandelbrot's book: Fractals: The Geometry of Nature, many scientists used fractals with great success that include Cohen, (1987) on fractal antennae; Krummel et al (1987) on forest fractals and others). It has found applications in various disciplines as well as in many areas of practical technology.

In Padua (2012), fractal geometry was translated to statistical language. A probability distribution akin to Pareto's distribution for incomes was proposed as a model for fractal random variables X:

(1)

$$\mathbf{A} = \mathbf{L}\mathbf{L}^T = \begin{pmatrix} L_{11} & 0 & 0 \\ L_{21} & L_{22} & 0 \\ L_{31} & L_{32} & L_{33} \end{pmatrix} \begin{pmatrix} L_{11} & L_{21} & L_{31} \\ 0 & L_{22} & L_{32} \\ 0 & 0 & L_{33} \end{pmatrix} = \begin{pmatrix} L_{11}^2 & & (symmetric) \\ L_{21}L_{11} & L_{21}^2 + L_{22}^2 & \\ L_{31}L_{11} & L_{31}L_{21} + L_{32}L_{22} & L_{31}^2 + L_{32}^2 + L_{33}^2 \end{pmatrix}$$

, $L_{i,j} = \frac{1}{L_{j,j}} \left(A_{i,j} - \sum_{k=1}^{j-1} L_{i,k} L_{j,k} \right), \qquad \text{for } i > j.$

Where λ = fractal dimension of x, $L_{i,i} = \sqrt{A_{i,i} - \sum_{k=1}^{i-1} L_{i,k}^2}.$ A maximum – likelihood estimator for λ based on a random sample of size n was provided as:

(2) $\hat{\lambda} = 1 + n\left(\sum_{i=1}^{n} log\left(\frac{x_i}{\theta}\right)\right)^{-1}.$

He then proceeded to show that for n=1:

(3) $z = \hat{\lambda}\log\left(\frac{x}{\theta}\right) - 1 \underset{\sim}{d} Exp(\lambda - 1)$or:

(4) $q(z) = (\lambda - 1)\, exp(-(\lambda - 1)z)$

For a random sample of size n, the random variable:

(5) $q = \hat{\lambda}\sum_{i=1}^{n} log\left(\frac{x_i}{\theta}\right) - n$

Has the same distribution as $q^* = \sum_{i=1}^{n} log\left(\frac{x_i}{\theta}\right) = \sum_{i=1}^{n} Z_i$. The distribution of (5) is $Gamma\left(n, \beta = \frac{1}{\lambda - 1}\right)$ therefore where $\lambda > 1$:

(6) $h(q) = \frac{(\lambda-1)^n}{\Gamma(n)} q^{n-1} e^{-q(\lambda-1)}, \quad q > 0, \lambda > 1$

$$h(q) = \frac{(\lambda-1)^n}{\Gamma(n)!} q^{n-1} e^{-q(\lambda-1)}$$

Thus, if we have one sample of a species and if we are able to estimate its (geometric) fractal (see for example some available freeware like FRAK. OUT), then we are able to compare the fractal dimension for species (say, λ_1) with the specimen (λ_2):

(7) $u = |\lambda_1 - \lambda_2|.$

We approximate the distribution of u by an exponential distribution and obtain:

(8) $\delta_\varepsilon = P(u \geq \varepsilon) = \frac{1}{2}\left(1 + exp\left(-\varepsilon^{(\lambda_2 - 1)}\right)\right)$

, a similarity index where = fractal dimension q specimen species. We refer to (8) as a similarity index. As the difference $L_{i,j} = \frac{1}{L_{j,j}} \left(A_{i,j} - \sum_{k=1}^{j-1} L_{i,k} L_{j,k} \right), \quad \text{for } i > j.$ increases, the similarity index decreases. If $L_{i,i} = \sqrt{A_{i,i} - \sum_{k=1}^{i-1} L_{i,k}^2}.$ (hence, $\hat{\lambda} = 1 + n\left(\sum_{i=1}^{n} log\left(\frac{x_i}{\theta}\right)\right)^{-1}$), the fractal dimensions are identical and the two documents are 100% similar. This means that the two species contains exactly the same fractal characteristics: straight lines, curves, strokes, spacings, slants and so on, and, must therefore belong to the same species.

It is also possible to determine what values of $z = \hat{\lambda}\log\left(\frac{x}{\theta}\right) - 1 \underset{\sim}{d} Exp(\lambda - 1)$ will yield high similarity index thus:

(9)

$$\mathbf{A} = \mathbf{L}\mathbf{L}^T = \begin{pmatrix} L_{11} & 0 & 0 \\ L_{21} & L_{22} & 0 \\ L_{31} & L_{32} & L_{33} \end{pmatrix} \begin{pmatrix} L_{11} & L_{21} & L_{31} \\ 0 & L_{22} & L_{32} \\ 0 & 0 & L_{33} \end{pmatrix} = \begin{pmatrix} L_{11}^2 & & (symmetric) \\ L_{21}L_{11} & L_{21}^2 + L_{22}^2 & \\ L_{31}L_{11} & L_{31}L_{21} + L_{32}L_{22} & L_{31}^2 + L_{32}^2 + L_{33}^2 \end{pmatrix},$$

