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Assessing Flora Bio-Diversity in Water Shed Environment and A Forest Environment: A Comparative Analysis of Ikot Uso Akpan Wildlife Sanctuary in Itu L.G.A. And Ayan Nsit Sacred Forest in Nsit Ibom L.G.A. Akwa Ibom State, Nigeria

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Abstract
Aim
Flora diversity in a watershed environment is dynamic and flora diversity in a forested environment is also dynamic. This study considers the dynamic nature of flora composition in both environments accounting for its diversity and similarity.
Location
The study areas were two sampled sites from a common ecological zone; Ikot Uso Akpan wildlife sanctuary and Ayan Nsit Sacred Forest all in Akwa Ibom State, Nigeria.
Taxons
The paper considered mostly species of the Aracaceadeas and other floral population within the sampled points
Methods
Both sites were sampled using systematic sampling methods using quadrats laid at 10m x10m on transects with 100 meters dimension.
Results
The study showed a high diversity index of 0.93 for the forested site and 0.92 for the water shed site. The reciprocal indexes were 1.07 and 1.09 respectively. Also the study determined the level of species overlap in both sites both this gave a negative value of 0.14 indicating no overlap. However, species of the Aracaceae family proved to be the richest with 51.82% and 29.69% of the total population.
Main Conclusion
The study revealed that species ecological importance value as exhibited by different population structure between the two points studied show a clear variation in the population structure of plants though they have same ecological characteristics.
Keywords: Diversity, Dynamics, Forest, Variation, Watershed, Wildlife

INTRODUCTION

The diversity of plants living in a specific region at a particular time is referred to as 'floral diversity'. Floral diversity varies spatially and it is dynamic. The composition of plants making up the population of a habitat is not uniformed spatially. Diversity is a measure of the heterogeneity of a site taking into consideration the number and density of individual species (Ogunleye et. Al. 2004). Diversity studies have taken the prime of scientific research due to the rate of exploitation of land resources. Thus, a study of biodiversity composition and dynamics is of importance to the sustainable livelihood as it assesses the available or the remaining unexploited diversity.

According to Oka et al. (2004), our forest lands are fast disappearing and only the relics are left to behold. Sacred forests are not left out in the continued forest destruction, more so when the present status of plant species composition remain largely unknown (Laloo et al., 2006). Sacred forests are a group or patch of vegetation protected by the local people through religious and cultural practices evolved to minimize destruction

(Israel et al., 1998; Jeeva et al., 2005).

A watershed being an area of land from which all water drains, running downhill, to a shared destination (a river, pond, stream, lake, or estuary) could also be defined as a catchment basin that is bound by topographic features, such as ridge tops.

MATERIALS AND METHODS

Study Area

The study area involves two sample sites from two local governments in Akwa Ibom state, Nigeria. Ayan Nsit Sacred Forest is about 28 ha and situates in Nsit Ibom Local Government Area (LGA) of Akwa Ibom State (as shown in FIG.1). Nsit Ibom LGA lies between latitude 7o50′E and longitude 4o47′N, with a land area of about 193,105km² and total population of 108,095 people (FRN, 2007). Ayan Nsit sacred forest has a long historical background in traditional worship. The topography of the forest is fairly undulating; rainfall varies from 1500mm to 2000mm with mean annual temperature and humidity range of 26oC - 28oC and 75% - 85% respectively (Nsit Ibom LGA, 2002).

Ikot Uso Akpan Wildlife Sanctuary is in Itu Local Government Area of Akwa Ibom State (as shown in FIG.2). Akwa Ibom State is situated between latitudes 4º31' and 5º30' N and longitude 7º31' and 8º20' E. It has a total land area of about 8,412km². The topography is partly plain (flat) and hilly, the surrounding lands are cultivated. The area has characteristically two seasons, dry and wet seasons. The dry season of the area occurs between November and April, while the wet season stretches between May and October. Rainfall is heavy and ranges from 3,000mm along the coast, but decreases to 2,000mm on the North fringe. Mean temperature of the area is usually uniformly high throughout the year with slight variation between 25ºC and 28ºC.

