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Simpson & Marisa Floral Diversity Index

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ABSTRACT: Most of floral diversity analysis use Shannon index for determining diversity of species in community. These index use individual proportion number of species for diversity index result. For one place analysis of diversity, it is not sufficient to descript the level of diversity, because of no range of diversity level. In order to get more perfect result, it is proposed to use Simpson diversity index as published in Krebs (1985); because the formula gave 0 – 1 range index, where the highest diversity represented by 1. And on perfection of these formula, it is proposed to use importance value data, alternatively for species proportion. Importance value represent the dominance of species ecologically, because it come from species existence frequency, species individual number,and species coverage on land. We could call these formula as Simpson and Marisa index of diversity for vegetation.

Keywords: simpson diversity index, importance value

I. INTRODUCTION

Species diversity may be thought of as being composed of two component. The first is the number of the species in the community, which ecologist often refer to species richness. The second component is species evenness or equitability.Evenness refer to how the species abundance (e.g., the number of individuals, biomass, cover, etc) are distributed among the species. For example, in a community composed of ten species, if 90 % of the individuals belong to a single species and the remaining 10 % are distributed among the nine other species, evenness would be considered low. On the other hand, if each of the ten species accounted for 10 % of the total number of individuals, evenness would be considered maximum (Ludwig & Reynolds, 1988).

There are some formulas of diversity index, according to each author. Hill (1973b in Ludwig & Reynolds, 1988) proposed below formula , and believed , the easiest to interpret ecologically:

$$N_A = \sum_{i=1}^{S} (p_i)^{1/(1-A)}$$

p_i = proportion of individuals (or biomass, etc) belonging to the i_{th} species.
S = total number of species.

Begon et al.,1986, wrote that the simplest measure of the character of a community that takes into account both the abundance patterns and the species richness is Simpson's diversity index. This is calculated by determining for each species, the proportion of individuals or biomass that it contributes to the total in the sample, i.e., the proportion is P_i for the i_{th} species:

$$\text{Simpson's index } D = \frac{1}{\sum_{i=1}^{S} P_i^2}$$

S = total number of species

Then, if we study furthermore about diversity formula, the popular one is Shannon diversity index as below:

$$\text{Diversity } H = -\sum_{i=1}^{S} P_i \ln P_i$$

Above function was derived independently by Shannon and Wiener. It is sometimes mislabeled the Shannon-Weaver function (Krebs, 1985). These formula also used as below (Krebs, 1985):

$$\text{Diversity } H = -\sum_{i=1}^{S} P_i \log_2 P_i$$

On the other hand, Krebs (1985) published that Simpson diversity index as below:

$$D = 1 - \sum_{i=1}^{S} (p_i^2)$$

Simpson index of diversity as in Krebs (1985) gives relatively little weight to the rare species and more weight to the common species. It ranges in the value from 0 (low diversity) to a maximum of (1 – 1/S), where S is the number of species.

Plant ecologist always use important value number to explain the dominance of a species in community, after measure the relative dominance, relative frequency and relative density. Some question could be asked now; which of those diversity formula good for descript diversity and could importance value be used as data for diversity measurement? To answer this question this paper be proposed.

II. METHODS

Data from ecology textbook were computed by our proposed formula that more representative to use in plant diversity computation. Data come from Mueller-Dombois & Ellenberg (1974) and Soerianegara & Indrawan, 1978). The results then be compared with previous formula that usually used in plant diversity computation

III. RESULT AND DISCUSSION

It is better to realize the function of proportion and existency of range of diversity before try to calculate important value of species in diversity index. The function of proportion of species incommunity in determining diversity index has clearly explained in Krebs (1985) and Begon et al., (1986). Furthermore, let us select the better one of two version of Simpson formula; in Krebs (1985) and in Begon (1986). We could choose the Krebs (1985) formula, because this formula give us the range, between low diversity (0) and highest diversity (1). These strenght could be used to explain plant diversity eventhough we just have one location observation, without need to compare with the other one. Now, we use the importance value of species as species data for Krebs (1985) version of Simpson formula. We could use Mueller-Dombois & Ellenberg (1974) data, come from Point Center Quarter Method at Gently Sloping Ridge below Pauoa Flats (Data March 4, 1972).

Tabel 1. Importance value of 4 species after calculated by sum of relative density, relative dominance and relative frequency.

no	Species	Number of individu	Importance value
1	Acaca koa	6	139.2
2	Metrosideros collina	4	57.0
3	Metrosideros tremuloides	1	18.5
4	Psidium guajava	9	85.4

From above data we could see that number of individu is not parallel with importance value. Why? Because importance value not only come from density of plant in community, but from frequency and dominance too. So if calculate the diversity index by using Simpson formula as Krebs (1985) published, we would find the value of diversity as:

$D = 1 – [(6/20)^2 + (4/20)^2 + (1/20)^2 + (9/20)^2] =$ 0,665

On the other hand, if we use importance value data to calculate the diversity index we would find below calculation:

$D = 1 – [(139.2/300)^2 + (57/300)^2 + (18.5/300)^2 + (85.4/300)^2 =$ 0.664

Above simple example is come from 4 species, and just find the different between the results if we use individuals number of species and importance value of species. If the data come from hundreds of inviduals and tens of species, we would find the real different on diversity index. Let us see below example.

Table 2. Data number individu and importance value of Natural Forest Resort, Cibodas, 1977 (Soerianegara & Indrawan, 1978).

no	Species	∑	IV	no	Species	∑	IV

1	Altingia excelsa	4	61.2	10	Ostodes sp	2	19.8
2	Castanopsis argentea	1	14.0	11	Persea rimosa	1	13.3
3	C. tunggurut	2	20.2	12	Pinanga kunii	1	12.1
4	Ehertia javanica	1	17.2	13	Quercus pseudomoluca	1	12.6
5	Ehertia sp	1	17	14	Schima wallichii	1	12.6
6	Ficus sp	1	8.7	15	Saurauya pendula	3	21.81
7	Ficus variegata	1	11	16	Xylebrunia rubescens	2	18.3
8	Litsea pamasea	1	9.4	17	Ostodes paniculata	2	13.7
9	Macropanax dispermum	2	13.1		T o t a l	27	

Calculated traditional D : 0.9245 New version of D (Simpson & Marisa) : 0.754

Which of them good for us? Mueller-Dombois & Elenberg (1974) explained that importance value in this case come from density, basal area and frequency of each species in community; it means better for us to consider importance value data for calculating plant diversity index.
So it is recommended to use the final formula as:

$$D = 1 - \sum_{i=1}^{S} (IV_i / IV_t)$$

where S = number of species and IV = importance value

Now we could call this formula as Simpson & Marisa index for plant diversity.

IV. SUMMARY

On perfection of Simpson diversity formula, it is proposed to use importance value data, alternatively for species proportion. Importance value represent the dominance of species ecologically, because it come from species existence frequency, species individual number,and species coverage on land. We could call these formula as Simpson and Marisa index of diversity for vegetation

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