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Research Article

The diversity and distribution of indigenous earthworm species of Golaghat district of Assam, Northeast India

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ABSTRACT

Diversity and distribution of earthworm species was conducted in the randomly selected places of Golaghat district ($93^0 16^/$to $94^0 10^/$ E and $25^0 50^/$ to $26^0 47^/$N) of Assam, North-East, India. Earthworms were collected from Different soil habitats i.e. Agricultural field (AF) soil, cow dung (CD), grassland (GL), Alluvial (AL) and Tea Garden (TG) Soil. Eight species of earthworms were identified as *Lampito maruitii* (Kinberg, 1866), *Perionyx excavates* (Perrier, 1872), *Perionyx pulvinnatus* (Stephenson, 1916), *Metaphire posthuma* (Vaillant, 1868), *Amyathas diffringens* (Baird, 1869) belonging to Family Megascolecidae*; Eutyphoeus kempi* Stephenson, 1914 belonging to family Octochaetidae; *Drawida nepelensis* Michaelsen,1907 belonging to family Moniligastridae, *Octolasion tyrtaeum* (Savigny, 1826) belonging to family Lumbricidae ; recorded from the study area. The distribution depends on different soil habitat and condition. We found in this study the species *Lampito maruitii* (Kinberg, 1866) is maximum and *Perionyx excavates* (Perrier, 1872) and *Eutyphoeus kempi* Stephenson, 1914 are minimum than other species. The present study is the pioneer documentation on diversity and distribution of earthworm species collected from different soil habitats of Golaghat district of Assam, India. This present study will help in conservation strategy of indigenous earthworm of study area in future prospects respectively.

Key words: Earthworm, Indigenous, Biodiversity, Population Density, Assam.

INTRODUCTION

Earthworm is a macro-fauna of soil. They play a vital role conservation of biodiversity and ecosystem management by degrading the organic materials into value added substances. It is found predominantly in damp and humas rich soil from time immortal. They are forms a major component of soil and these organisms have been critically ploughing the land for millions of years and assisting in the recycling of organic nutrients for the efficient growth of plants. So, conservation of earthworm population is very much essential to maintain the soil ecology as well as soil health. They must live in moist soil containing organic matter. The distribution of earthworm observed in undisturbed soil (Frazao *et al.*, 2017). The presence of earthworm in soil is important and significant because they performs different role in aerating and enriching soil (Baskin, 2005; Colemon *et al.*, 2004). Different studies in varied times showed its role in ecosystem building (Dash and Patra, 1977, Fragosco and Lavelle, 1992; Lavele, 1974). They are specific bio-indicator which can change the soil quality (Paoletti, 1999, Edwards and Bohlen, 1992), fertility by fragmentation and amalgamation of soil with the minerals which promotes microbial population in soil and enhances in the process of breakdown of organic matters, when these organic matters are reached to the gut of the earthworms and converts as cast, these are enrich with nutrients (Stephenson, 1993). Soil texture depends on activity and distribution of earthworm (Yvan, *et al.*, 2016). The distribution of large number of earthworm in soil is very important because they are involved in soil formation (Callahan, 1988; Goats and Edwards, 1988). In the temperate and tropical soil earthworm diversity dominates the biomass of invertebrates (Rai, 2017). In the litter lots of carbon and nitrogen are deposited, these inorganic molecules are very much important for earthworms, earthworms obtains these inorganic molecules from litter by decomposing process, So, C:N ratio indicates the distribution of earthworms in a particular region of the soil(Edwards and Bohlen, 1996). Distribution of earthworms is irregular (Svendsen,1957) according to type of soil (Curry,1998) Earthworm are important organism plays a role in agro-ecosystem because they considerably influence physical structure of soil, and promotes plant growth (Lavelle *et al.*, 1988, Lee, 1985, Julka, 1993, Sathianarayanan and Khan, 2006, Suthar, 2009). The earthworm produces caste, it increases organic compounds by producing auxin, cytokinin in soil (Krishnamoorthy and Vajranabhaiah, 1986). Earthworm has valuable effects on the physical and biological and chemical properties of soil (Senthil and Sivakami, 2018).