Data Collection and Analysis

Data for the watershed environment was derived using Systematic sampling method; species were sampled in 10m x 10m quadrat, spaced at regular interval of 100m (Ogbemudia et. al, 2013). Plants were enumerated and species were properly identified to the species level. For the forest community, an extensive reconnaissance survey was carried out between July and October 2010 by Udofia et. al. (2014). Line transect was then laid at 20m away from each other and parallel to the access route. Plant species found within 20m on both sides of the transect were enumerated and recorded. The data collected was analysed using the Simpson's Diversity index given as:

$$\text{Simpson's diversity index } D = 1 - \left(\frac{En(n-1)}{N(N-1)} \right)$$

Simpson's reciprocal index= 1/D

Sorrenson's co-efficient is used to measure species overlap given as:

$$CC = \frac{2C}{S1+S2}$$

RESULTS

Forest Community

a. Measuring Diversity

The Simpson's Diversity Index is a mathematical formula that takes into account species richness and evenness. When maximum diversity occurs, the value of the index is zero and when minimum diversity occurs, the value of the index is 1. The range is therefore 0 - 1 with an inverse relationship between diversity and the index value. It is given as shown in table 1;

Species	No. of individuals per hectares	n-1	n(n-1)
Musanga cecropioides	2	1	2
R*aphia hookeri*	18	17	306
Elaeis guineensis	5	4	20
Dacryodes edulis	2	1	2
Magnifera indica	1	0	0
Anacardium occidentale	1	0	0
Spondias mombin	4	3	12
Ceiba pentandra	2	1	2
Pistia sratiotes	9	8	72
Crystoperma senegalensis	9	8	72
Xanthosoma maffafa	19	18	342
Caladium Bicolor	11	10	110
Diodia scandens	2	1	2
Platycerium stemaria	2	1	2
Musa sapientum	7	6	42
Coula edulis	1	0	0
Lasienthera africana	7	6	42
Pycnanthus angolensis	2	1	2
Pterocarpus soyauxii	4	3	12
Leucaenae leococephala	2	1	2
Pentaclethra macrophylla	1	0	0
Xylopia aethiopica	5	4	20
Acanthus montanus	14	13	182
Gongronema latifolium	7	6	42
Total	137		1288

Table 1.Simpson Diversity Index distribution

Simpson's diversity index D= 1- $\left(\frac{En(n-1)}{N(N-1)}\right)$

$1-\left(\frac{1288}{137\ (137-1)}\right)$

Simpson's diversity index = 0.93

This indicates a high level of diversity in the composition of the species in the forest community.

Simpson's reciprocal index= 1/D

= 1/0.93

= 1.07

b. Measuring Family Richness within Species

Species	No. of individuals per hectares	Family
Musanga cecropioides	2	Cecropiaceae
Raphia hookeri	18	Aracaceae
Elaeis guineensis	5	Aracaceae
Dacryodes edulis	2	Burseraceae
Magnifera indica	1	Anacardiaceae
Anacardium occidentale	1	Anacardiaceae
Spondias mombin	4	Anacardiaceae
Ceiba pentandra	2	Bombacaceae
Pistia sratiotes	9	Aracaceae
Crystoperma senegalensis	9	Aracaceae
Xanthosoma maffafa	19	Aracaceae
Caladium Bicolor	11	Aracaceae
Diodia scandens	2	Rubiaceae
Platycerium stemaria	2	Polipodiaceae
Musa sapientum	7	Musaceac
Coula edulis	1	Olacaceac
Lasienthera africana	7	icacinaceac
Pycnanthus angolensis	2	Myristicaceae
Pterocarpus soyauxii	4	Leguminosae
Leucaenae leococephala	2	Leguminosae
Pentaclethra macrophylla	1	Leguminosae
Xylopia aethiopica	5	Annonaceae
Acanthus montanus	14	Acanthaceae
Gongronema latifolium	7	Asclepiadaceae
Total	137	

Table 2: Family richness of species

Species of the Aracaceae family are the richest in number of individuals in the forest community as seen in table 2 with number of individuals in the sampled community = 71

= 51.82% of the total population.

