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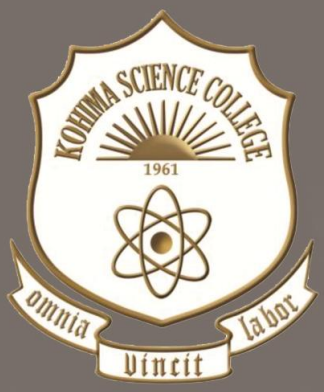

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CODE-SWITCHING AND CODE-MIXING IN ANGAMI CHURCHES

Double reviewed

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Abstract: Tenyidie is a Tibeto-Burman language which is spoken in Nagaland basically in two districts, Kohima and Dimapur by the Angami community. This paper investigates the types of code-switching or code-mixing used in churches of Angami community. Language used in Church services and Sunday schools are investigated. This empirical study is done by observing the services.

Keywords: Code-switching, Code-mixing, Bilingual, Multilingual, Tenyidie, Angami, English, Church.

Introduction

Church is a platform where massive use of code-switching and code-mixing takes place among the Nagas. The religion of Christianity was introduced to the Angami community by the American Missionaries. By embracing Christianity in the later part of the 19th century AD, which was a foreign religion, came along with development and education. The American Baptist Missionaries first taught Assamese in schools which was not very successful in its implementation among the Angami community. The medium of studies, thus, bounced back to the native language which has no written literature. And so English was the only medium to be taught in schools. The American Missionaries' primary objective was to spread the gospel to the people, but necessity compelled them to impart education, which was another privilege for them to spread the gospel. Likewise, education and religion during this era were like two sides of the same coin for the Americans as one helps the other in both ways. During the time of Rev. S.W. Rivenburg, it was learnt that, the first five years of his mission to the Angami community was of zero conversion from the natives but he conducted church services for the British Soldiers (Shürhozelie 1989, *U Niedimia* p, 11-30).

This was the beginning of the set up of church or religious institution by the American missionaries in the Angami region. The tradition thus follows that there were occasional church services conducted in English language among the Angamis. Moreover, since Nagaland is a multi-lingual state and there is no any particular Naga language as common standard language. Thus, people resorted to English language whenever there was communication complication because of language differences.

Theoretical Review

Code-switching and Code-mixing

Code-switching is generally defined as the shifting that occurs "between two or more languages simultaneously or interchangeably within one conversation" (Grosjean, 1982, p. 145).

Code-switching in itself is perhaps not a linguistic phenomenon, but rather a psychological one and its causes are obviously extra-linguistic. But bilingualism is of great interest to the linguist because it is the condition of what has been called interference between languages [Vogt 1954, p, 368]. In Kohima and Dimapur, Tenyidie is commonly mixed or switched with English or Nagamese in conversation amongst the Angami.

Example:

God so loved the world, *süla puo nuo pfuliu ketseshü.*

This is an example of code switching; the sentence is being switched with English language at the intra-sentential level. The clause *'God so loved the world'* is embedded to the matrix language that is Tenyidie.

Code-mixing is the term used when a linguistic unit such as phrases, words and morphemes are embedded from one language into the utterance of another language. Maschler (1998) defines code mixing or a mixed code as

"using two languages such that a third, new code emerges, in which elements from the two languages are incorporated into a structurally definable pattern" (p.125). Blom and Gumpers as quoted by Gibbons (1987:80) they say that code mixing is behavior element from one code become to some extent integrated into another. One code, the base code, is normally dominant, and speakers use the second code in additive fashion. Elements from the latter code tend to be some extent assimilated and consequently are used less consciously.

Example:

1st child- No ndu **Park** nu vo rüzhü me?

You play in the park yesterday?

2nd child - Ule hieko **Park** nu vo rüzhü derei **sunlight** la tei lethor.

Yes we played in the park but it was too hot because of sunlight.

In the above example, the first child asks a question in Tenyidie and the second child answers the question. We can make out from the example, the words which they mixed in their conversation is not the base language, but derived from another language which is English language or the supra/source language. Comparing to the children in rural areas, the urban children tends to resort to other languages when they are not familiar with Tenyidie. The given code-mixing example is produced out of their conveniences and so they are not aware of the language involved in the conversation.

Various scholars like Halliday (1978), Atoye (1994) and Muysken (2000) attempted to define code-switching and code mixing. While Bokamba (1989:281) defined code-switching and code mixing as "Code-switching is the mixing of words, phrase and sentences from two distinct grammatical (sub) system across sentence boundaries within the same speech event… code-mixing is the embedding of various linguistic units such as affixes, (bound morphemes), words (unbound morphemes), phrases and clauses from a corporative activity where the participants, in order to infer what is intended, must reconcile what they hear with what they understand".

Types of Code-switching

This research focused on the three major types of code-switching identified by Poplack (1980, p. 613-615) as "tag-switching," "inter-sentential switching," and "intra-sentential switching." Tag-switching is phrased by Romaine (1989, p. 112) as the insertion of words that can be put anywhere within the boundary of a sentence or speech without violating the grammatical rules of that sentence. Inter-sentential switching involves "a switch at a clause or sentence boundary" (Romaine, 1989, p. 112) where, for example, the clause or sentence might have been in L1 before changing to L2 (Yletyinen, 2004, p. 15). Intra-sentential switching occurs when words or phrases from another language are inserted into a sentence of the first language (Yletyinen, 2004, p. 15). When two different languages are utilized in a sentence, proficiency in both languages is a prerequisite in avoiding structural errors.

Type of Code Mixing

According to Suwito (1983:76), code mixing is divided into two types: a) Inner code mixing, in which happens because elements insertion from original language with all its variation. b) Outer code mixing, in which occurs because of elements insertion stemming from foreign language.

Objectives

The objective of the study is to deal with the practice of code-switching and code-mixing that is widely operational in Angami Naga society and church in particular and also seeks to address the following points:

1. To examine different type of Code-switching and code-mixing in Angami churches.
2. To identify the factors that influence Code-switching and code-mixing in Angami churches.
3. To establish the impact of Code-switching and code-mixing on the development of Tenyidie in Angami Naga society.

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Methodology

Code-Switching and Code-mixing can be studied through different means and approach depending on the context. Thus, this study implies both qualitative and quantitative method such as observation and interviews. Since the study is confined to the Churches, services conducted are observed through video and presence in church. Interviewees are the pastors and Sunday school teachers. The study was conducted from ten (10) churches and five (5) Sunday schools in Kohima and Dimapur. Altogether, ten (10) sermons and five Sunday schools were observed with 200-250 words from each sermon. Interview was also conducted on five (5) youth preachers and five (5) elderly preachers. Code-Switching and code-mixing in churches also differs from generation to generation, which means that the youth speakers use much more of other languages especially English than the elderly speakers. The advancement of education system and the rapid use of English language among the younger generation urge them to frequently use English language in every walks of their life, which is not just leisure, fun or a fashion but a necessity in the society today. Interviewing five (5) youth preachers in churches revealed that, they are more comfortable preaching in English language than preaching in Tenyidie. Almost all the interviewees give the reason that while preaching, the English Bible commentaries provide elaborate meaning but, since there is less Bible commentaries in Tenyidie they couldn't express entirely in Tenyidie. Moreover, by code-switching and code-mixing English words, sentences or quotations in their preaching in Tenyidie, it is easy for the congregation to perceive the meaning. Interviewing five (5) elderly preachers in between 70 and above years of age for the reason of applying or not applying code-switching or code-mixing in their sermons, it was revealed that two (2) preachers reply with the reason for not well acquainted with English language and the other three (3) preachers answer were to preserve and stick to the Tenyidie language and improve themselves while preaching in Tenyidie. This doesn't mean code-switching and code-mixing never occurs in their sermons, but if not in unavoidable circumstance, they are more attached with the native language. There are even cases when youth preachers deliver a sermons, some elderly people would complain about the language used with switched and mixed and that they could only understand two third of their sermon because of code-switching and code-mixing.