Earthworms play a major role in recycling of organic waste, so earthworms are very familiar among the people of different country of the world including India. Nature of waste discharged, season, humidity, rainfall, temperature, soil type's earthworms distributed

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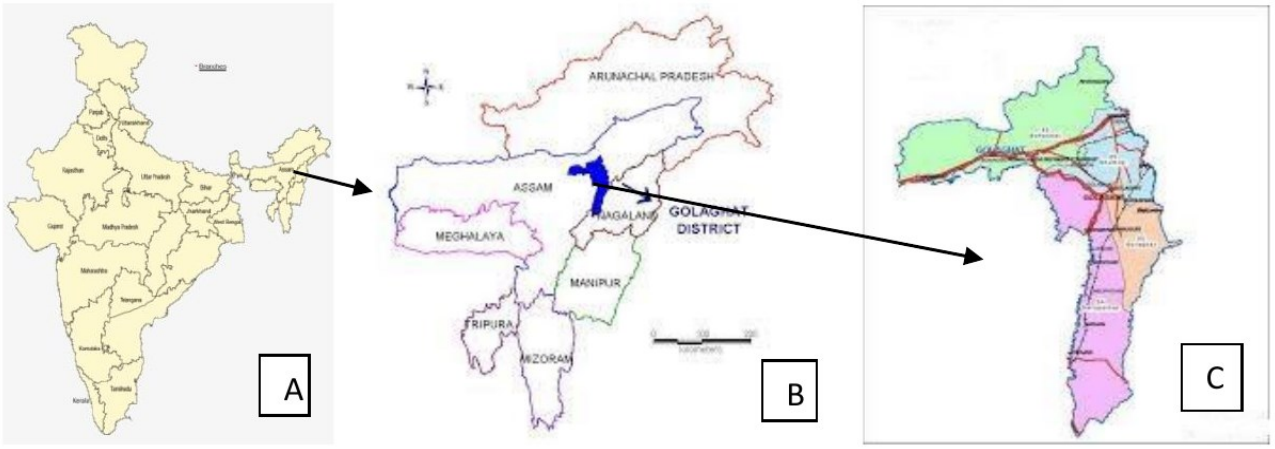

Figure 1. (A). Map of India, (B). Map of North-East India including Assam, (C). Map of study area.

place to place in the world. The knowledge of distribution of earthworms in Assam including specially in Golaghat district in unknown, therefore the present study was undertaken to know the details of distribution and diversity of indigenous earthworm.

Earlier studies by different researcher shows that the studies on diversity and distribution of earthworm in India is limited including Assam and Golaghat district of Assam, North-East India, so we were tried to documented some indigenous species of earthworm from study area to explore the earthworm from the unexplored soil habitat of Golaghat district, in view of their beneficial role in agriculture and sustainability of soil and better productivity.

MATERIALS AND METHODS

Description of the study area:

The survey was done during the summer, winter and rainy season of 2019-2020 in four different Sub-division viz: Golaghat Sub-division, Bokakhat Sub-division, Dhansiri Sub-Division and Merapani Sub-division of Golaghat district of Assam, North-East, India (Figure 1). Golaght district is a agriculture based place. In this district rice, tea, "Sashi", vegetables, mustard plant are grown. The farmers used the conventional methods for ploughing the soil by bullock cart. However, now a day's modern technology is introduced by youth farmers. Different soil habitats at each place i.e. Agricultural field (AF) soil, cow dung (CD), grassland (GL), alluvial (AL) and tea garden (TG) soil were selected for collection of earthworm population.

Sampling of earthworm population:

The earthworms were collected by the digging method (Julka, 1988) from the soil. The earthworms were collected from the sampling area in the morning time because in that time they were found in active. Collected earthworms were washed in fresh water and stored in plastic container in the field, then used narcotising solution as ethyl alcohol. Live worms were placed in flat bottomed container with little fresh water. Ethyl alcohol was gradually added to the water till the worms became motionless. When the worms showed no longer respond to probing they are removed from the water and placed on a piece of blotting paper. They were then transferred to a flat dish containing a solution of 5% formalin for fixation for a period of at least 6-8 hours. The worms after fixation were stored in suitable sized bottles filled with 70% ethyl alcohol for further identification. All specimens were serially numbered and important field data such as habitat, locality, soil p^H, moisture content and occurrence was recorded.

