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Species Diversity and Evenness of Some Organisms in Usumani and Imo Rivers, Abia State, Nigeria

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ABSTRACT

An analytical study was done on the species diversity and species evenness of some organisms in Usumani river and Imo rivers (at Owerrinta and Uzuaku) in Abia State , Nigeria.The study area was surveyed to establish sampling points downstream and plankton net of 80µM mesh and 18cm diameter was used to collect the Planktons for wet microscopy (at X 40) to establish available microscopic organisms. Organisms were identified on the basis of acceptable scientific procedures: using indexed invertebrates and non flowering plants. Shannon Weinner's diversity index(H), and Pileos's evenness index (J) or Equitability, were adopted in establishing the diversity and evenness of the species respectively. Results of the study show that the highest diversity index of 2.0312 and equitability (evenness) index of 0.8471 were recorded at Usumani river . At Imo river Uzuaku, diversity index of 0.6560 and equitability of 0.4076 were recorded. In addition, Imo river Owerrinta had diversity index of 0.7407 and equitability of 0.4134.

Keywords: *Species, diversity, evenness, Survey, Downstream, Planktons, Shannon Weinner, Pileo*

I. INTRODUCTION

Ecologists have shown that differences in how species interact with their environment counter the inevitable loss of biodiversity that occurs when better competitors overrun their inferior counterparts(Levine and HilleRisLambers,2012).The biological species concept, as described by Mayr and Ashlock (1991), states that a species is a group of interbreeding natural populations that is productively isolated from other such groups'. According to the phylogenetic species concept, as defined by Cracraft (1983), a species is the smallest diagnosable cluster of individual organisms within which there is a parental pattern of ancestry and descent.

When two or more groups show different sets of shared characters, and the shared characters for each group allow all the members of the group to be distinguished relatively easily and consistently from the members of another group, then the groups are considered different species. This approach relies on the objectivity of the phylogenetic species concept and applies it to the practicality of the morphological species concept, in terms of sorting specimens into groups (Kottelat 1995).

In his book *Ancient Forests of the Pacific Northwest'* , Norse (1990) identified three levels of biological diversity:

1. The species diversity:- is the kind that we are familiar with. It is represented by the incredible variety of different species on the planet.

2. Within any species, there is genetic diversity:-this is the variety of combinations possible at the molecular level and is represented by all the possibilities in the coding of the very complex DNA molecule. That gives rise to all the variations in colours or size or all the other slight differences that make individuals within the particular species .

3. The third level of biodiversity is ecosystem diversity:- an ecosystem is the result of all the biological, climatic, geological and chemical 'ingredients' in a particular area.

   This total combination of factors give rise to certain kinds of plant and animal communities whose needs can be met by interacting with all the other parts of the ecosystem.

This study therefore seeks to establish the species evenness/equitability and diversity of some species in three focal areas (rivers): Usumani river and Imo river at Owerrinta and Imo river at Uzuaku, all in Abia State Nigeria. Such parameters (species diversity and evenness) are often the justifications for the level of stability applicable to the fresh water communities investigated.

II. METHODOLOGY

Plankton net of 80µM mesh and 18cm diameter was used to collect Plankton samples for wet microscopy, conducted to establish some algal filaments and invertebrates. Direct counting of invertebrates in the sampled area was executed in accordance with William (1996). The species were established using animal index and plants index.

III. RESULT

Table 1: The selected aquatic fauna and flora at sampling points.