Technique of Data Collection

Data collection is a process of gathering information on the field of interest, in a systematic manner that enables the author to answer stated research questions, test hypotheses, and evaluate outcomes. While methods vary by discipline, the emphasis on ensuring accurate and honest collection remains the same. In this study observation and interview are used as the basic tools for data collection.
Various techniques are used to collect data as:

1. Downloading videos and recording of programs conducted in Angami churches.
2. Visiting different churches.
3. Making list of interviews conducted.
4. Transcribing people's utterances.

Data Presentation and Analysis: Types of code-switching and code-mixing

The researcher collected data through audio recordings and videos of church sermons conducted in Tenyidie language and the following type of code-switching and code-mixing were found; intra-sentential code-switching, inter-sentential code-switching, tag-switching, inner code-mixing and outer code-mixing.

Nieko penuo kesa la morosuo, hau meyie se. ***You must be born again.***

This is an example of inter-sentential code-switching where the code *'You must be born again'* is switched as the embedded language from the matrix language Tenyidie. It is a repetition of Tenyidie sentence, *'Nieko penuo kesa la morosuo'* that is repeated in English in clause form.

Keze di ***Luke sixteen nineteen to thirty one*** *hau phrütuo khe.*

The above given example is an intra-sentential code-switching since the code applied is within the sentence as a phrase.

*Nieko mia pete kelalie vite**, right?***
This is an example of a tag-switching where the speaker uses the English word *'right'* as a tag in a Tenyidie sentence.

*U nhicu ki **camp**-ko **attend** chülie ro vi.*
From the example given, it is shown that the English words *'camp'* and *'attend'* are mixed in the sentence which is an inner-code mixing.

***Really?** No kelalie vita zo mo?*
This is an example of outer-code mixing with the mixed word outside the sentence which is stemming from English language.

Results

Types of code-switching and code-mixing involved

Based on observation and interview, all types of code-switching are applied in the churches. However, amongst the types of code-switching involved, the most frequent use of code switching is intra-sentential code-switching followed by inter-sentential code-switching and tag-switching. While in the context of code-mixing, inner code-mixing is more frequently used than that of outer code-mixing. Comparing the frequency of both code-switching and code-mixing used in Angami churches, inner code-mixing is the commonly and most employed type of codes used while intra-sentential code-switching is next as per the frequency of its usage.

Reasons for code switching and code-mixing

There are several reasons that trigger the speaker to switched or mixed in church in their sermon such as; emphasizing a point, habitual experience, addressing different audience, mood of the speaker and to attract attention. Of all this factors, the first factor i.e. emphasizing a point is the core reason for code-switching and code-mixing in churches which stands at 40%. Secondly, habitual experience 30% followed by addressing a different audience 20% and mood of the speaker at 10%. Moreover, every speaker admits to the use of code-switching and code-mixing while preaching in one way or the other with or without realization.

Language used in code-switching and code-mixing

In all the churches studied, the dominant language is Tenyidie, even though there are some occasional church services conducted exclusively in English. The language that is embedded to the dominant language for code-switching and code mixing is mainly English. Since English is the official language of Nagaland, besides the medium of education from childhood is through English and every congregation is familiar with English, the speakers tend to use it as codes in their sermons.

Conclusion

Based on the findings from above, it can be concluded that, there is a vast dominance of code-switching and code-mixing in Angami churches. Urban communities are more vulnerable to the use of codes as inter-language and inter-cultural phenomenon exists side by side in their settings. Majority of the youth uses codes subconsciously because of bilingual or multilingualism, which invade the mindset of the younger generation. Code-switching and code-mixing is a common factor in multilingual society, since Nagaland is a multilingual state with numerous tribes with each tribe having its own language, there is high chances of this phenomenon. Multilingual societies normally choose a code for religious gatherings and a single language is often chosen for formal situations instead of an indigenous language (Holmes, 2013).

In Angami community, though Tenyidie is the dominant language and churches use Tenyidie, the inhabitant districts of Angami nestled the capital and commercial hub of the state i.e. Kohima and Dimapur. Therefore environmental impact subside the importance of native language which results to bilingualism and multilingualism, code-switching or code-mixing. This pace of alienation of first language (L1) by the community could endanger the mother tongue if not revived in time.

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NUTRIENT ANALYSIS OF SOILS FROM ZUBZA, KOHIMA TOWN AND KIRUPHEMA VILLAGE, KOHIMA DISTRICT, NAGALAND

Reviewed

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Abstract: Soil analysis is important to assess the potentiality of soil to supply plant nutrient for healthy growth of crops/plants as soil serves as a source of nutrients and water for crops. Study of soil profile is important from crop point of view. To determine the fertility of soils, samples were collected from three villages.i.e . Zubza, Kohima town and Kiruphema village of Kohima districts. Laboratory methods as well as soil testing kits were used for elemental analysis along with electrical conductivity and P^H values. Study suggests that the soils from these localities have low concentration of Nitrogen, Phosphorus and Potassium but have high organic content. Study further suggests that they are acidic in nature. Study also points towards a low Nutrient index of these soils. Study recommends the use of fertilizers to enhance the quality and productivity of soils for better yield.

Key words: Electrical conductivity (EC), Organic Carbon (OC), Nitrogen (N), Nutrient index (NI) Phosphorus (P), Potassium (K), Soil p^H .

Introduction

The determination of amount of plant nutrients in soil and characterization of physical, chemical and biological properties by chemical process is known as soil analysis. It is the soil nutrients and water quality which influence the healthy growth of plants and crops Due to the difference in physical, chemical and biological properties of soils, some soils are either red or black, deep or shallow, fine textured or coarse texture Rocks are main source for the parent materials over which soils are developed. Knowing the soil health and its maintenance, the quality of crop and suitable crop grown can be predicted. Chemical soil analysis determines the contents of basic plant nutrients in the soil such as N, P, K, water holding capacity, organic carbon, sulphur, electrical conductivity and P^H.

When essential plant nutrients are below required amount for optimum yield or when there is imbalance with other nutrients then it is considered deficiency of nutrients in soils. The deficiency of these conditions will result in form of poor yielding. Nutrients are lost through crop removal, erosion, leaching, de-nitrification, heat, volatilization, addition of salts and excess addition of chemical compounds. Nitrogen is easily lost through de-nitrification in which nitrogen is released as nitrogen gas (N_2) or nitrous oxide where as Phosphorus is lost due to soil erosion. Soil may have large amount of available nutrients but all or a portion of these may not be used by crops because they may not be in usable form.

Objective of the present work is to analyze the soil nutrients and soil fertility of three areas on the basis of nutrient index of Kohima districts i.e Zubza, Kohima town and Kiruphema village of Nagaland state. Present work will enhance our understanding and knowledge of the soil of the studied area and use of land for maximum and healthy production of crops.

Study areas

Kohima is the capital city of Nagaland of India's North Eastern state. It is the second largest city in the state. This city has moderate to high steep mountain system and experiences subtropical high land climate. Agriculture is the main occupation of the people in the district.

Kiruphema and Zubza are Angami Naga tribe occupied villages located in Sechu- Zubza of Kohima district. Kohima town is situated in

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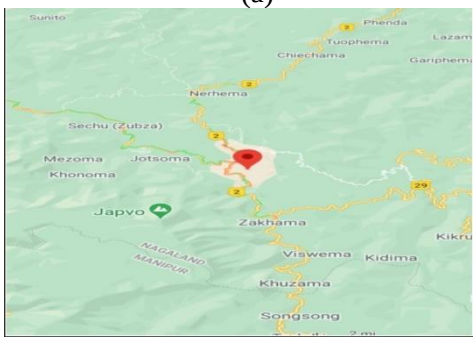
the south at an altitude of 1444m above sea level and occupies the pride as capital city of Nagaland.