Analysis in the laboratory:

Different morphological characters such as length, colour, diameter, size, prostomium, clitellum, setal arrangement, genital pore, dorsal pore, genital marking of preserved earthworms were again recorded.

Identification of Earthworm:

The collected earthworms were identified in Zoological Survey of India at Dehradun. The voucher specimens (Regt^n. No- Table 1) were examined and deposited in the museum of ZSI, Dehradun and P.G. Department of Life Sciences, D.R. College, Golaghat, Assam, India for future references.

Soil Analysis:

The p^H of the soil was recorded by the method (Jackson, 1973). The moisture content of the soil where earthworms were found was done by Oven dry method. The available nitrogen was done by the methods (Subbiah and Asija, 1956) and available phosphate was detected by the method (Bray and Kurtz, 1945) and the available potash was done by the method (Champson and Pratt, 1961) in the department of Soil Tocklai Tea Research Institute, Jorhat, Assam.

RESULT AND DISCUSSION

Diversity and distribution of earthworm studied in Golaghat district of Assam:

The survey was done from Jun 2019-July 2020. In this present study we have found 259 number of earthworm belonging to 8 species (Figures 12-19) *viz. Lampito maruitii* (Kinberg, 1866) (Figure 12), *Perionyx excavates* (Perrier, 1872) (Figure 16), *Perionyx pulvinnatus* (Stephenson, 1916) (Figure 17), *Metaphire posthuma* (Vaillant, 1868) (Figure 19), *Amyathas diffringens* (Baird, 1869) (Figure 15), *Eutyphoeus kempi* Stephenson, 1914 (Figure 13), *Drawida nepelensis* Michaelsen,1907 (Figure 14), *Octolasion tyrtaeum* (Savigny, 1826) (Fig. 18) and four different families (Table 1). Among these all collected specimen we have found all

Table 1. Collected indigenous species of earthworm

Phyllum	Class	Order	Family	Species	Accession No of ZSI
Annelida	Clitellata	Haplotaxi-da	Megascolecidae	*Lampito maruitii* (Kinberg, 1866)	IV-1227
				Perionyx excavates (Perrier, 1872)	IV-1232
				Perionyx pulvinnatus (Stephenson, 1916)	IV-1233
				Metaphire posthuma (Vaillant, 1868)	IV-1231
				Amyathas diffringens (Baird, 1869)	IV-1229
			Lumbricidae	*Octolasion tyrtaeum* (Savigny, 1826)	IV-1234
			Octochaetidae	*Eutyphoeus kempi Stephenson, 1914*	IV-1230
			Moniligastridae	*Drawida nepelensis Michaelsen,1907*	IV-1228

Table 2. Occurrence of collected earthworm species in the study area

Sl. No.	Indigenous earthworm species	TG Soil	AF Soil	CD Soil	GL Soil	AL Soil
1	*Lampito maruitii* (Kinberg, 1866)	-	++	-	+	-
2	*Perionyx excavates* (Perrier, 1872)	-	+	-	-	-
3	*Perionyx pulvinnatus* (Stephenson, 1966)	-	-	+	-	+
4	*Metaphire posthuma* (Vaillant, 1868)	+	-	-	+	-
5	*Amyathas diffringens* (Baird, 1869)	+	++	-	-	-
6	*Octolasion tyrtaeum* (Savigny, 1826)	+	++	-	-	+
7	*Eutyphoeus kempi Stephenson, 1914*	-	+	-	-	-
8	*Drawida nepelensis Michaelsen,1907*	+	-	-	-	+

TG=Tea Garden, AF=Agricultural field, CD=Cow Dung, GL=Grass Land, AL=Alluvial
(-)= Absent, (++) = High Population (20-40 Nos/Unit area), (+) = Low population (10-20) Nos/Unit area.