For instance, if

$$\mathbf{A} = \mathbf{L}\mathbf{L}^T = \begin{pmatrix} L_{11} & 0 & 0 \\ L_{21} & L_{22} & 0 \\ L_{31} & L_{32} & L_{33} \end{pmatrix} \begin{pmatrix} L_{11} & L_{21} & L_{31} \\ 0 & L_{22} & L_{32} \\ 0 & 0 & L_{33} \end{pmatrix} = \begin{pmatrix} L_{11}^2 & & (symmetric) \\ L_{21}L_{11} & L_{21}^2 + L_{22}^2 & \\ L_{31}L_{11} & L_{31}L_{21} + L_{32}L_{22} & L_{31}^2 + L_{32}^2 + L_{33}^2 \end{pmatrix}$$

, then the values of above will indicate 95% similarity index or greater.

Fractal Analysis and Biodiversity

Fractal is the exact repetition of detail at every observation scale, its strict self-similarity. In science, it is termed as the "roughness". Fractal analysis is literally the analysis of its roughness. D or FD (fractal dimension) is a parameter that describes the relationship between measured size and the measuring scale in fractal analysis (Jelinek et. al, 2005). The >FD indicates the most rougor complicated an object is, in contrast the <FD tells that the object is less rough and irregular. Benoit Mandelbrot (1967) is a mathematician who opened roughness as a legitimate topic for investigation in modern science. There are many studies related to fractals that help the researcher better understand the relationship between the variables used.

Fractals have been used recently to describe spatial patterns in many landscape-level applications. One such application has been to measure the geometric complexity of landscape features. It describes a modified fractal dimension to be used as a measure of distribution of landscapes diversity in a classified GIS image. The resulting modified fractal dimension calculation consistently describes diversity for the landscape, accounting not only for patch shape, but also for patch juxtaposition and evenness (Olsen et.al, 1993).

In the study of Chaturvedi et al (2013), fractal analysis is used to assess presence of pseudo random quadrats or spatial dependence which hamper generality and performance of classical inferential statistics. Fractal dimension (FD) as a function of scale is used to determine quadrat size which eliminates spatial dependence.

In the study of Kenkel & Irwin (1994), it suggests that through fractal dimension species with low dispersability have a higher fractal dimension (D=2). As such they are expected to move to move through the landscape as a slowly advancing front, and to be relatively evenly distributed across the landscape. By contrast, species of low fractal dimension (D=<1) show higher dispersability. Such species are expected to move through the landscape in jumps, forming isolated colonies.

3.0 DESIGN AND METHODOLOGY

Research Design

The study utilized the descriptive and correlational methods of analysis. It is all about quantifying the relationships between variables. Variables are the things measured on the subjects, which can be humans, animals, or cells. To quantify the relationships between these variables, it uses values of effect statistics such as the correlation coefficient, the difference between means of something in two groups, or the relative frequency of something in two groups. The aim of this type of research design is to determine how one thing (a variable) affects in a population (Hopkins, 1998). This study is designed to evaluate the capability of fractal analysis in determining and analysing the diversity of anurans based on the fractal dimension of their distribution. This study also determined on how the plant cover was affected by the diversity of anurans.

The Study Area

From the data of Andres (2009), the researchers conducted the study in the selected 15 barangays of the Rajah Sikatuna Protected Landscape (RSPL) in Bohol, Philippines. These barangays are: Cansambol, Anunang, La Victoria, Cambuyo, Datag, Canlambong, Monte Video, Nueva Vida Esta, Monte Hermoso, Danicop, Bugsoc, San Isidro, Casilay, Canlangit, and Nan-od. In each barangay, there were two habitats being studied as sampling stations, the forest and agricultural areas.

Data Gathering

The researchers underwent data mining; utilizing the data from the study of Andres (2009), with the researcher's permission. The present researchers gathered the frequency of occurrence of the anurans and their plants cover in percentage in both forest and agricultural areas from the selected 15 barangays under the Rajah Sikatuna Protected Landscape (RSPL) in Bohol, Philippines. The gathered data were subjected in data software used to attain the results.

Data Analysis

In the 1st data, the plant covers in the forest area was converted into decimal equivalents such that the median was computed and divided by 2 and analysed through MINITAB Statistical Software, followed by the plant covers in the agricultural area. The result was further treated in data software using the FRACTSOFTWARE to get its fractal dimension (FD).The 2nd data, the frequency of anurans were also analysed using the same process with the plant covers. Results were then treated to software using the FRACSOFTWARE for fractal statistics, where the fractal dimensions (FD) results were taken.