(a)



(b)

(c)

Location map of Zubza (a), Kohima town (b) and Kiruphema village (c).

Methodology

Soil sampling and tools

The objective of soil sampling is to collect it in a cost effective manner and sets of samples that accurately represent the properties of the interest for the area. There is no universally appropriate soil sampling approach. The structure and magnitude of field variability is site specific, and affordability of various approaches depends on crop value. The sampling is a compromise between expenditure, labour and time on one hand and precision on the other hand.

The following tools were used

- A soil auger and spade,
- A clean tray and plastic sheet were used for mixing the soil sampling,
- Small plastic pouches,
- Tags for sample information i.e. sampling date, location of the sampling and sampling number

Selection of sample and sampling procedure: (ISRIC,2002).

- V-shaped cut was made to collect the soil sample
- Samples were taken from each field (1-2 cm thick slice) and distance between them was 10 to 20 steps. All together nine samples were taken for analysis.
- Samples were taken before fertilization.
- Samples were dried in the open air and screened through sieve.
- Samples were thoroughly mixed after passing through sieve.

Abnormal soil patches, highly fertilized and manure areas, road cuts and soil filled areas were avoided while collecting the soil samples.

Results

a. *Mineralizable Nitrogen* - For estimation of mineralizable nitrogen method suggested by Subbiah and Asija (1956) was used because of its rapidity and reproducibility and data obtained by analysis have been shown in table -1.

b. *Phosphorus* – Phosphorus is an essential nutrient element for plant healthy growth and is mainly applied to agricultural land to increase crop production. Animal wastes generally have high content of phosphorus. Bray's method (for acidic soil) suggested by Bray and Kurtz (1945) was used for estimation of phosphorus nutrients and data obtained is shown in table – 2.

c. *Potassium* – Potassium present in the soil is extracted with neutral ammonium acetate of one molarity. This is considered as plant available K in the soil. It is estimated with the help of flame

photometer (Toth and Prience, 1949) and data obtained is shown in the table – 3.

d. *Organic carbon / organic matter (OC / OM)*

Knowledge of organic matter content is important in P^H maintenance, soil quality and productivity assessments. Walkely and Black 1934, factor 1.72) suggested method to calculate organic matter and in present study method it was used (some time factor 2, Nelson & Sommers,1982) . It is also known as wet digestion method that involves a rapid titration procedure for the estimation of organic carbon /organic matter content of the soil. The data obtained is shown in the table – 4.

e. Soil p^H test

The measure of soil p^H is an important parameter which helps in identification of chemical nature of soil (Shalini et al, 2003). It is the measure of the acidity and alkalinity of soil sample. p^H does not directly affect plants but it affects the availability of various nutrients to plants. Nutrients should be dissolved in the soil solution before they can be absorbed by plants .The soil P^H changes whether a nutrient is dissolved in the soil or form other less soluble compounds. Soil microbes have low activity in low p^H soils. This can make them to take much longer time to release necessary plant nutrients, such as N, P and Sulphur from organic matter. For practical purposes, the soil with a p^H value 6.6- 7.5 are considered nearly neutral. Such soils do not need soil modification by treating with lime or gypsum. Soils which are acidic or alkaline beyond this limit, the growing of acid loving crops and salt –tolerant crops are considered suitable in such conditions, because soil amendment is expensive process. Only highly acidic or high alkaline soils need amendment with chemicals. The data obtained for P^H of different soils is shown in table -5.

f. *Electrical conductivity (EC)*

Electrical conductivity is the measurement of ionic transport in solution between two electrodes. The electrical conductivity of a soil is measured by conductivity meter known as "Solubridge". This gives the idea of total amount of water soluble salt present in soil. Observation of EC value is shown in table-6.

N,P,K Tests using soil testing kit

The testing of NPK of soil samples collected from Kiruphema village was performed by using Agrinex soil Doctor formulated capsules: Doctor – N, Doctor- P, and Doctor- K, and they give different colours intensity with soil extracted nutrients. Results obtained by this shown in table -7.

Nutrient Index (Parker *et al., 1951)*

The concept of nutrient index is used for the area wise fertilizer recommendation and comparisons of the soil fertility levels of different areas under observation. The nutrient index is calculated on the basis of Parker's method.

Nutrient Index = $\frac{Nl \times 1 + Nm \times 2 + Nh \times 3}{Nt}$

Parker's nutrient index is use to calculate the fertility status of the soil based in the percentage of the samples in each of three categories that is low ,medium and high multiplied by 1,2 and 3 respectively.

Discussion

Zubza and Kohima town **:** The soil from Zubza and Kohima town shows low content in nitrogen, potassium and phosphorus. The carbon contain is high and the conductivity is greatly influenced due to high concentration of dissolved salt concentration in the soils. These soils are found to be extremely acidic.

*Kiruphema village***:** This soil analysis shows low concentration of nitrogen. However it contains high amount of potassium and organic carbon. The phosphorus concentration is moderate whereas the conductivity is high. This soil has extremely acidic character.

Since in the performed soil test, the concentration of N, P and K are low, it can be improved by the application of fertilizer having high NPK ratio. Nitrogen is the basic need of all the plants for growth and development.

Nitrogen deficiency can be corrected by using fertilizers having higher nitrogen, besides it can also be corrected by adding composted

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manure to the soil, planting a green manure crop, planting nitrogen fixing plant, etc.

Phosphorus plays a vital role in plants. Phosphorus is an important macronutrient available in the biological system, which constitute more than 1% of organic weight. It exists in the soil in organic and inorganic form. It improves the root development, improves flower and seed formation, and its resistant strength to plant diseases. Phosphorus deficiency can be corrected by adding rock phosphate, manure and phosphate fertilizer.

Potassium regulates the growth of plants. Potassium deficiency can be corrected by application of fertilizers such as potassium chloride, Potassium nitrate and potassium sulphate.

Living and dead soil organism all together forms organic carbon or organic matter. Organic carbon is an important factor for plants growth as it acts as a source of soil nutrients such as nitrogen, phosphorus and sulphur. It is the main factor which contributes to soil fertility. Soil organic matter can be improved by maintaining soil fertility using organic and inorganic fertilizer. It can be also improved by using manure and compost.

Soil p^H and Electrical conductivity: Soil p^H determines whether nutrients may be absorbed by plants from the soil or not. p^H of soil can be modified by adding lime and potash. Conductivity of the soil is mainly due to present of soluble salt that generates ions which can conduct electricity. There are other factors (soil texture, water content, organic matter, cation exchange capacity and temperature), which influences the conductivity in the soil. Higher value of soil electrical conductivity affects growth rate and productivity of the plants. Adding manure and composts to soil increases the soil electrical conductivity. Irrigation and proper water drainage is necessary to lower the salt concentration and electrical conductivity.

Conclusions

With a huge increase in the population every year, there is too much stress on the soil to increase the production of crops. Agricultural lands are under stress due to both anthropogenic as well as natural activities. Hence, to meet the requirement of human and other organism, it is very much necessary for farmers and growers to have the proper knowledge of soil nutrients and its ability to support the maximum production and growth of most suitable crops. By knowing the deficiency of soil nutrients, the farmers and growers can opt for selective crops for minimum risk and maximum yield of product with more profit in agriculture sector. Fertilizers and manures can be used to enhance the productivity of crops, however excessive and misinformed used of fertilizer enhances the growth of unwanted crops also. Hence it is essential for farmers and growers to know the amount and type of fertilizer to be used to get the healthy crops with maximum amount of product with less investment.

Acknowledgements

For this study, soil samples were analyzed by using simple and reliable techniques for the determination of plant nutrients in soil in laboratory of Directorate of Soil &Water Conservation, Nagaland; Kohima. Authors thank the concerned authority and Dr. Chetan Kachhara, Department of Physics, Kohima Science college, for his help.