Watershed Community

a. Measuring Biodiversity

Species	No of individuals per hectares	n-1	n(n-1)
Aframomum sceptrum	*4*	3	12
Baphia nitida lodd	*4*	3	12
Barteria nigritiana Hook. F.	16	15	240
Brachystegia eurycoma	16	15	240
Carpolobia lutea	4	3	12
Coelocaryon preussi	4	3	12
Costus afer	4	3	12
Costus schlechteri	4	3	12
Dracaena arborea	4	3	12
Elaeis guineensis	29	28	812
Homalium letestui	8	7	42
Musanga cecropioides	12	11	132
Palisota hirsute	8	7	42
Parkia biglobosa	4	3	12
Pentaclethra macrophylla	4	3	12
Persea americana	4	3	12
Ptero carpus osun	8	7	12
Raphia hookeri	20	19	380
Rauvolfia vomitoria	4	3	12
Tristemma hirtum	4	3	12
Total	165		2044

Table 3: Biodiversity distribution in watershed

Simpson's diversity index D= 1- $\left(\frac{En(n-1)}{N(N-1)}\right)$

$= \left(\frac{2044}{165(165-1)}\right)$

=0.92

Simpson's reciprocal index= 1/D

= 1/0.92

= 1.09

b. Measuring within species family richness

Species	No of individuals per hectares	Family
Aframomum sceptrum	*4*	Zingiberaceae
Baphia nitida lodd	*4*	Papillionaceae
Barteria nigritiana Hook. F.	16	Typus
Brachystegia eurycoma	16	Passifloraceae
Carpolobia lutea	4	Caesalpiniaceae
Coelocaryon preussi	4	Polygalaceae
Costus afer	4	Costaceae
Costus schlechteri	4	Costaceae
Dracaena arborea	4	Dracaenaceae/ Agavaceae
Elaeis guineensis	29	Arecaceae/ Palmae
Homalium letestui	8	Flacourtiaceae
Musanga cecropioides	12	Cecropiaceae
Palisota hirsute	8	Commenliaceae
Parkia biglobosa	4	Fabaceae
Pentaclethra macrophylla	4	Mimisaceae
Persea americana	4	Lauraceae
Ptero carpus osun	8	Papilionaceae
Raphia hookeri	20	Arecaceae/ Palmae
Rauvolfia vomitoria	4	Apocynaceae
Tristemma hirtum	4	Melastomataceae
	165	

Table 4: Family richness within watershed community.

As seen in Table 3 and 4 above, Arecaceae is the richest family of species in the Watershed community with individual members accounting for 49 individuals in the sample sites = 29.69% of the total population.

Measuring species overlap in the two sites

Sorrenson's co-efficient is used to measure species overlap given as:

$CC = \frac{2C}{S1+S2}$

Where C is the number of species the two communities have in common., S1 is the total number of species found in Community 1 and S2 is the total amount of species found in community 2.

Forested community= 24 species

Watershed community= 20 species

They have three species in common namely:

1. *Raphia hookeri*
2. *Elaeis guineensis*
3. *Pentaclethra macrophylla*

Sorenson's co-efficient= $\frac{2*3}{24+20} = \frac{6}{44} = 0.14$.

This indicates that there is no species overlap between the two communities and that each community is diverse in its species composition.

DISCUSSION OF FINDINGS

The main aim of the study was to evaluate the floral diversity in a watershed environment and a forest environment in a tropical rainforest ecosystem. Species diversity index was calculated for the different

communities. The Simpson's diversity index was used and this gave the value of 0.93 for the forest community and 0.92 for the watershed community. The implications of the values are that there is a very high rate of species diversity in both communities. This means that both communities are rich in various types of flora species and that there is no singular uniform distribution of species in any of the communities. This correlates with general common characteristics of the tropical floral composition of high diversity. The reciprocal index was also calculated and the results were 1.07 and 1.09 respectively. The reciprocal index indicates the possibility that any species chosen at random belong to at least one family in the community. The result was positive that any species chosen at random belongs to at least a different family.

Within family richness was calculated. This was done to identify the family richest in number of individual species in the community. From the result of the analysis, the Aracaceae family appears to be the richest with value of 51.82% of the population in the forest community and 29.69% of the population in the water shed environment. Although the Aracaceae family presents itself as the richest, it appears to be richer in the forest community than in the watershed communities this implies that Aracaceae or the palm family is commoner in the Forest than in the watershed environment.

Species overlap (which is a type of similarity index), was calculated to determine if there is presence of similar species in the two communities. This however gave a negative result of 0.14 and just three species were observed to have been duplicated they are: *Raphia hookeri, Elaeis guineensis and Pentaclethra macrophylla ,* indicating that each of the community enjoys a uniqueness in flora composition.

CONCLUSION

The study has revealed that in there exist internal dynamics and variation in the composition of flora biodiversity in the two communities. The watershed community and the forest community show no correlation in species overlap this implies that each community is unique in its floral composition. However there exist a common and dominant family of flora the Arecaceae family which show a high level of presence and richness in both communities. With the variant of its species it dominates both communities in richness and presence.