Data were tabulated in Excel for enhanced data

Table 1.1 Plant Cover in Agricultural Area

Plants group	Scientific name	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14	Site 15
Emergent Trees	*Ficus indica (Balete)*	3	0	0	3	0	3	3	3	3	3	3				
	Cocos nucifera (Coconut)	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5
	Sweitenia macrophylla(Mahogany)	0	3	3	0	0	0	3	3	3	3	3	3	3	3	0
	Ficus nota(Tibig)	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
	Saurauia latibractea(Kolalabang)	0	0	0	3	0	0	0	0	0	0	0	0	0	0	3
	Mangifera indica(Mango)	0	0	15.5	15.5	0	0	3	3	3	0	3	0	0	3	15.5
	Cananga odorata(Ilang-ilang)	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
	Leucaena glauca (Ipil-ipil)	0	0	0	0	0	0	0	0	0	15.5	0	0	0	0	0
	Artocarpus heterophylla	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
	Nauclea orientalis(Bangkal)	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
	Tectona grandis(Teak)	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
	Erythria sp.(Rarang)	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
	Eugenia jambulana(Duhat)	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
	Psisdium guajava (Guava)	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	Coffe aratica(Coffee)	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
Understory Plant	*Gnetum guemon (Bago)*	3	3	0	3	0	0	3	3	3	0	3	3	3	0	0
	Melicophe tryphylla (Matang Araw)	3	0	0	3	0	0	3	3	3	0	0	3	0	0	3
	Ficus hauli (Lagnub)	3	0	0	3	3	3	3	3	3	3	3	3	0	3	3
	Melanolepsis multiglanulosa(Alim)	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
	Spondias pinnata(Libas)	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
	Securinaga flexousa(Anislag)	0	3	0	0	0	3	0	0	0	0	0	0	0	0	0
	Ormesia calavensis(Bahai)	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
	Macaranga tanarius(Binunga)	0	0	0	3	0	0	0	0	0	0	0	0	0	0	3
	Alstonia scholaris(Dita)	0	0	0	3	0	0	0	0	0	0	0	0	0	0	3
	Mallatus philippinensis(Banato)	0	0	0	3	0	0	0	0	0	0	0	0	0	0	3
	Leca guinensis(Mali-mali)	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
	Gmelina arborea(Yemane)	0	0	0	0	3	0	0	0	0	0	0	0	0	3	0
	Anonas reticulata	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
	Pterocymbium tinctorium(Taluto)	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
	Eugenia javanica(Macopa)	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
	Ficus nota(Tibig)	0	0	0	0	0	0	0	0	0	3	0	0	0	0	15.5
	Leucaena glauca (Ipil-ipil)	15.5	15.5	15.5	15.5	15.5	15.5	3	3	3	3	3	15.5	0	15.5	15.5
Ground Cover Plants	*Paspalum conjugatum (Carabao grass)*	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5
	Oryza sativa (Rice)	38	65	65	38	38	38	38	38	38	38	38	38	63	38	38
	Zea maize (Corn)	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38
	Imperata cylindrica (Cogon)	3	3	3	3	3	3	3	3	3	3	3	3	15.5	3	3
	Andropogon asiculatus (Amor seco)	3	3	15.5	3	3	3	3	3	3	3	3	3	15.5	3	3
	Ipomea aquatica(Kangkong)	0	15.5	0	0	0	0	0	0	0	0	0	0	15.5	0	0
	Pennesitum purpureum(Napier grass)	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
	Poaceae Family (Bikal Baboy)	0	0	0	15.5	0	0	0	0	0	0	0	0	0	0	0
	Eleusine indica(Padpad)	0	0	0	0	3	0	0	0	0	0	0	0	0	3	0
	Saccharum spontaneum(Bugang)	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
	Artocarpus cetuecarpus(Lubihan)	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0
	Mimosa pudica (Makahiya)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15.5
Pandan Density		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ficus Density		13	3	3	3	3	13	3	3	3	5	3	3	3	13	13
Fern Density		3	3	2	3	3	3	3	3	3	5	3	3	3.5	3	3
Fruit Density		15.5	15.5	15.5	15	15.5	15.5	15.5	15.5	15.5	15	15.5	15.5	15.5	15.5	15.5
Musa Density		15.5	15.5	15.5	15	15.5	15.5	15.5	15.5	15.5	15	15.5	15.5	15.5	15.5	15.5
Moss Density		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

sheets. After 5 trials of using the FRACSOFTWARE in the frequency of anurans, it was calculated to get the average FD. Results together with the FD of the plant covers were then analysed to Multiple Linear Regression and Correlation, getting its fitted regression line using MINITAB software.

5.0 RESULTS AND DISCUSSION

Plant Diversity

Plant diversity is one of the indicators of the presence of species in an area.