Samples	Kg/ha	Remarks (Gov. India,2011)
Zubza-1	112.86	Low
Zubza-2	125.40	Low
Zubza-3	112.88	Low
Kohima town-1	112.70	Low
Kohima town-2	85.28	Low
Kohima town-3	112.86	Low

Table 1 : showing the amount of Nitrogen in the analyzed soil sample.

Samples	Kg/ ha	Remarks (Gov. India, 2011)
Zubza-1	26.22	LOW
Zubza-2	22.00	LOW
Zubza-3	16.78	LOW
Kohima town-1	5.93	LOW
Kohima town-2	3.82	LOW
Kohima town-3	3.41	LOW

Table 2 : showing the amount of phosphorus in the analyzed soil samples

Samples	Kg/ ha	Remarks (Gov. India, 2011)
Zubza-1	84.00	LOW
Zubza-2	97.32	LOW
Zubza-3	114.24	LOW
Kohima town-1	24.64	LOW
Kohima town-2	28.00	LOW
Kohima town-3	25.20	LOW

Table 3: showing the amount of Potassium in the analyzed soil samples

Samples	% of OC	Remarks	Y= C×1.3		% of OM=Y×1.724
Zubza-1	1.67	High	2.17		3.74
Zubza-2	1.27	High	1.65		2.84
Zubza-3	1.37	High	1.78		3.06
Kohima town-1	1.02	High	1.32		2.27
Kohima town-2	1.03	High	1.33		2.29
Kohima town-3	1.33	High	1.73		2.98
Kiruphema-1	1.50	High	1.95		3.36
Kiruphema-2	1.40	High	1.82		3.13
Kiruphema-3	1.60	High	2.08		3.56

Table 4: showing the calculated amount of organic carbon in the soil samples

Samples	P^H
ZUBZA-1	4.68
ZUBZA-2	5.37
ZUBZA-3	5.33
KOHIMA TOWN -1	5.31
KOHIMA TOWN -2	4.92
KOHIMA TOWN -3	4.90
KIRUPHEMA-1	4.68
KIRUPHEMA-2	4.60
KIRUPHEMA-3	4.60

Table 5: showing the P^H values of soil sample

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Samples	EC	REMARKS
Zubza-1	1.07	Critical for salt sensitive crops
Zubza-2	1.31	Critical for salt sensitive crops
Zubza-3	1.25	Critical for salt sensitive crops
Kohima town-1	0.73	Normal soil
Kohima town-2	0.82	Critical for salt sensitive crops
Kohima town-3	0.73	Normal soil
Kiruphema-1	0.74	Normal soil
Kiruphema-2	0.63	Normal soil
Kiruphema-3	0.65	Normal soil

Table 6: Showing the EC values of soil samples

Parameters	Nitrogen (Kg/ha)	Phosphorus (Kg/ha)	Potassium (Kg/ha)
Kiruphema-1	74.13	35	150
Kiruphema-2	69.20	25	145
Kiruphema-3	69.20	26	147

Table -7 showing NPK values using Soil testing kit

Sample	NUTRIENTS	NI values	NI fertility status (Gov. India.2011)
Zubza	N	1.0.	LOW
	P	1.0	LOW
	K	1.0	LOW
Kohima town	N	1.0	LOW
	P	1.0	LOW
	K	1.0	LOW
Kiruphema	N	1.0	LOW
	P	1.0	LOW
	K	1.0	LOW

Table 8: Nutrient Index of Soils of Zubza, Kohima town and Kiruphema village

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SAXICOLOUS MOSSES OF NAGALAND, INDIA

Reviewed

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Abstract: The recent investigation or studies on the moss flora of Nagaland State of India reveals the presence of 38 species of Saxicolous moss taxa belonging to 24 Genera, 10 Families and 4 Orders. The morphological and anatomical characters of the various specimens are studied and noted. The various specimens were found to be growing on rock. 23 species were found to be new to the Moss Flora of Nagaland.

Keywords: Saxicolous, Musci, Nagaland.

Introduction

Saxicolous mosses are mosses which grow on rocks. Nagaland is a vibrant hilly State located in the North Eastern region of India with a rich biodiversity. The first work on the Moss Flora of Nagaland was recorded by Gangulee (1969 – 80) in "Mosses of Eastern India and Adjacent Regions" where he described some of the Moss taxa to be found in Naga Hills but no localities were specified. Lal *et al*. (2003) published an abstract on "New distributional records of a rare and endemic moss Fabronia assamica Dix. (Fabroniaceae) from Nagaland". Bansal *et al.* (2011) published a paper on "Epiphytic Bryophtyes on Thuja orientalis in Nagaland, North-Eastern India". Chaturvedi *et al.* (2011) published a paper on "Morphotaxonomic study on some corticolous mosses of Longkhum reserve forest, Mokokchung district, Nagaland". Chaturvedi *et al.* (2011) published a paper on "Diversity of genus *Fissidens* hedw. (Musci) from Kohima district, Nagaland". Another work on moss is the Ph.D. thesis titled "Studies on Mosses of Mokokchung and Kohima Districts, Nagaland 2012" by Vaphuno Sale (2012). Sale & Yanthan (2020) published a paper on "Mosses of Phek District, Nagaland, India". Bryological studies of Nagaland are rather unexplored as there is no detailed account on mosses of Nagaland. The present study has been carried out with an aim to record the diversity of Moss taxa in the state of Nagaland.

Materials and Methods

Specimens were collected from different localities in Nagaland in the year 2018 and 2019. Field pictures were taken with the help of Canon camera EOS 1100D. The fresh specimens collected from the natural habitats were spread between sheets of blotting papers and made to absorb off the moisture. After drying, the specimens were put in small paper packs and then kept in brown paper herbarium packets mentioning the important details on the herbarium labels (Specimen number, date, name of locality, collector's name, specimen name and family). For the study, the plant materials were soaked in water for few hours for proper stretching of the specimen and mounted in plain water for quick examination or observation. Observations and photographs of the specimens were carried out with the help of Coslab trinocular microscope and Vision USB camera.

Results and Discussion

Campylopus fragilis (Brid.) B. S. G. in Bryol. Eur., 1 : 164 (1847)

Plants pale green or yellowish green in colour, slender, caespitose, branching not seen, size varies from 5 mm to 1 cm. Leaves erectopatent when moist, flexuose or appressed to the stem when dry, ovate-lanceolate at the leaf base, becoming into a canaliculated subula towards the leaf apex, leaves about 5 mm long. Leaf tip dentate,leaf margin involute towards the upper portion of the leaf, costa covers about one third of the leaf base and covers almost the

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whole of subula. Upper leaf cells and basal leaf cells rectangular which becomes narrower towards the margin, some narrow rectangular hyaline cells forms the leaf margin at the basal area. Leaf cells at the leaf base shoulder irregularly rhomboid. Alar not bulging, hyaline.
Habitat: found growing on soil and rock
Locality: Khensa (1254 Vap Mkg), Ungma (1239 Vap Mkg), Old Zunheboto town (1112 Vap Zunhe), Old Zunheboto town (1110 Vap Zunhe), Wokha town (1058 Vap Wokha)
Range: Western Himalayas and South India

Campylopus introflexus (Hedw.) Brid. in Mant. Musci.: 72 (1819)