Thus we can interpolate that each ecosystem in the state is peculiar and dynamic and should be preserved as floral species is location defined. That is the degradation of a habitat may lead to the extinction of a flora species native to that location and may not be found again in any other location. The study has revealed the indigenous nature of floral species to their habitat and the scarcity in replication in other ecosystems irrespective of the prevailing ecological zoning.

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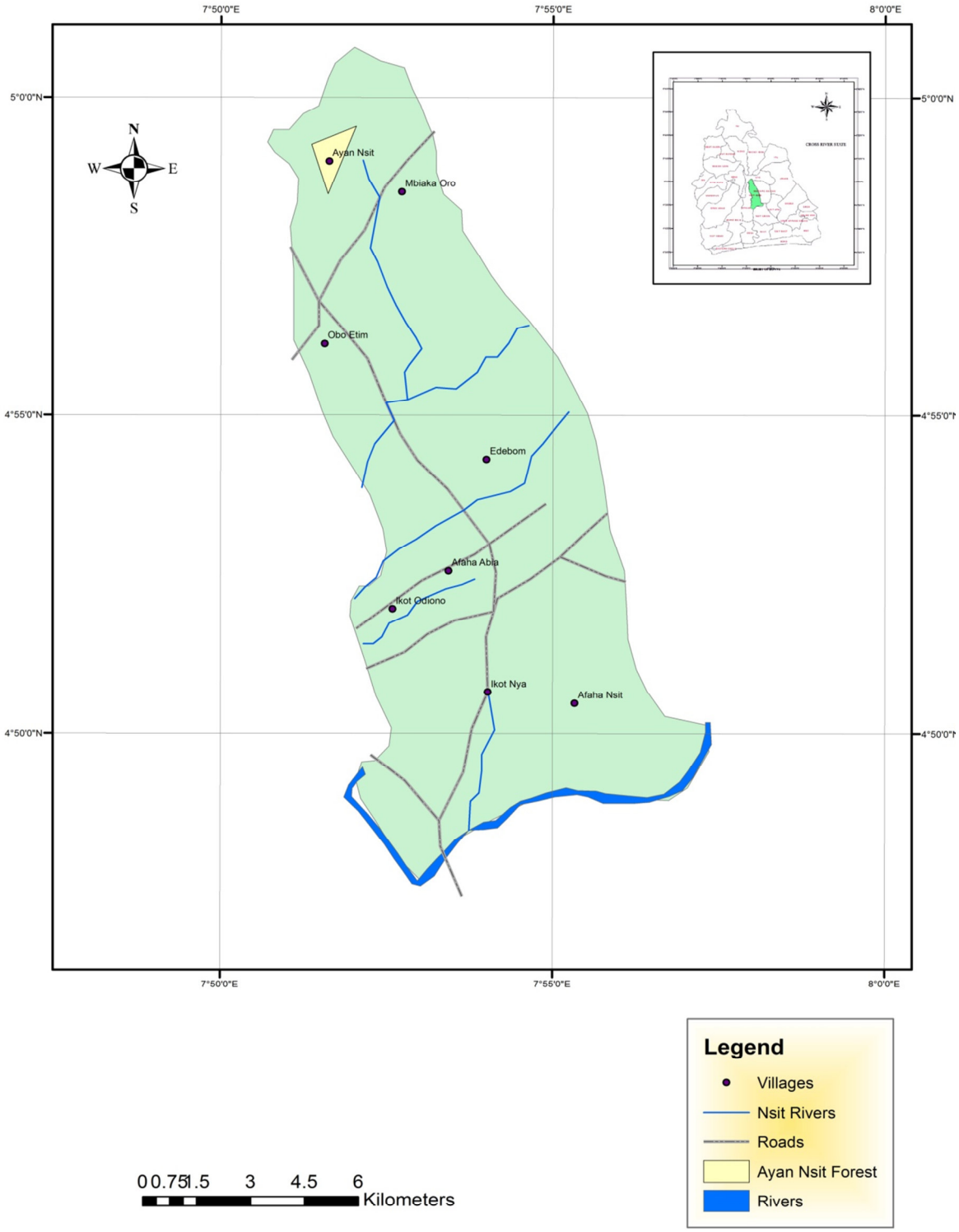