From the data of Mr. Andres (2009), the Braun-Blanquet method was used in determining the plant cover. The data were organized according to its plant habitat. There were 4 habitats listed: emergent trees, understory plant, ground cover plant and the last one are the combinations of 6 kinds of plants where the anurans usually reside. Under the emergent trees, Cocos nucifera (coconut) was the most abundant where it can be found in all sites. In the understory plant, the most abundant is the Leucaena glauca (Ipil-ipil). The data were presented in decimal equivalents such that the median was computed and divided by 2 (Table 2). The conversion was needed to be analysed on the MINITAB software. This suggested that the plants found in each barangay were almost the same from the other barangays. The most dominant plants found were rice and corn since the area was used mainly for agricultural purposes. The least dominant were those plants that mostly belongs to the understory plant. With the presence of few trees in the agricultural area that held up water, it has a great help to the anurans to at least survive in

Table 1.2 Plant cover in Forest Area

Plants group	Scientific name	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14	Site 15
Emergent Trees	*Casuarina sumatranum* (Agoho)	15.5	0	0	0	0	15.5	15.5	3	15.5	3	0	15.5	0	0	0
	Ficus Indica (Balete)	15.5	15.5	0	0	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	0
	Pashorea plicatoa (Bagtikan)	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ficus nota (Tibig)	3	0	0	0	3	3	15.5	0	15.5	15.5	0	3	0	0	0
	Samanea saman (Rain Tree)	0	3	0	3	0	0	0	0	0	0	0	0	3	0	3
	Alstonia scholaris (Dita)	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sweitenia macrophylla (Mahogany)	0	15.5	3	15.5	0	15.5	15.5	38	15.5	15.5	38	0	15.5		15.5
	Bischofia javanica (Tuai)	0	0	15.5	0	0	0	0	0	0	0	0	0	0	0	0
	Vitex parviflora (Molave)	0	0	3	0	15.5	0	0	0	0	0	0	0	0	15.5	0
	Ficus ulmifolia (Is-is)	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
	Ectocarpus macoranths (Bayokyok)	0	0	0	15.5	0	0	0	0	0	0	0	0	0	0	3
	Gmelina arborea (Yemane)	0	0	0	3	0	0	3	3	0	3	3	0	0	3	3
	Myristica philippinensis	0	0	0	0	0	3	0	0	3		0	0	0	0	0
	Pterocarpus sp. (Narra)	0	0	0	0	0	0	0	0	0	15.5	0	0	0	0	0
	Ficus ulmifolia (Hagimit)	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
	Pterocymbium tinctorium (Taluto)	0	0	0	0	0	0	0	0	0	3	0	0	0	3	0
	Baringtomia racemosa (Putat)	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0
	Cassia siamea (Acasia)	0	0	0	0	0	0	0	0	0	0	15.5	0	0	0	0
	Gymnostoma rhumpiana (Maribuhok)	0	0	0	0	0	0	0	0	0	0	15.5	0	0	0	0
	Tectona grandis (Teak)	0	0	0	0	0	0	0	0	0	0	0	3	3	0	0
	Pisidium sp. (Wild guava)	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
	Shorea squamata (Myapis)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15.5
Epiphyte	*Dynaria quircifolia* (Kabkab)	1	0	0	3	1	1					3	1		1	3
Vines	*Schleifera odorata* (Five fingers)	1	0	0	3	0	0	0	0	0	0	0	0	0	0	3
	Mikania cordata (Duko)	0	3	0	0	15.5	0	0	0	0	0	0	0	3	1	0
	Polypodiaceae sp.	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0
	Lygodium japonicum (Nitong baging)	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0
Understory Plants	*Casuarina equisitifolia* (Agoho)	0	0	0	15.5	0	0	0	0	0	0	0	0	0	0	15.5
	Ficus Indica (Balete)	0	0	0	15.5	0	0	0	0	0	0	0	0	0	0	15.5
	Ficus nota (Tibig)	0	0	0	3	0	0	0	0	0	0	3		15.5		3
	Erythria spp. (Rarang)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15.5
	Aglea diffusa (Malasaging)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
	Gymnostoma rhumiana (Maribuhok)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
	Canarium villosum (Pasainguin)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
	Baringtomia racemosa (Putat)	0	0	0	0	0	3	0	0	0	0	0	0	0	0	3
	Tectona grandis (Teak)	0	0	0	15.5	0	0	0	0	0	0	0	0	0	0	3
	Leca guinensis (Mali-mali)	15.5	0	0	0	15.5	15.5	3	3	3	0	0	0	0	15.5	0
	Ficus ulmifolia (Hagimit)	0	0	0	0	3	15.5	0	0	0	0	3	0	3	15.5	0
	Gnetum guemon (Bago)	15.5	0	0	0	15.5	0	15.5	15.5	15.5	0	0	15.5	0	15.5	0
	Evodia confusa (Bugauak)	0	0	0	0	3	0	0	0	0	0	0	0	0	3	0
	Ficus hauli (Hauli)	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
	Ficus variegata (Tangisag bayawak)	0	15.5	0	0	0	0	0	0	0	0	0	0	15.5	0	0

behalf of its great exposure to an open field.

The data in Table 1.2 indicate that the forest area was more diverse than the agricultural area in terms of plant richness through the indications of the different plant species found in the forest area.

There were 7 habitats of plants listed above: emergent trees, epiphyte, vines, understory plants, ground cover plants, grasses and the last was a combination of different plants that anurans preferred to cohabit .