Plants dark green in colour, caespitose, about 2 cm high or more, branching present. Leaves erect to erectopatent, appressed to the stem when dry, not much change when dry, leaves are crowded at the top of the plant body. Leaves lanceolate subulate, about 3 mm long, red rhizoids present on the leaf base of older leaves, leaf tip denticulated, leaf margins incurved strongly, costa covers almost half of the leaf base. Upper leaf cells rhomboid, mildly incrassate, lower leaf cells rectangular becoming narrower towards the margin. Alar not bulging, formed by pale cells which becomes coloured in older leaves.
Habitat: found growing on soil, rock and dead log
Locality: Asukhomi village (1113 Vap Zunhe), Asukhomi village (1091 Vap Zunhe), Sukhalu village (1103 Vap Zunhe), New colony, Zunheboto town (1089 Vap Zunhe), Pfutsero (1007 Vap Phek)
Range: Eastern Himalayas and South India

Bryoerythrophyllum gymnostomum (Broth.) Chen in Hedwigia, 80: 255 (1941)

Plants reddish in colour, branching present, caespitose, about 9 mm tall. Leaves erectopatent to erect-spreading when moist, slightly curled when dry, lanceolate, carinate from anovate-rectangular leaf base, about 1.5 mm long. Leaf apex acute, leaf margin unbroken and involute, leaf margin not serrated, costa wide at the leaf base, percurrent, ending a little below the leaf tip, papillose on the costa back. Upper leaf cells round to quadrate, multipapillose, chlorophyllose. Mid-leaf cells rectangular, multipapillose, chlorophyllose. Lower basal leaf cells rectangular, hyaline, smooth, becoming shorter and more quadrate towards the leaf margin.
Habitat: found growing on stone
Locality: Mokokchung town (1214 Vap Mkg), Mokokchung town (1217 Vap Mkg)
Range: Western Himalayas and Eastern Himalayas

Bryoerythrophyllum yunnanense (Herz.) Chen in Hedwigia, 80 : 259 (1941)

Plants reddish brown in colour, branching present, sturdy, caespitose, up to 2 cm tall. Leaves erectopatent to erect-spreading when moist, curled when dry, not crowded on stems, lanceolate, carinate from anovate-rectangular leaf base, about 3 mm long. Leaf apex acute, leaf margin serrated or denndate on at the leaf apex, leaf margin unbroken and involute only at the leaf basal region, leaf margin flat in the leaf apex region, costa wide at the leaf base, percurrent, ending a little below the leaf tip. Upper leaf cells round to quadrate, multipapillose, incrassate, chlorophyllose. Mid-leaf cells rectangular, multipapillose, chlorophyllose. Lower basal leaf cells irregularly rectangular, hyaline, smooth, becoming shorter and regularly rectangular towards the leaf margin.
Habitat: found growing on rock and soil
Locality: Lekhromi (1031 Vap Phek), Tizit town (1115 Vap Mon), Bhumnyii village (1164 Vap Long)
Range: Western Himalayas and Eastern Himalayas

Hyophila involuta (Hook.) Jaeg. in Ber. S. Gall. Naturw. Ges. 1871 – 71: 356 (1873)

Plants dark green in colour, densely tufted, simple or branched, erect, about 1 cm tall, stems reddish in colour and usually covered with rhizoids below. Leaves erect-spreading when moist and forms a rosette, curled when dry, oblong-lingulate, about 3 mm long. Leaf base sheathing, leaf base pale, leaf margin smooth or entire but leaf apex denticulate, costa narrow at the upper region but wider at the leaf base, single, percurrent. Upper leaf cells round-quadrate, chlorophyllose, mamillose, obscure, few larger cells towards the margin. Lower leaf cells rectangular, smooth, hyaline.

Habitat: found growing on rock and concrete or guard walls
Locality: Zapami (1020 Vap Phek), Thetsumi (1040 Vap Phek), Asukhomi (1093 Vap Zunhe), Kiphire town (1181 Vap Kip), Vungojuu, Wokha town (1201 Vap Wokha), Ungma (1241 Vap Mkg), Mekhuli (1252 Vap Mkg), Mopungchuket (1256 Vap Mkg), Tuli (1267 Vap Mkg), Phek town (1327 Vap Phek)
Range: Eastern Himalayas, Western Himalayas, Central India, South India, Gangetic Plains, Rajasthan

Leptodontium handelii Ther. in Ann. Crypt. Exot., 5 : 171 (1932)

Plants yellowish green in colour, caespitose, slender, simple or branched, about 2 cm tall. Leaves erectopatent to erect-spreading when moist, appressed to the stem when dry, lingulate, about 1.5 mm long. Leaf margin smooth or entire, unbroken but inrolled towards the lower region of the leaf, leaf apex obtusely acute and serrated, costa narrow at the upper region but wider at the leaf base, single, percurrent or ends below the leaf tip. Upper leaf cells round-quadrate, multi-papillose, thin-walled, becoming rectangular below. Lower leaf cells rectangular, smooth, incrassate, becoming narrow towards the leaf margin.
Habitat: found growing on rock
Locality: Lekhromi (1030 Vap Phek)
Range: Eastern Himalayas

Oxystegus cylindricus (Brid.) Hilp. in Beih. Bot. Centralbl., 50 :(2) 620 (1933)

Plants yellowish green in colour becoming brownish in the lower regions, tufted, slender, simple, about 3 cm tall. Leaves erect-spreading when moist, curled when dry, flexuose, lanceolate-lingulate, about 4 mm long. Leaf base slightly sheathing, leaf margin flat, smooth or entire, unbroken but slightly crenulated by the papillae, leaf apex acute with a short apiculus, costa narrow at the upper region but wider at the leaf base, single, percurrent or excurrent. Upper leaf cells round-quadrate, multi-papillose, incrassate, obscure, chlorophyllose. Lower leaf cells rectangular, hyaline, thin-walled, smooth, becoming shorter towards the leaf margin.
Habitat: found growing on rock
Locality: Hakching village (1154 Vap Tuen)
Range: Eastern Himalayas, Western Himalayas and South India

Semibarbula orientalis (Web.) Wijk. & Marg. In Taxon, 8: 75 (1959)

Plants yellowish green in colour, densely tufted, slender, simple, branching absent, about 1-2 cm tall. Leaves laxly arranged on the stems, erectopatent when moist, curled when dry, oblong to ovate-lanceolate, about 1.5 mm long. Leaf margin smooth or entire except for the crenulations by the papillae, unbroken, flat, leaf apex obtusely acute and serrated, costa narrow, single, percurrent or excurrent ending in a short apiculus, costa papillose on the back. Upper leaf cells round-quadrate-hexagonal, chlorophyllose, multi-papillose, obscure. Lower leaf cells rectangular, smooth, hyaline.
Habitat: found growing on rock and soil
Locality: Kiphire town (1182 Vap Kip), Mekhuli (1249 Vap Mkg), Mekhuli (1250 Vap Mkg)
Range: Eastern Himalayas, Western Himalayas, Central India and Gangetic Plains

Anomobryum filiforme var. concinnatum (Spruce) Loesk. (Asthana & Sahu, 2013).