Table 3. Total number of earthworm distribution in the study area

Species Name	*Lampito maruitii* (Kinberg, 1866)	*Perionyx excavates* (Perrier, 1872)	*Perionyx pulvinnatus* (Stephenson, 1966)	*Metaphire posthuma* (Vaillant, 1868)	*Amyathas diffringens* (Baird, 1869)	*Octolasion tyrtaeum* (Savigny, 1826)	*Eutyphoeus kempi Stephenson, 1914*	*Drawida nepelensis Michaelsen,1907*	*Total*	*Total In %*
TG Soil	-	-	-	11	14	11	-	13	49	0.18
AF Soil	38	18	-		35	29	18	-	138	0.53
CD Soil	-	-	12	-	-	-	-	-	12	0.04
GL Soil	12	-	-	17	-	-	-	-	29	0.11
AL Soil	-	-	15	-	-	-	-	16	31	0.11
Total number of earthworm collected from study site									**259**	

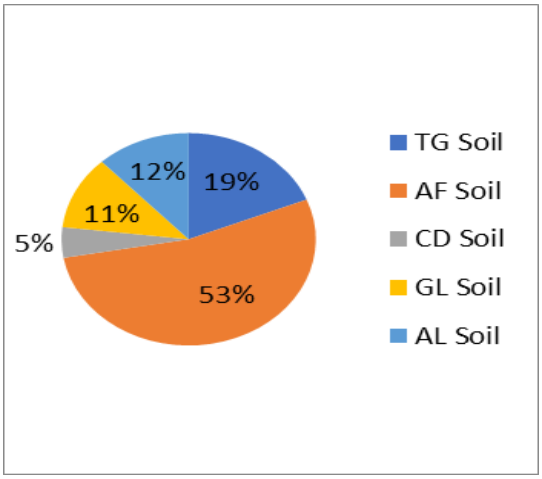

Figure 2. Distribution of earthworm in different sampling sites

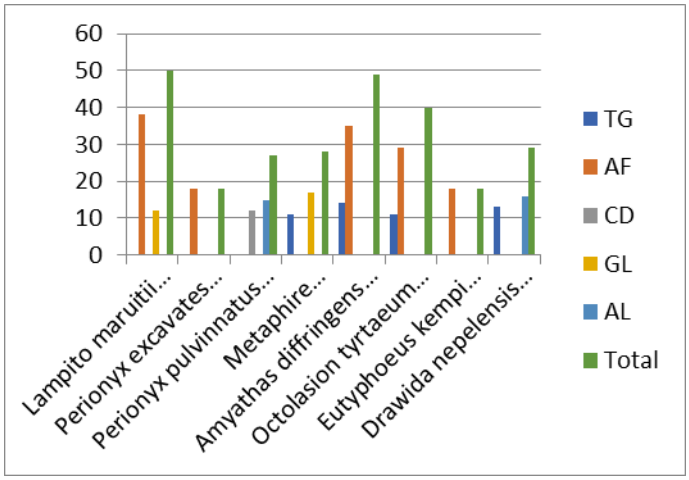

Figure 3. Total number of earthworm species soil found in sampling sites

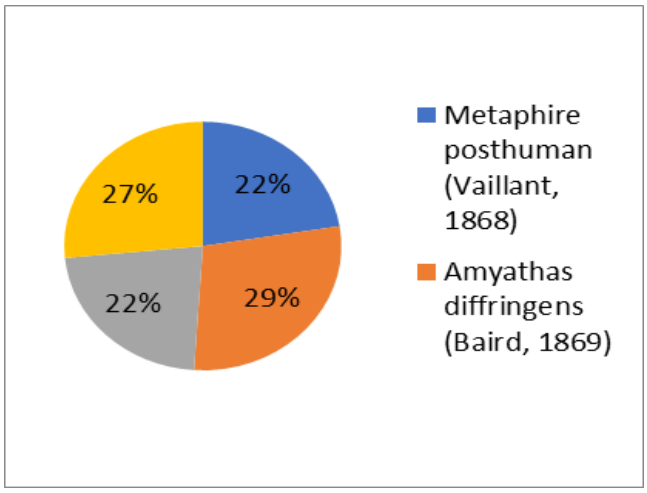

Figure 4. Abundance of Earthworm in Tea Garden (TG) Soil

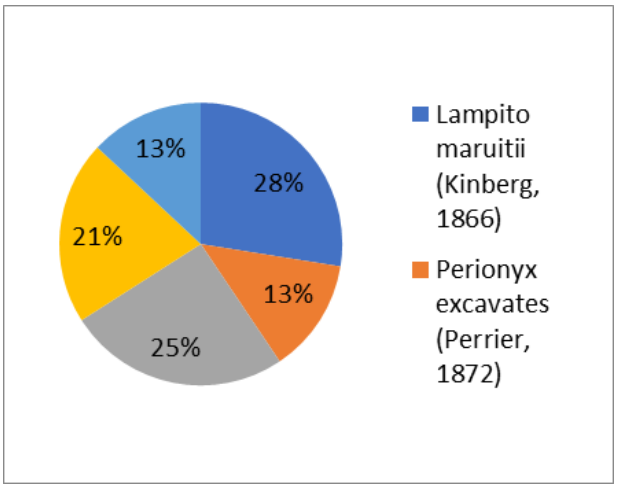

Figure 5. Abundance of Earthworm in Agricultural field (AF) Soil

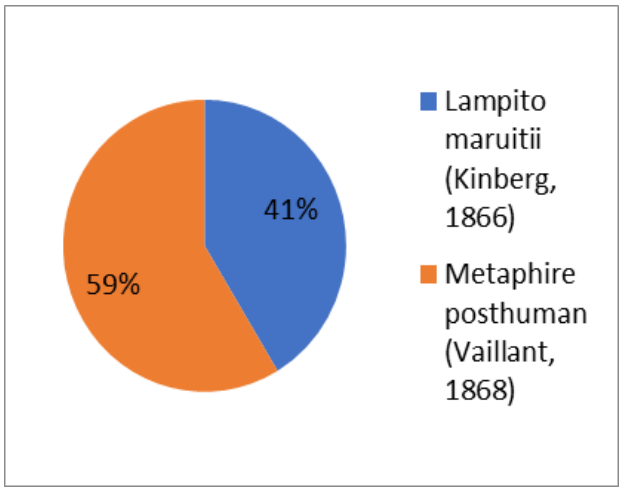

Figure 6. Abundance of earthworm in grassland (GL) soil