Ground Cover Plants	*Lantana camara* (Koromitas)	15.5	3		15.5	15.5	15.5	3	3	3	15.5	3	15.5	3	15.5	15.5
	Chromolaena odorata (Hagonoy)	15.5	15.5	15.5	0	15.5	15.5	15.5	15.5	15.5	0	15.5	0	15.5	15.5	0
	Elephantopus tomentosus (Tabtabako)	15.5	0	0	15.5	0	0	0	0	0	0	0	15.5	0	0	0
	Ficus septica (Hawili)	3	0	0	0	0	0	15.5	15.5	15.5	0	0	3	0	0	0
	Selaginella spp.	3	0	0	3	3	3	3	3	3	3	3	3	0	3	3
	Pirus stephanus (Fern)	15.5	0	0	0	0	3	0	0	0	0	0		0	0	0
	Alphinia elegans (Tagbak)	3	3	0	0	15.5	15.5	0	0	0	0	0	3	0	0	0
	Stachytarpheta urticaefolia (Kadilaan)	0	15.5	3	15.5	3	0	0	0	0	0	0	0	15.5	15.5	3
	Hyptis capitata (Turulcan)	0	3	3	0	3	0	0	0	0	0	0	0	0	0	0
	Ipomea triloba (Kamoti-kamotihan)	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mimosa pudica (Makahiya)	0	15.5	0	0	0	3	0	0	0	0	0	0	15.5	0	0
	Laurentia longiflora (Estrella)	0	0	15.5	3	0	0	0	0	0	0	0	0	0	0	0
	Mikania cordata (Duko)	0	0	3	0	0	0	3	3	3	3	3	0	0	0	0
	Pseudelephantopus spictus (Dilang-baka)	0	0	15.5	0	15.5	0	0	0	0	0	0	0	0	15.5	0
	Mahania spp. (Payang-payang)	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
	Solanum biflorum (Bagan-bagan)	0	0	0	15.5	0	0	0	0	0	0	0	0	0	0	3
	Acalypha indica (Bogus)	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
	Evodia confusa (Bagauak)	0	0	0	15.5	0	0	0	0	0	0	0	0	0	0	0
	Borreria laevis (Borreria)	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
	Ageratum conyzaides (Gapas-gapas)	0	0	0	0	0	15.5	0	0	0	0	0	0	0	0	0
	Ectocarpus macaranths (Bayokyok)	0	0	0	0	0	0	15.5	15.5	15.5	0	0	0	0	0	0
	Nauclea orientalis (Bangkal)	0	0	0	0	0	0	3	3	3	3	0	0	0	0	0
	Begonia sp. (wild begonia)	0	0	0	0	0	0	0	0	0	15.5	0	0	0	0	15.5
	Ipomea tribola (Kamoti-kamotihan)	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
	Shrubs and herbaceous plants	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0
Grasses	*Scleria scrobiculata* (Sarat)	15.5	0	0	15.5	0	15.5	0	15.5	15.5	15.5	15.5	15.5	0	0	15.5
	Axonopus compressus(Carabao-grass)	0	15.5	15.5	0	0	0	0	0	0	0	0	0	15.5	15.5	0
	Bambusa sp.(Bamboo)	0	15.5	1	0	0	0	15.5	15.5	15.5	15.5	15.5	0	15.5	0	15.5
	Imperata cylindrica (Cogon)	15.5	0	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	0	15.5	15.5
	Pennesitum purpureum (Napier grass)	0	0	15.5	0	0	0	0	0	0	0	0	0	0	0	0
	Eluesine indica (Paragis)	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
	Cyperus brevifolius (Busikad)	0	0	0	0	15.5	0	0	0	0	0	0	0	0	15.5	0
	Scleria scrobiculata(daat)	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
	Saccharum spontaneum (Bugang)	0	0	0	0	15.5	0	0	0	0	0	0	0	0	15.5	0
	Mimosa pudica (Makahiya)	0	0	0	0	0	0	0	0	0	0	15.5	0	0	0	0
	Andropogon asiculatus (Amor seco)	0	0	0	0	0	0	0	0	0	0	0	0	15.5	0	15.5
	Cyperacea Family	0	0	15.5	0	0	0	0	0	0	0	0	0	0	0	0
	Themeda gigantea (Tambo)	15.5	0	0	15.5	0	15.5	15.5	15.5	15.5	15.5	0	15.5	0	0	15.5
Pandan Density		15.5	1	1	15.5	15.5	15.5	3	3	3	3	3	15.5	1	15.5	15.5
Ficus Density		3	2.5	2.5	15.5	3	3	3	15.5	15.5	3	3	3	2.5	15.5	15.5
Fern Density		15.5	15.5	3	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5
Fruit Density		2.5	2.5	2.5	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3
Musa Density		2.5	3	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3	2.5	2.5
Moss Density		2.5	0	0	2.5	2.5	2.5	0	0	0	0	0	2.5	1	0	2.5