Plants green in colour, densely tufted, slender, julaceous, often flexuose, branching present, rhizoids present at the base which binds the stems together, about 1 cm tall. Leaves erectopatent or appressed to the stem when moist, contorted when dry, ovate-oblong, about 1 mm long. Leaf base not sheathing, leaf apex acute to acuminate, leaf margin flat and entire, minutely dentate at the leaf tip, costa single and reaches the leaf tip. Upper leaf cells narrow, elongated, thin-walled, prosenchymatous. Lower leaf cells lax and sub-rectangular, gets shorter at the extreme base.
Habitat: found growing on soil and rocky soil
Locality: Kami (1019 Vap Phek), Dzuleke (1290 Vap Koh)
Range: Western Himalayas, Eastern Himalayas and South India

Bryum paradoxum Schwaegr. in Sp. Musc. Suppl. 3 (1) : 224a (1827)

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Plants green in colour, slender, tufted, sub-floral innovations present, about 1-3 cm tall, leaves arranged closely above and leaves loosely arranged below. Leaves erectopatent when moist, appressed to the stem when dry, oblong lanceolate, about 2 mm long. Leaf apex acuminate, leaf margin entire and revolute, slight dentation at the leaf tip, costa single and excurrent in an arista. Upper leaf cells thin-walled and rhomboid-hexagonal, becoming narrower towards the leaf margin which forms an indistinct border, lower leaf cells rectangular.
Habitat: found growing on rock
Locality: Sukhalu village (1105 Vap Zunhe)
Range: Eastern Himalayas

Bryum salakense Card. in Annuair. Cons. Jard. Bot. Geneva, 15-16 : 166 (1912)

Plants green in colour, loosely tufted, branching present, sub-floral innovations present, about 1 cm tall, the leaves are usually clustered on the top forming comal tufts. Leaves erectopatent when moist, curled when dry, ovate-oblong, carinate, about 3 mm long. Leaf apex apiculate, leaf base not sheathing, leaf margin entire and recurved at the lower region of the leaf, slight serration on the leaf tip. Costa single and excurrent or reaching the leaf tip. Upper leaf cells thin-walled and rhomboid-hexagonal, about two rows of thick-walled elongated cells forms the border at the leaf margin. Lower leaf cells rectangular, narrower and irregular towards the margin which forms a distinct border.
Habitat: found growing on rock
Locality: New colony, Zunheboto town (1096 Vap Zunhe)
Range: South India

Mniobryum ludwigii (Schwaegr.) Loesk., Stud. Morph. Syst. Laubm. : 124. 1910.

Plants green in colour, tufted, erect, branching may be absent or present, about 2.3 cm long, stems red in colour. Leaves broad, ovate-lanceolate, erect to erectopatent when moist, flexuose when dry, about 1.3 mm long, costa decurrent, leaf apex acute, leaf margin flat, leaf margin serrulated at the tip of the leaf. Costa single, ending little below the leaf tip. Upper leaf cells rhomboid-hexagonal and narrow towards the margin at the mid-leaf region. Lower leaf cells rectangular, narrower towards the margin.
Habitat: found growing on soil and stone
Locality: Zapami (1021 Vap Phek), Mon town (1206 Vap Mon)
Range: Western Himalayas and Eastern Himalayas

Mnium integrum Bosch & Lac. in Bryol. Jav., 1 : 153 (1861)

Plants green in colour, creeping and growing in mats, branching present, leaves are distantly arranged on the stem, tomenta at the base below, more than 8 cm long. Leaves spreading when moist , crumpled when dry, oblong-ovate, about 4 mm long. Leaf base narrow, leaf apex obtuse with a very short mucro, leaf margin wavy, entire, costa single and percurrent or ends below the leaf tip. Leaf bordered by four to five rows of elongated narrow thick-walled cells which gives the toothed appearance on the leaf margin. Upper leaf cells round-quadrate and thin-walled. Lower leaf cells quadrate-hexagonal and thin-walled.
Habitat: found growing on soil and rock
Locality: Mew colony, Zunheboto town (1099 Vap Zunhe), Tuensang town (1134 Vap Tuen), Jotsoma (1276 Vap Koh), Phek town (1325 Vap Phek)
Range: Western Himalayas and Eastern Himalayas

Pohlia ampullacea Gang., Mosses E. India 4 : 921. 1974

Plants green in colour, erect, slender, loosely tufted, branching present, about 2 cm tall. Leaves erect when moist, flexuose when dry, narrow, ovate-lanceolate, about 3 mm long. Leaf base slightly sheathing, leaf apex apiculate, leaf margin flat and entire, slightly dendate at the leaf tip, costa single and percurrent or short excurrent. Upper leaf cells narrow, vermicular or linear. Mid-leaf cells elongated hexagonal and narrower towards the margin. Lower leaf cells irregular and rectangular.
Habitat: found growing on rock
Locality: New colony, Zunheboto town (1094 Vap Zunhe)
Range: Eastern Himalayas

Claopodium prinophyllum (C. Muell.) Broth. in Nat. Pfl., 1 (3) : 1009 (1908)

Plants yellowish green in colour, densely tufted, main stem creeping with distantly placed leaves, branching present, secondary branches pinnately branched, about 2 cm long. Leaves dimorphic, stem leaves large and cordate-lanceolate, branch leaves small, erect-spreading when moist, curved when dry, cordate-lanceolate, about 1 mm long. Leaf apex narrow, leaf margin flat and denticulate, costa single and percurrent. Leaf cells ovate-hexagonal, single papillae on the lumen of the cell, some smooth larger cells forms the leaf border or the denticulate border, some smooth rectangular cells at the mid region of both the leaf bases.

Habitat: found growing on rock.

Locality: Tuensang town (1136 Vap Tuen)

Range: Eastern Himalayas, Western Himalayas and South India

Thuidium cymbifolium (Doz. & Molk.) Doz. et Molk. Bryol. Jav., 2 : 115 (1865)

Plants green in colour, brown colour in older parts, robust, in dense mats, main stem creeping, branching present, main stem gives rise to semi-erect secondary branches. Leaves dimorphic. Stem leaves distantly placed on the stem, erectopatent when moist, plicate, ovate-lanceolate, about 2.5 mm long, leaf apex long acuminate, costa single, excurrent into an arista. Branch leaves dense, ovate-lanceolate, erectopatent when moist, not much changed when dry, concave, ovate-lanceolate, about 0.5 mm long, leaf apex acute, leaf margin crenulated, costa single and vanishes below apex. Leaf cells rhomboid, papillose, at the extreme base of leaf attachment area cells are elongated and smooth.

Habitat: found growing on soil and rock.

Locality: Lekhromi (1029 Vap Phek), Phek town (1316 Vap Phek), Dzuleke (1293 Vap Koh), Tuensang town (1132 Vap Tuen)

Range: Eastern Himalayas, Western Himalayas, Central India and South India

Thuidium meyenianum (Hamp.) Doz. & Molk. in Bryol. Jav., 2: 121 (1865)

Plants yellowish green in colour, delicate, wiry, in dense mats, branching present, main stem creeping giving rise to bipinnately branched secondary branches. Leaves dimorphic. Stem leaves distantly placed on the stem, suddenly narrowed into a long acumen from cordate base, plicate, about 0.7 mm long. Branch leaves dense, smaller than the stem leaves, erect-spreading when moist, curled or appressed to the stem when dry, concave-ovate, about 0.1 mm long. Leaf tip acute, leaf margin crenulate and flat, costa single and ending below leaf apex. Leaf cells small, irregularly hexagonal, obscure, papillose.

Habitat: found growing on rock and tree.

Locality: Pfutsero (1011 Vap Phek), Hakching village (1149 Vap Tuen)

Range: Eastern Himalayas, Western Himalayas and South India

Brachythecium buchananii (Hook.) Jaeg. in Ber. S. Gall. Naturw. Gess., 1876 – 77 : 341 (1878)

Plants yellowish green in colour, medium-sized, slender, tufted in dense mats, main stem creeping giving rise to erect secondary branches. Leaves dense, concave, plicate, ovate to oblong-lanceolate, erectopatent when moist, appressed to the stem or imbricate when dry, about 1.5 mm long. Leaf base mildly decussate and auriculate, leaf apex acuminate, leaf margin dentate in the upper part of the leaf, costa single and covers about half of the leaf length. Leaf cells elongate linear-rhomboid, becoming laxer below, alar differentiated, alar cells inflated and rectangular.

Habitat: found growing on rock and soil.