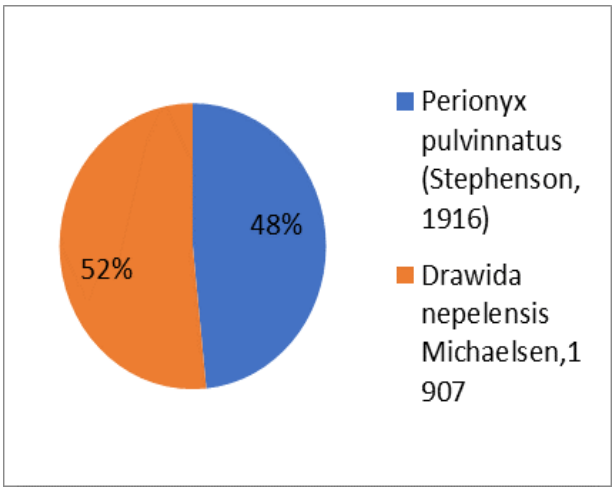

Figure 7. Abundance of earthworm in alluvial (AL) soil

total eight different species belonging to four families of the class Clitellata, order Haplotaxida were sampled from the study sites. Of the eight species *Lampito maruitii* Kinberg.1866 was collected from Agricultural soil and Grassland soil, *Perionyx excavates* (Perrier,1872) (Figure 16) were collected from only agricultural field soil, *perionyx pulvinnatus* Stephenson,1916 (Figure 17) were collected from Cow dung and Alluvial soil, *Metaphire posthuma* (Vaillant,1868) (Figure 19) were collected from Tea garden soil and Alluvial soil, *Amyathas diffringens* (Baird,1869) (Figure 15) were collected from agriculture soil and tea garden soil, *Eutyphoeus kempi* Stephenson,1914 (Figure 13) were collected from agricultural field soil, *Drawida nepalensis* (Michaelson, 1907) (Figure 14) were collected from tea garden soil and Alluvial soil, *Octolasion tyrtaeum* (Savigny, 1826) (Figure 18) (Table 3) were collected from Tea garden soil and Agricultural field soil. The diverse habitat of earthworms signified that the quality of soil affects the earthworm distribution.