Anuran Frequency within Sampling Sites

Anurans Species	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14	Site 15
Megophrys stejnegeri	0	0	0	0.014	0	0	0	0	0	0	0.014	0	0	0	0.042
Kalophrynus pleurostigma	0.097	0.083	0.111	0.097	0.069	0.83	0.083	0.069	0.069	0.069	0.083	0.069	0.083	0.083	0.042
Limnonectes leytensis	0.153	0.139	0.125	0.139	0.153	0.111	0.069	0.083	0.056	0.083	0.097	0.125	0.139	0.139	0.125
Limnonectes magnus	0.069	0.069	0	0.083	0	0.028	0	0	0	0.043	0.056	0.083	0.069	0.069	0.069
Platymantis guentheri	0.069	0	0	0.042	0	0.028	0.042	0.056	0.042	0.056	0.056	0.042	0.042	0.042	0.083
Platymantis corrugatus	0.111	0.042	0.014	0.028	0.056	0.042	0.056	0.069	0.042	0.083	0.069	0.014	0	0	0.111
Rana grandocula	0.056	0	0	0.028	0	0	0	0	0	0	0.042	0	0	0	0.042
Rana everetti	0	0	0	0.111	0	0	0	0	0	0	0	0	0	0	0
Nyctixalus spinosus	0.056	0	0	0.069	0.028	0	0	0	0	0.042	0	0.028	0.014	0	0.83
Rhacophorus appendiculatus	0.069	0.028	0.042	0.069	0.042	0.028	0.097	0.069	0.083	0.056	0.069	0.042	0.056	0.042	0.056
Rhacophorus pardalis	0.042	0	0	0.097	0.097	0.056	0.083	0.083	0.097	0	0.042	0.056	0.042	0	0.069

Presences of anurans were taken through anuran frequency in both areas.
Table 2.1 Anuran frequency in the forest area.

Eleven species were observed (Table 2.1), with Linmonectes magnus having the highest frequency across 15 sites except site 9 with 2 species of Rhacophorus having the highest frequency. The data suggest that the most abundant site in terms of the presence of anurans was site 4, having all the species listed in the table. Site 3 was the least abundant of all sites having only 4 species of anurans out of 11 species

Table 2.2 Anuran frequency in the agricultural area.

Anurans Species	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14	Site 15
Bufo marinus	0.069	0.097	0.111	0.153	0.083	0.167	0.097	0.083	0.125	0.167	0.125	0.139	0.111	0.181	0.097
Kaloula picta	0.153	0.181	0.125	0.139	0.153	0.111	0.097	0.111	0.083	0.097	0.125	0.069	0.125	0.139	0.069
Fejevarya cancrivora	0.097	0.125	0.125	0.139	0.139	0.111	0.111	0.097	0.097	0.097	0.153	0.069	0.111	0.139	0.111
Polypedates Leucomystax leucomystax	0.111	0.069	0.125	0.097	0.097	0.097	0.111	0.111	0.083	0.083	0.083	0.125	0.125	0.083	0.097
Polypedates Leucomystax quadrilineatus	0.097	0.083	0.083	0.111	0.083	0.056	0.083	0.097	0.083	0.083	0.069	0.083	0.069	0.083	0.083

The Agricultural area (Table 2.2), has only 5 species of anurans namely, Bufo marinus, Kaloula picta, Fejevarya cancrivora, Polypedates Leucomystax leucomystax, Polypedates Leucomystax quadrilineatus. All these species were present in all sites. These species only varied on its frequency of occurrence on every site.

This explains that the agricultural area can still support the needs of anuran in a limited way, having 5 species of anuran present in the area that has less plant species compared to the forest area.

Fractal Dimension of Plant Diversity

Site	Fractal Dimension of Forest Plant Cover	Fractal Dimension of Agricultural Plant Cover
Site 1	1.4777	1.4826
Site 2	1.4942	1.4623
Site 3	1.5178	1.4713
Site 4	1.5000	1.4826
Site 5	1.6411	1.4491
Site 6	1.6792	1.6566
Site 7	1.5938	1.621
Site 8	1.6141	1.621
Site 9	1.5938	1.5938
Site 10	1.6266	1.5938
Site 11	1.6054	1.574
Site 12	1.6141	1.6141
Site 13	1.5938	1.6141
Site 14	1.5938	1.6493
Site 15	1.685	1.6141
Average FD	1.588693333	1.566646667

Table 3 Results on the application of fractal analysis of plant diversity in both forest and agricultural areas.

The plant cover data suggested that the forest area was more diverse compared to the agricultural area having the forest area FD= 1.589 while agricultural area FD= 1.567.

These supported the evidence of the plant cover of forest area and agricultural areas, showing the plant cover of the forest area to have many plant species present on it compared to the agricultural area.

Fractal Dimension of Anuran Diversity

Table 4.1 Results of fractal dimension of anuran diversity in the forest area.