Locality: Old Zunheboto town (1107 Vap Zunhe), Kiphire town (1191 Vap Kip)

Range: Eastern Himalayas, Western Himalayas and South India

Brachythecium formosanum Takaki in J. Hattori Bot. Lab., 15 : 2 (1955)

Plants yellowish green in colour, medium-sized, tufted, main stem creeping giving rise to erect secondary branches. Leaves dimorphic. Stem leaves larger than the branch leaves, lax, concave, plicate, ovate-lanceolate, about 2.5 mm long. Branch leaves dense,

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concave, plicate, ovate-lanceolate, erectopatent when moist, about 1.5 mm long. Leaf base decussate, leaf apex acuminate, leaf margin dentate in the upper part of the leaf, costa single and covers about two third of the leaf length. Leaf cells narrow elongate linear, becoming shorter towards the base, alar differentiated, alar cells quadrate-rectangular.
Habitat: found growing on stone or rock and tree.
Locality: Suruhuto (1218 Vap Zunhe), Bhumnyu village (1223 Vap Long), Jotsoma (1282 Vap Koh), Phek town (1328 Vap Phek)
Range: Eastern Himalayas

Brachythecium plumosum (Hedw.) B. S. G. in Bryol. Eur., 6 : 8 (1853)

Plants green in colour, medium-sized, densely tufted, robust, main stem creeping giving rise to erect secondary branches. Leaves dense, imbricate, concave, ovate-lanceolate, erectopatent when moist, appressed to the stem when dry, about 1.5 mm long. Leaf apex sharp acuminate, leaf margin entire or maybe finely denticulate, costa single and covers about two third of the leaf length. Leaf cells narrow rhomboid, becoming sub-rectangular or rectangular at the base, alar differentiated, alar cells quadrate.
Habitat: found growing on rock.
Locality: Thetsumi (1043 Vap Phek)
Range: Eastern Himalayas, Western Himalayas and South India

Eurhynchium hians (Hedw.) Lac. in Ann. Mus. Bot. Lugd. Bat., 2 : 299 (1866)

Plants yellowish green in colour, tufted, robust, branching present, main stem creeping. Stem leaves larger than the branch leaves. Leaves erectopatent when moist, still erect and imbricate when dry, ovate-lanceolate, concave, lightly plicate, about 1.5 mm long. Leaf apex narrow acuminate in stem leaves and pointed acute in branch leaves, leaf margin dentate in the upper portion of the leaf, costa ends a little below the leaf tip. Leaf cells elongated, narrow rhomboid, cells at the extreme base rectangular and lax.
Habitat: found growing on rock.
Locality: Tuensang town (1133 Vap Tuen)
Range: Eastern Himalayas and Western Himalayas

Eurhynchium riparioides (Hedw.) Richs. In Ann. Bryol., 9 : 135 (1937)

Plants green in colour, robust, in tall tufts, branching present, main stem prostrate or pendulous giving rise to erect secondary branches. Leaves erectopatent when moist, shrunken but erect when dry, concave, plicate, orbicular, about 2 mm long. Leaf base decurrent, leaf apex acute, leaf margin dentate up to the base, costa covering about two third of the leaf length. Leaf cells linear rhomboid, incrassate, becoming vermiform towards the leaf margin at the leaf apex area, cells at the extreme base and alar region are lax and rectangular.
Habitat: found growing on rock.
Locality: Tuensang town (1135 Vap Tuen)
Range: Eastern Himalayas, Western Himalayas and South India

Eurhynchium swartzii (Turn.) Curnow in Rabenh. : Bryoth. Eur., 12: 593 (1862)

Plants yellowish green in colour, delicate, in thin mats, branching present, main stem creeping which gives rise to erect barnches. Leaves somewhat complanate, lax, erectopatent to erect-spreading when moist, shrunken but spreading when dry, ovate, about 1 mm long. Leaf apex acuminate in stem leaves and acute in branch leaves, leaf base decurrent, leaf margin denticulate almost to the base, costa covering about three fourth of the leaf length. Upper leaf cells elongate rhomboid, becomes broader lower down, extreme base leaf cells rectangular and lax.
Habitat: found growing on rocky soil, tree and rock.
Locality: Zapami (1026 Vap Phek), Saptiqa (1086 Vap Zunhe), Hakching village (1145 Vap Tuen), Mopungchuket (1260 Vap Mkg)
Range: Eastern Himalayas

Rhynchostegiella assamica Card. & Dix. in Rec. Bot. Surv. Ind., 6 (3) : 72 (1914)

Plants green in colour, lax, branching present, main stem creeping which gives rise to irregular pinnate branches. Leaves squarrose to erectopatent when moist, shrunk when dry, lax, ovate-lanceolate, about 1.5 mm long. Leaf base

narrow, leaf apex acute, leaf margin dendate to a little above base, costa covering about three-fourth of the leaf length. Leaf cells narrow rhomboid, becoming rectangular at the leaf base, alar differentiated, alar cells quadrate to rectangular.
Habitat: found growing on rock.
Locality: Tuensang town (1130 Vap Tuen)
Range: Eastern Himalayas

Rhynchostegium celebicum (Lac.) Jaeg. in Ber. S. Gall. Naturw. Ges., 1876-77 : 374 (1878)

Plants yellowish green in colour, tufted, branching present, main stem creeping which gives rise to pinnate branches. Leaves erectopatent to erect-spreading when moist, shrunk but spreading when dry, elliptical-ovate, about 1.5 mm long. Leaf base decurrent, leaf apex acute acuminate, leaf margin dendate to above base, costa covering about two-third of the leaf length. Leaf cells narrow rhomboid, becoming rectangular to quadrate at the leaf base.
Habitat: found growing on soil, rock and tree.
Locality: Thetsumi (1045 Vap Phek), Saptiqa (1079 Vap Zunhe), Old Zunheboto town (1108 Vap Zunhe), Hakching village (1147 Vap Tuen), Mokokchung town (1228 Vap Mkg)
Range: Eastern Himalayas, Western Himalayas and South India

Rhynchostegium duthiei C. Muell. ex Dix. in J. Bomb. Nat. Hist. Soc., 39 : 789 (1937)

Plants yellowish green in colour, branching present, main stem creeping which gives rise to erect branches. Leaves erectopatent when moist, not much changed when dry, concave, cordate-acute in stem leaves, ovate-acute in branch leaves, about 2 mm long in stem leaves, about 1.2 mm in branch leaves. Leaf base broad in stem leaves and narrow in branch leaves, leaf apex acute, leaf margin dendate to above base, costa covering about two-third of the leaf length. Leaf cells linear, becoming incrassate, shorter towards the leaf base, alar cells at the decurrent region rectangular.
Habitat: found growing on rock.
Locality: Sukhalu village (1106 Vap Zunhe)
Range: Eastern Himalayas, Western Himalayas and South India

Rhynchostegium herbaceum (Mitt.) Jaeg. Ber. S. Gall. Naturw. Ges., 1876-77 : 368 (1878)

Plants yellowish green in colour, robust, laxly tufted, branching present, main stem creeping and wiry which gives rise to irregular branches. Leaves erectopatent to erect-spreading when moist, shrunk but spreading when dry, concave, ovate, plicate, about 2 mm long. Leaf base decurrent, leaf apex acute apiculate, leaf margin dendate to above base, costa covering about two-third of the leaf length. Leaf cells narrow rhomboid and thick-walled, becoming shorter, lax and rectangular at the leaf base.
Habitat: found growing on rock.
Locality: New colony, Zunheboto town (1101 Vap Zunhe), Hakching village (1150 Vap Tuen)
Range: Eastern Himalayas, Western Himalayas and South India

Stereophyllum lingulatum Jaeg. in Ber. S. Gall. Naturw. Ges., 1877-78 : 277 (1880)