Aquatic Lives Observes	IM 1 W	IM 2 W	IM 3 W	IM 4 W	IM 5 W	IM IU	IM 2U	IM 3U	IM 4U	U SI	U S2	U S 3	US 4	US 5	EF F
Fingerlings of Tilapia sp	-	-	-	7	7	3	-	6	-	9	5	-	-	-	-
Spirogyra sp	-	26	-	-	-	-	17	-	-	40	-	-	-	-	-
Chlamydomonas sp	-	-	-	-	-	-	-	-	-	-	-	-	20	-	-
Closterium sp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aeshna sp (dragonfly larva)	-	5	-	-	-		3	-	-	-	-	2	2	-	-
Mayfly (Baetis sp)	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-
Larva of dronefly fly	-	3	-	-	-	-	7	-	-	-	-	-	5	-	-
Culex mosquito larva/pupa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20
Water scorpion (Nepa sp)	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-
Dytiscid beetle (Eretes sp)	-	-	-	-	-		13	-	-	5	4	6	-	5	-
Water measurer (hydrometra)	-	-	-	-	7		-	-	-	1	1	1	-		-
Pond skater (Gerris sp)	-	-	-	-	5		-	-	-	2	-	2	-	1	-
Herpobdella sp(leech)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tadpoles	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Key : IM..W = Imo river Owerrinta , Im..U = Imo river Uzuaku US = Usumani river, Abiriba

+= positive (observed activity). - =Negative(not observed) . Figures(1…) = sampling points

Distribution of species studied in sampling points.

- Fingerlings of *Tilapia sp*:- These were common in sampling points: IM2 U, IM4 W, IM5W, IM1U, IM3U, US1 and US2
- Spirogyra: This alga was common in sampling points: IM2W, US1 and US2
- *Chlamydomonas*:- This was record at sampling points US1 and US4
- Mayfly (*Beatis*):- Was common in sampling point US3
- Dronefly (larval form):- Was common is sampling points IM2W, IM2U
- *Aestina sp*:- Was common at sampling points IM2W, IM2U, US3and US5
- Dysticid beetle :- This was recorded in sampling points: IM2U,US1, US2, US3 and US5
- Water measurer (an insect):- This was recored in samplimg points IM5 W, US1,US2 and US3
- Pond Skater (an insect):- Was recorded in sampling points: IM5W, US1, US3 and US5.

Tilapia sp, *Eretics sp* (Dysticis beetle) and spirogyra were the most diverse of the aquatic fauna and flora. *Hypobdella sp* and *Closterium sp* (an alga) were the least in distribution. The result equally shows that fingerlings of *Tilapia sp*, Dysticid beetle (*Eretis sp*) and the green alga-spirogyra were the most evenly spread of the aquatic organisms studied. The least, in terms of spread were *Closterium sp* and *Hepobdella sp* (an annelid).

THE DETERMINATION OF SPECIES DIVERSITY USING SHANNON WEINER'S INDEX

SURFACE WATER COMMUNITY : USUMANI RIVER

Table 2: Calculation of Shannon Weiner's index of species diversity in Usumani river

Species	Number(n_i)	$n_i/N=P_i$	$(P_i)^2$	P_i Log e (P_i)
Tilapia sp	14	0.1022	0.0104	-0.2331
Spirogyra sp	40	0.2920	0.0853	-0.3595
Chlamydomonas sp	20	0.1460	0.0213	-0.2837
Aestina sp	4	0.0292	0.0853	=0.1032
Mayfly (baetis sp)	3	0.0219	0.0005	-0.837
Dronefly larva *(Erisolis sp*	5	0.0365	0.0013	-0.1208
Mosquito larva *(culex)*	20	0.1460	0.0213	-0.2809
Water scorpion*(Nepa sp)*	3	0.0219	0.0005	-0.0837
Dystiscid beetle *(Eretis sp)*	20	0.1460	0.0213	-0.2809
Water measurer	3	0.0219	0.0005	-0.0837
Pond skater	5	0.0365	0.0013	-0.1208
Total	**137**		**0.2490**	**-2.0312**

SHANNON WEINNER'S INDEX OF SPECIES DIVERSITY (H)

$-\sum P_i$ Log e (P_i) = - (-2.0312) = 2.0312

H_{max} = Log e S i.e Log .ex 11 = 2.3979

Pileos's evenness index (J) or Equitability

J = (H) / (H_{max}) i.e - $\sum P_i$ log (P_i) / Log e S =2.0312/2.3979 = 0.8471

(B) THE DETERMINATIONS OF SPECIES DIVERSITY USING SHANNON WEINER'S INDEX

SURFACE WATER COMMUNITY : IMO RIVER, OWERRINTA

Table 3: Calculation of Shannon Weiner's index of species in Imo river, Owerrinta