Forest Areas		Cansambol	Anunang	La Victoria	Cambuyo	Datag	Canlambong	Monte Video	Nueva Vida Este	Monte Hermoso	Danicop	Bugsoc	San Isidro	Casilay	Canlangit	Nan-od
Anurans Species		Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14	**Site 15**
Megophrys stejnegeri		0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.04
Kalophrynus pleurostigma		0.10	0.08	0.11	0.10	0.07	0.83	0.08	0.07	0.07	0.07	0.08	0.07	0.08	0.08	0.04
Limnonectes leytensis		0.15	0.14	0.13	0.14	0.15	0.11	0.07	0.08	0.06	0.08	0.10	0.13	0.14	0.14	0.13
Limnonectes magnus		0.07	0.07	0.00	0.08	0.00	0.03	0.00	0.00	0.00	0.04	0.06	0.08	0.07	0.07	0.07
Platymantis guentheri		0.07	0.00	0.00	0.04	0.00	0.03	0.04	0.06	0.04	0.06	0.06	0.04	0.04	0.04	0.08
Platymantis corrugatus		0.11	0.04	0.01	0.03	0.06	0.04	0.06	0.07	0.04	0.08	0.07	0.01	0.00	0.00	0.11
Rana grandocula		0.06	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.04
Rana everetti		0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nyctixalus spinosus		0.06	0.00	0.00	0.07	0.03	0.00	0.00	0.00	0.00	0.04	0.00	0.03	0.01	0.00	0.83
Rhacophorus appendiculatus		0.07	0.03	0.04	0.07	0.04	0.03	0.10	0.07	0.08	0.06	0.07	0.04	0.06	0.04	0.06
Rhacophorus pardalis		0.04	0.00	0.00	0.10	0.10	0.06	0.08	0.08	0.10	0.00	0.04	0.06	0.04	0.00	0.07
Fractal Dimension	Trial 1	1.4777	1.4942	1.5178	1.5000	1.6411	1.6792	1.5938	1.6141	1.5938	1.6266	1.6054	1.6141	1.5938	1.5938	1.6850
	Trial 2	1.5178	1.4942	1.4895	1.5000	1.5938	1.5275	1.4942	1.4826	1.4942	1.4895	1.4975	1.4656	1.4777	1.4623	1.5381
	Trial 3	1.5178	1.4942	1.4895	1.4826	1.5938	1.6792	1.5938	1.6141	1.5938	1.6266	1.6054	1.6141	1.5938	1.6266	1.6290
	Trial 4	1.6290	1.4942	1.4895	1.4826	1.6411	1.6792	1.5938	1.6141	1.5938	1.6266	1.6054	1.6141	1.5938	1.5938	1.6850
	Trial 5	1.4777	1.4942	1.4895	1.5000	1.5938	1.6202	1.5938	1.6141	1.5938	1.6266	1.6054	1.6141	1.5938	1.5938	1.6850
	AVERAGE	1.5240	1.4942	1.4952	1.4930	1.6127	1.6371	1.5739	1.5878	1.5739	1.5992	1.5838	1.5844	1.5706	1.5741	1.6444

The results in Table 4.1 shows site 15 (Barangay Nan-od) the most diverse compared to the other barangays. The least diverse is site 4 (Barangay Cambuyo). The top three barangays having the highest diversity were Site 15 (Barangay Nan-od) with FD=1.6444, followed by site 6 (Barangay Canlambong) with FD=1.6371 and site 5 (Barangay Datag) with FD=1.6127.

The results taken were analysed together with the result of the plant cover diversity. As observed, the highest diversity of the plant diversity was site 15, for the anuran diversity, the highest diversity was site 15 also. This explains that the anurans inhabit to where it find preferable.

This suggests that the forest provide heterogeneity of habitats that the anurans find it preferable to live with the presence of canopy epiphytes, pandan and ferns were good indicators of the presence of anurans such that they accumulates rainwater or moisture from air where some frog species breed (Alcala and Brown, 1998; Heanaey and Regalado, 1998).

Agricultural Areas		Cansambol	Anunang	La Victoria	Cambuyo	Datag	Canlambong	Monte Video	Nueva Vida Este	Monte Hermoso	Danicop	Bugsoc	San Isidro	Casilay	Canlangit	Nan-od
Anurans Species		Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14	Site 15
Bufo marinus		0.07	0.10	0.11	0.15	0.08	0.17	0.10	0.08	0.13	0.17	0.13	0.14	0.14	0.18	0.10
Kaloula picta		0.15	0.18	0.13	0.14	0.15	0.11	0.10	0.11	0.08	0.10	0.13	0.07	0.07	0.14	0.07
Fejervarya cancrivora		0.10	0.13	0.13	0.14	0.14	0.11	0.11	0.10	0.10	0.10	0.15	0.07	0.07	0.14	0.11
Polypedates Leucomystax leucomystax		0.11	0.07	0.13	0.10	0.10	0.10	0.11	0.11	0.08	0.08	0.08	0.13	0.13	0.08	0.10
Polypedates Leucomystax quadrilineatus		0.10	0.08	0.08	0.11	0.08	0.06	0.08	0.10	0.08	0.08	0.07	0.08	0.08	0.08	0.08
Fractal Dimension	Trial 1	1.4826	1.4623	1.4713	1.4826	1.4491	1.6566	1.6210	1.6210	1.5938	1.5938	1.5740	1.6141	1.6141	1.6493	1.6141
	Trial 2	1.4561	1.4091	1.4488	1.3968	1.3968	1.4473	1.4547	1.4547	1.4494	1.3827	1.3517	1.3968	1.3968	1.4488	1.3968
	Trial 3	1.4826	1.4623	1.4713	1.4826	1.4491	1.4826	1.4713	1.4713	1.4713	1.4713	1.4826	1.4826	1.4826	1.4713	1.4826
	Trial 4	1.4826	1.4623	1.4713	1.4826	1.4491	1.4826	1.4713	1.4713	1.4713	1.4713	1.4826	1.4826	1.4826	1.4713	1.4826
	Trial 5	1.4826	1.4623	1.4713	1.4826	1.4491	1.4826	1.4713	1.4713	1.4713	1.4713	1.4826	1.4826	1.4826	1.4713	1.4826
	AVERAGE	1.4773	1.4517	1.4668	1.4654	1.4386	1.5103	1.4979	1.4979	1.4914	1.4781	1.4747	1.4917	1.4917	1.5024	1.4917