FIG 1: NSIT IBOM SHOWING AYAN NSIT FOREST

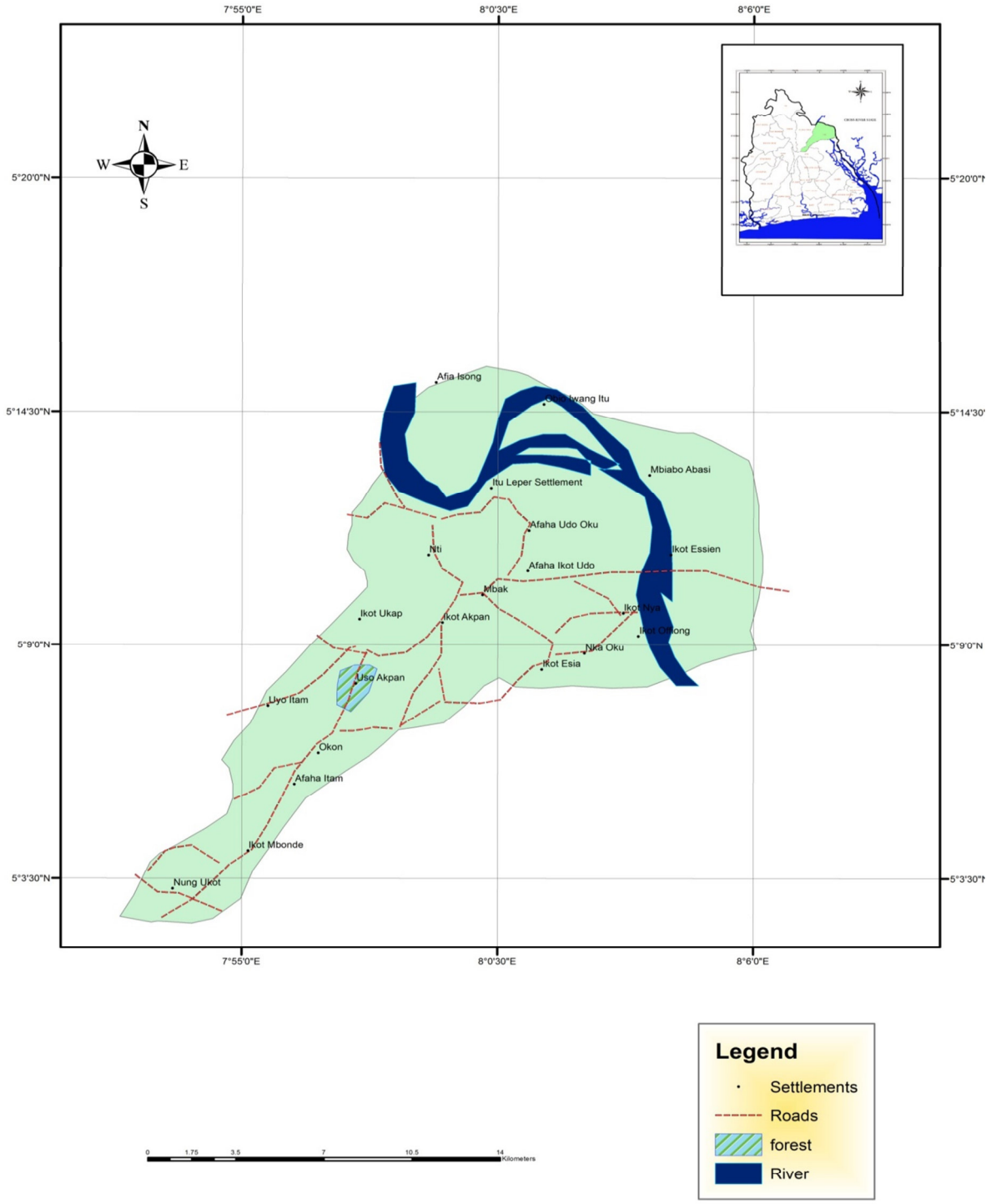

FIG 2: ITU SHOWING IKOT AKPAN OSU WILDLIFE SANCTUARY

BIOSKETCH

Mbuotidem S. Ebong is a lecturer in the department of Geography and Natural Resources Management. He is a certified biogeographer who is passionate about biodiversity analysis and conservation as well as ecosystem management. He is vastly knowledgeable as regards ecosystem diversity in the southern part of Nigeria which is reflected in his arrays of studies and works