Species	Number(n_i)	$n_i/N=P_i$	$(P_i)^2$	P_i Log e (P_i)
Tilapia sp	14	0.3500	0.1225	-0.2572

Spirogyra sp	26	0.4333	0.1877	0.3140
Aestina sp	5	0.1250	0.0156	-0.0649
Dronefly larva *(Eristolis sp)*	3	0.0750	0.0056	-0.0290
Water measurer	7	0.01750	0.0306	-0.0107
Pond skater	5	0.1250	0.0156	-0.0649
Total	**60**	**1**		**-0.7407**

SHANNON WEINNER'S INDEX OF SPECIES DIVERSITY (H)

$-\sum P_i \text{ Log e } (P_i) = - (-0.7407) \quad = 0.7407$

H_{max} = Log e S i.e Log e 6 = 1.7018

Pileos's evenness index (J) or Equitability

$J = (H) / (H_{max})$ i.e $- \sum P_i \log (P_i) / \text{Log e S} \quad = 0.7407/1.7918 \quad = 0.4134$

THE DETERMINATIONS OF SPECIES DIVERSITY USING SHANNON WEINER'S INDEX

SURFACE WATER COMMUNITY : IMO RIVER, UZUAKU

Table 4: Calculation of Shannon Weiner's index of species in Imo river, Azuaku.

Species	Number(n_i)	$n_i/N=P_i$	$(P_i)^2$	$P_i \text{ Log e } (P_i)$
Tilapia sp	9	0.1837	0.0337	-0.1143
Spirogyra sp	17	0.3469	0.1203	0.2548
Aestina sp	3	0.10612	0.0037	-0.0207
Dronefly larva (*Eristolis sp*)	7	0.1429	0.0204	-0.0794
Dystiscid beetle	13	0.2653	0.0704	0.1868
Total	**49**		**0.2485**	**-0.6560**

SHANNON WEINNER'S INDEX OF SPECIES DIVERSITY (H)

$-\sum P_i \text{ Log e } (P_i) = - (-0.6560)$

$= 0.6560$

H_{max} = Log e S i.e Log e 11

$= 1.6094$

Pileos's evenness index (J) or Equitability

$J = (H) / (H_{max})$ i.e $- \sum P_i \log (P_i) /$ Log e S

$=0.6560/1.6094$

$= 0.4076$

IV. DISCUSSION

An evolutionarily significant unit (ESU) is defined, in conservation biology, as a group of organisms that has undergone significant genetic divergence from other groups of the same species. According to Ryder (1986), identification of ESUs requires the use of natural history information, range and distribution data and results from analyses of morphometric cytogenetics, allozymes and nuclear and mitochondrial DNA.

In this study, the highest diversity index of 2.0312 and equitability (evenness) index of 0.8471 were recorded at Usumani river . Imo river at Uzuaku, recorded diversity index of 0.6560 and equitability of 0.4076 while Imo river at Owerrinta had diversity index of 0.7407 and equitability of 0.4134.Species that inhabit a given ecosystem are those best adapted to growth with the nutrients and conditions that prevail there(Michael,John,Paul and David 2009). In evolutionary terms and hence in many systematic studies, species are recognized as the minimum identifiable unit of biodiversity (Kottalat, 1997). Thus there is generally more systematic information available for species diversity than for subspecific categories and for ESUs. Consequently estimates of species diversity are used more frequently as the standard measure of overall biodiversity of a region. In some places and some groups, hundreds of species exist, whereas in others, very few have evolved; the tropics, for example, are a complex paradise compared to higher latitudes.The interplay between environment and living organisms, and between the organisms themselves play key roles in encouraging or discouraging diversity, as do human disturbances, predator –prey web connections.

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