Five trials were done to get the result of the fractal dimension of anurans in the agricultural area (Table 4.2). The most diverse of all the sites was site 6 (Barangay Canlambong) with FD=1.5103 and the least diverse was site 5 (Barangay Datag) with FD=1.4386. The top three with the highest diversity of anurans in the agricultural area were site 6 (Barangay Canlambong) FD=1.5103, site 14 (Barangay Canlangit) FD=1.5024, and site 7 (Barangay Monte Video) and site 8 (Barangay Nueva Vida Este) having the same FD=1.4979.

Same thing were done to the anuran diversity found in the agricultural area. As observed the highest diversity of the plant cover in the agricultural area was site 6, and the highest diversity of anuran were also found in site 6.

On the other hand the agricultural area having less number of anurans shows that it is not as preferable as the forest is. Since they were lesser number of trees and plants in the agricultural area, it cannot provide protection from extreme temperature and has less water. Thus, anthropogenic disturbance such as conversion of forest to agricultural areas may lead to extinction of some anuran species that are adapted to a forest habitat (Gray et al., 2004).

Table 4.3 Results of fractal dimension of anurans in both habitat.

Barangays/Sites	Forest Areas	Agricultural Areas
Site 1 (Cansambol)	1.52	1.48
Site 2 (Anunang)	1.49	1.45
Site 3 (La Victoria)	1.50	1.47
Site 4 (Cambuyo)	1.49	1.47
Site 5 (Datag)	1.61	1.44
Site 6 (Canlambong)	1.64	1.51
Site 7 (Monte Video)	1.57	1.50
Site 8 (Nueva Vida Este)	1.59	1.50
Site 9 (Monte Hermoso)	1.57	1.49
Site 10 (Danicop)	1.60	1.48
Site 11 (Bugsoc)	1.58	1.47
Site 12 (San Isidro)	1.58	1.49
Site 13 (Casilay)	1.57	1.49
Site 14 (Canlangit)	1.57	1.50
Site 15 (Nan-od)	1.64	1.49
AVERAGE	1.57	1.48

The two habitats for fractal dimension of anurans were tabulated in one table to compare the difference (Table 4.3). All the results of all sites on every habitat were added and got its average. It shows that the forest area (FD= 1.57) was more diverse compared to the agricultural area.

When analysed with its plant cover diversity, it showed that the results coincide with the results of the anuran diversity through the use of fractal analysis in both agricultural and forest areas.

From the results, researchers found out that the forest area is more diverse than in the agricultural area in terms of the presence of anurans. Anurans prefer a forest area compared to lower vegetation of agricultural area.

Linear Regression

Table 5: Result for the linear regression of the combined fractal dimension results of anuran diversity and plant diversity.

The regression equation is Diversity anurans per Site = 0.807 + 0.455 COVER Diversity of plants per site				
Predictor	Coef	SE Coef	T	P
Constant	0.80736	0.05930	13.61	0.000
Cover Di	0.45543	0.03756	12.12	0.000
S = 0.008889 R-Sq = 91.9% R-Sq(adj) = 91.3%				

The results of the fractal dimension of the plant covers and the presence occurrence of anurans were calculated in the MINITAB Software to determine the correlation between the two variables through Multiple Linear Regression. The result (Table 5) shows that the anuran species' diversity increased the as the number of plant cover species increased with R-Sq= 91.9% of increase, indicates the increase of anurans species diversity as the number of species of the plant covers in both agricultural and forests increased. The result further suggests that for every unit increase of the number of species in the cover increased the anurans species' diversity to approximately 45.5%, suggesting a positive correlation.

5.0 CONCLUSION

From the data, the most diverse habitat was the forest area. The fractal statistics analysis results can determine which habitat was more diverse. Habitat features were found to be important factor in determining the presence and distribution of anurans. These included the biotic factors that might elevate the extinctions of anuran species within such habitat. This suggested that the place should need to be protected.

As a result this study shows a high species distribution of anurans in the forest habitat.

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