Rajkhowa *et al.* 2014 described about high diversity and distribution of earthworm in Assam, North–East India including the districts such as Golaghat, Jorhat, Sibsagar, Tinsukia, Sonitpur, Nalbari and Barpeta. According their result they shown 17 species of earthworm belong to eleven genera and six families such as *Drwida nepelensis, Gordiodrilus elegans, Drwida sp1., Eutyphoeus sp., Lampito mauritii, Perionyx excavates, Glyphidrilus gangeticus, Eisenia sp., Metaphira postuma, Dichogaster saliens, Perionyx sp.. Amynthas alexandri , Amynthas diffringens, Pontoscolex corethrurus, Eisenia Sp., Drwida sp.2, and Eisenia Foetida etc.* Similar investigation was done by (Mandal, 2018), who reported 8 species of earthworm from

Table 4. Locality, colour, average weight of the collected earthworm species

Sl. No.	Indigenous Earthworm species	Order	Family	Locality (Soil)	Colour	Average Weight (gm)
1	*Amyathas diffringens* (Baird, 1869)	Haplotaxida	Megascolecidae	AF & TG	Purple	0.50-0.60
2	*Drawida nepelensis Michaelsen,1907*	Haplotaxida	*Moniligastridae*	TG & AL	Redish	1.40-1.50
3	*Eutyphoeus kempi Stephenson, 1914*	Haplotaxida	*Octochaetidae*	AF	Blackish	0.50-0.60
4	*Lampito maruitii* (Kinberg, 1866)	Haplotaxida	Megascolecidae	AF & GL	Blackish	1.00-2.00
5	*Metaphire posthuman* (Vaillant, 1868)	Haplotaxida	Megascolecidae	GL, & TG	Blackish	0.60-1.00
6	*Octolasion tyrtaeum* (Savigny, 1826)	Haplotaxida	*Lumbricidae*	AF &TG	Blackish	1.40-1.00
7	*Perionyx excavates* (Perrier, 1872)	Haplotaxida	Megascolecidae	AF	Redish	1.40-2.00
8	*Perionyx pulvinnatus* (Stephenson, 1966)	Haplotaxida	Megascolecidae	AF & CD	Brown	1.21-1.00

TG=Tea Garden, AF=Agricultural field, CD=Cow Dung, GL=Grass Land, AL=Alluvial

Table 5. Moisture, temperature, p^H, total nitrogen and total carbon and C/N ratio of the soil.

Habitat	Moisture Of Soil (%)	Temperature Of Soil (^{0}C)	p^H	Total Nitrogen	Total Carbon	C/N Ratio
TG Soil	29	17	6.9	117	0.61	.0052
AF Soil	30	25	6.7	114	1.23	.0107
CD Soil	37	18	4.12	111	0.84	.0075
GL Soil	25	20	6.45	112	1.56	.0139
AL Soil	35	15	5.85	111	0.78	.00702

Table 6. Taxonomic characters of collected indigenous species of earthworm

Species Name	*Amyathas diffringens* (Baird, 1869)	*Drawida nepelensis Michaelsen,1907*	*Eutyphoeus kempi Stephenson, 1914*	*Lampito maruitii* (Kinberg, 1866)
Length (mm)	70	79	92	96
Diameter (mm)	4	3	4	4
Colour	Purple	Redish	Blackish	Blackish
Setae	40	4	1.8-2.5ab	28
Prostomium	Epilobic	Prolobic	Prolobic	Epilobic
Pore	Swelling	Prominent	Single	Slightly raised porophores.
Segment	140	155	140	158
Clitellum	Annular	Annular	Annular	Annular
Spermathecal aperture	Paired in 4/5	Slit like, one pair at intersegmental furrow 7/8	Paired in 7/8	Paired in 6/7/8/9
Septa	Absent	12/13 muscular	11/12 muscular	4/5 muscular

Table 7. Taxonomic characters of collected indigenous species of earthworm

Species Name	***Metaphire posthuman* (Vaillant, 1868)**	***Octolasion tyrtaeum* (Savigny, 1826)**	***Perionyx excavates* (Perrier, 1872)**	***Perionyx pulvinnatus* (Stephenson, 1966)**
Length (mm)	70	35	40	56
Diameter (mm)	4	4	3	3.5
Colour	Blackish	Blackish	Redish	Brown.
Setae	106	small	47	Small.
Prostomium	Epilobic	Epilobic	Epilobic	Epilobous
Pore	Present in 12/13	Present in 9/10	Present in 2/3-5/6	Exists from furrow 5/6
Segment	94	95	125	126
Clitellum	Annular	Annular	Annular	Annular
Spermathecal aperture	Paired	Paired	Paired	Large, 7/8 concerning one-half of the borders apart.
Septa	5/6 muscular	11/12 muscular	4/5 muscular	7/8 muscular

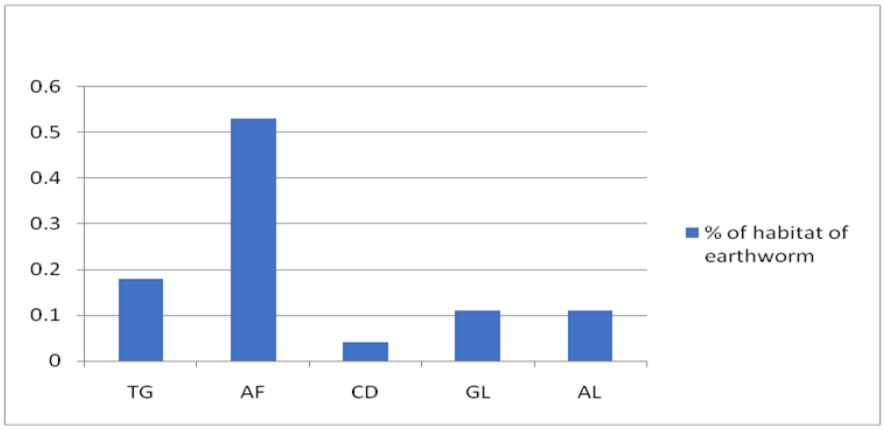

Figure 8. Habitat percentage of collected earthworm species

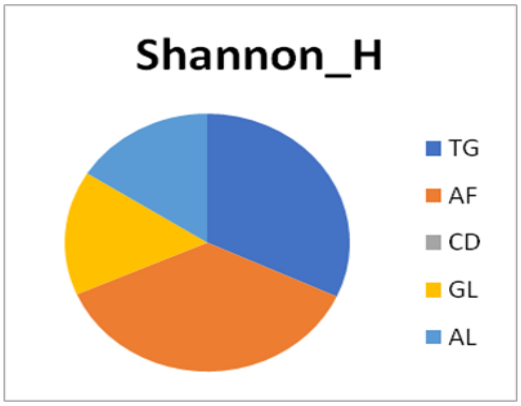

Figure 9. Shannon diversity (H' Log Base 10) index of different habitats

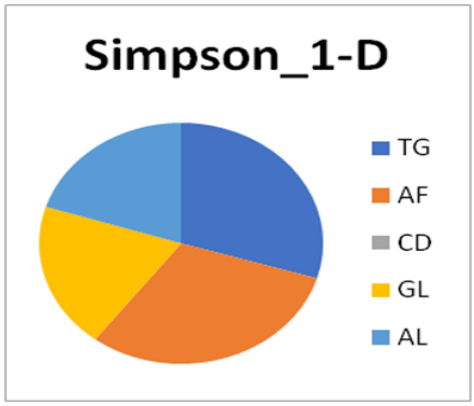

Figure 10. Simpson diversity index (1/D)

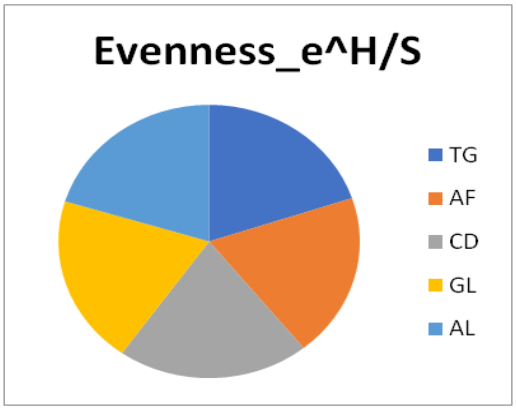

Figure 11. Evenness index of different diversity

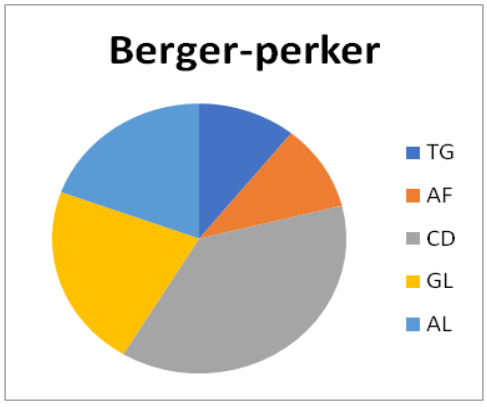

Figure 12. Berger-Parker dominance (d)

kolkota, they documented *Metaphira postuma, Metaphira peguana, Eutyphoeusincommodus, Drwida nepelensis, Metaphira houlleti, Amynthas alexandri, Lampito mauritii etc* due to ecology of soil and quality of soil.

In recent years, The earthworm diversity studied by Julka and Senapati (1987), Julka (1988), Julka and Paliwal (1994). However, the study on diversity and distribution of earthworm in North-East India including Assam indicates that the first report recorded in 2014. Thereafter the taxonomical study in the Golaghat district of Assam is scanty. Therefore, it is a modest effort to update current knowledge on the diversity and distribution of Indigenous earthworm in the study area.

The species richness, diversities, evenness and dominance were analysed using the following indices of Shanon-Shimpson diversity index (Shannon H' Log Base 10) (Figure 9). Simpson diversity index (1/D) (Fig. 10) and Berger-Parker Dominance (d) index (Figure 12). Present study indicates the eight species of earthworm study area (Figure 3). The highest abundance (Fig. 6) and distribution (Fig. 2) with height diversity is found in Agriculture field (0.53%) area, though the lowest abundance found in Cow dung (0.04%). The Shannon diversity index value and Simpsons diversity index value shows the highest in the Agricultural Field soil (1.548) areas with lowest were documented in Grass land (0.661) soil. On the contrary

Photo (Figures 12-19): Photographs of collected indigenous earthworm species of Golaghat, district of Assam.

Figure 12. *Lampito maruitii* Kinberg, 1866

Figure 13. *Eutyphoeus kempi* Stephenson,1914

Figure 14. *Drawdia nepalensis* Michaelsen, 1970

Figure 15. *Amynthas diffringens* (Baird, 1869)

Figure 16. *Perionyx excavates* (Perrier, 1872)

Figure 17. *Perionyx pulvinnatus* Stephenson, 1916

Figure 18. *Octolasion tyrtaeum* (Savigny, 1826)

Figure 19. *Metaphire posthuma* (Vaillant,1868)

Margaleff M Base 10 index depicts the highest diversity values in the Agricultural soil (0.8118) (Figure 5) and lowest in Alluvial (0.291) (Figure 7) soil. Though the Shannon evenness index shows the highest values in the Agricultural field (1.548) soil with lowest in Grass land (0.661) habitat.

Earlier researcher documented more than 4000 species of earthworm worldwide (Sinha, 2009). According to (Julka *et al.,* 2009) 590 species of earthworms were found in India. India represents a high diversity of earthworm; they are distributed basically in two basic hot spot of India such as Western Ghats and Eastern Himalayas (Verma *et al.*, 2010). It has been known since ancient time that earthworm improves the fertility of soil (Bahl, 1950;Vejdovsky, 1884, Stephenson, 1923). All over the world earthworms are distributes basically in tropical and temperate regions, earthworms covers 80% of total biomass of soil by alone (Kale, 1998). The soil structure and pore of soil is also key role of distribution of earthworm (Schon, 2017).

CONCLUSION

The all eight indigenous earthworm species belonging to two families were recorded in different soil habitats of Golaghat District of Assam, India. Among the founded earthworms relative high population was recorded *Lampito maruitii* (Kinberg, 1866) (0.53%) of the earthworm species varied under different soil habitats condition. Founding a high numbers of indigenous earthworm species in the study area is a good significant for soil health; they can improve the soil quality by degrading the organic waste to valuable compost. The indigenous earthworm also improves the soil porosity which uplifts the agricultural productivity in natural way. Therefore, it is urgent to documentation of different indigenous earthworm species in soil for further long term productivity of soil. Earthworm is considered as friend of "farmer" because they increase the productivity of soil. Different organic materials are decomposed by them and help in management of organic pollution which results directly or indirectly conservation of ecological biodiversity of soil.

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