Plants yellowish green in colour, main stem creeping which gives rise to complanate branches. Leaves erectopatent to erect-spreading when moist, shrunk and appressed to the stem when dry, concave, asymmetrical, ovate, about 1.5 mm long. Leaf apex obtuse with suddenly narrow acute leaf tip, leaf margin smooth except for some papillose cells at the borders which gives an appearance of dentation, leaf margin revolute on one side of the leaf base, costa single and covering about half of the leaf length. Leaf elongate narrow rhomboid, some apical cells show some papillose developments at the cell tips, becoming shorter and rhomboid towards the leaf margin, cells becoming more elongated or longer at the mid-leaf region. Extreme basal cells tinted, large and rectangular, shorter quadrate lattice like cells above it.
Habitat: found growing on tree and stone.
Locality: Tuensang town (1137 Vap Tuen), Vungojii, Wokha town (1199 Vap Wokha)
Range: South India and Central India

Stereophyllum tavoyense (Hook.) Jaeg. in Ber. S. Gall. Naturw. Ges., 1877-78 : 279 (1880)

Plants yellowish green in colour, robust, main stem creeping which gives rise to complante pinnate branches. Leaves erect-spreading when moist, appressed to the stem and

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imbricate when dry, oblong, about 2 mm long. Leaf base slightly decussate, leaf apex acute, leaf margin smooth and involute on one side of the leaf base, costa single and vanishes a little above the mid-leaf region. Leaf linear, becoming shorter and broader towards the leaf base. Alar differentiated, alar cells quadrate with some irregular rectangular cells above it and at the leaf attactment areas.
Habitat: found growing on stone.
Locality: Vungojii, Wokha town (1200 Vap Wokha)
Range: Western Himalayas, South India and Gangetic plains

Brotherella dixonii Herz. in Ann. Bryol., 12 : 95, 14 (1939)

Plants yellowish green in colour, slender, laxly tufted, main stem creeping which gives rise to erect pinnate branches. Leaves laxly arranged on the stem, erectopatent to squarrose when moist, appressed to the stem with spreading tips when dry, concave, ovate-lanceolate, about 0.7 mm long. Leaf apex narrow acuminate, leaf margin dentate to a little above base, leaf base sub-cordate, costa absent. Leaf cells narrow rhomboid with papillae at the cell tips. Alar differentiated, alar cells large sub-rectangular or sub-quadrate with the extreme angle cell tinted.
Habitat: found growing on rock.
Locality: Wokha town (1072 Vap Wokha)
Range: Eastern Himalayas

Taxiphyllum taxirameum (Mitt.) Fleisch. in Musci Fl. Buitenz., 4 : 1435 (1923)

Plants yellowish green in colour, tufted in low mats, main stem creeping which gives rise to complanate branches. Leaves erect-spreading when moist, shrunken but still spreading when dry, densely arranged on the stem, ovate-lanceolate, concave, about 1.5 mm long. Leaf apex acuminate, leaf margin denticulate and flat but revolute on one side of the leaf base, costa double and short or often indistinct. Leaf cells narrow, elongate and rhomboid to linear, with papillose cells tips, some small short quadrate cells at the leaf attachment area.
Habitat: found growing on soil, rock and tree.
Locality: Thetsumi (1044 Vap Phek), Tuensang town (1126 Vap Tuen), Tuensang town (1131 Vap Tuen), Hakching village (1143 Vap Tuen), Hakching village (1148 Vap Tuen), Bhumnyu village (1166 Vap Long)
Range: Eastern Himalayas, Western Himalayas, South India, Central India and Nicobar Islands

Vesicularia montagnei (Bel.) Broth. in Nat. Pfl., 1 (3) : 1094 (1908)

Plants yellowish green in colour, in thin mats, main branches spreading, secondary branches pinnate and complanate. Leaves erectopatent to erect-spreading when moist, shrunken and curved when dry, ovate, concave, about 1.5 mm long. Leaf apex acuminate, leaf margin faintly dendate only at the leaf tip, costa very short, double, mostly indistinct. Leaf cells lax, rhomboid to hexagonal, smooth and chlorophyllose, becomes shorter at the extreme base . Alar not differentiated.
Habitat: found growing on rock and soil.
Locality: Tizit town (1116 Vap Mon), Nangtan village (1119 Vap Mon), Bhumnyu village (1155 Vap Long)
Range: Eastern Himalayas, Western Himalayas and Gangetic plains

Ectropothecium compressifolium (Mitt.) Jaeg. in Ber. S. Gall. Naturw. Ges., 1877-78 : 260 (1808)

Plants yellowish green in colour, tufted in low mats, main stem creeping giving rise to erect branches, branches complanate. Leaves erectopatent when moist, shrunk and appressed to the stem when dry, falcate, compressed complanate, ovate, about 0.8 mm long. Leaf apex acute, leaf margin dendate only at the leaf apex, costa short and double. Leaf cells narrow rhomboid and papillose, a row of rectangular cells at the extreme base with some smaller irregular cells above it.
Habitat: found growing on rock and soil.
Locality: Nangtan village (1122 Vap Mon), Nangtan village (1123 Vap Mon), Bhumnyu village (1156 Vap Long), Bhumnyu village (1158 Vap Long)
Range: Eastern Himalayas

Ectropothecium sikkimense (Ren. & Card.) Ren. & Card. in Bull. Soc. R. Bot. Belg., 41 (1) : 109 (1905)

Plants yellowish green in colour, tufted in low mats, main stem creeping giving rise to erect frondose branches, branches complanate. Leaves erectopatent when moist, shrunk and appressed to the stem when dry, falcate, lanceolate, about 1 mm long. Leaf base narrow, leaf apex narrow acuminate, leaf margin dendate only at the leaf apex, costa double and covers nearly half the length of the leaf. Leaf cells narrow rhomboid and papillose, alar distinct with several rows of quadrate cells.
Habitat: found growing on soil and rock.
Locality: Phek town (1315 Vap Phek)
Range: Eastern Himalayas

Hypnum subimponens Lesq. In Trans. Am. Phil. Soc. n. ser. 13 : 14 (1865)

Plants yellow green in colour, maybe with a coppery tinge, densely tufted, main stem creeping giving rise to pinnate branches. Leaves erectopatent and falcate when moist, erect and tips hooked when dry, densely arranged on the stem, oblong-lanceolate, about 1.5 mm long. Leaf apex narrow acuminate, leaf margin dentate only at the leaf tip and narrowly revolute at places, costa double, short or indistinct. Leaf cells linear, alar differentiated, alar cells are rectangular with some irregular quadrate cells above it.
Habitat: found growing on soil and rock.
Locality: Wokha town (1073 Vap Wokha), Asukhomi village (1111 Vap Zunhe), Kiphire town (1186 Vap Kip), Mopungchuket (1258 Vap Mkg), Sungratsu (1263 Vap Mkg), Tuli (1269 Vap Mkg), Phek town (1311 Vap Phek), Phek town (1313 Vap Phek)
Range: Eastern Himalayas

Hypnum submolluscum Besch. in Ann. Sc. Nat. Bot. ser. 7, 15: 93 (1892)

Plants yellowish green in colour, robust, branching present, main stem creeping which gives rise to pinnate branches, tufted in dense mats. Leaves erectopatent, falcate and imbricate when moist, shrunked and circinate when dry, densely arranged on the stem, concave, ovate-lanceolate, falcate, imbricate erectopatent, circinate when dry, about 1 mm long. Leaf apex denticulate and narrow, leaf margin recurved at places. Costa absent or indistinct. Leaf cells elongated and irregular, a row of tinted or golden coloured rectangular cells at the extreme leaf base with some shorter irregular cells above it.
Habitat: found growing on rocky soil and rock.
Locality: Lekhromi (1033 Vap Phek), Wokha town (1065 Vap Wokha), Sukhalu village (1104 Vap Zunhe), Khensa (1253 Vap Mkg)
Range: Eastern Himalayas

Isopterygium micans (Sw.) Kindb. In Enum. Bryin. Exot. 21 (1888)

Plants yellowish green in colour, slender, tufted in thin loose mats, main stem creeping which gives rise to prostrate branches. Leaves erectopatent when moist, shrunk but not much change when dry, concave, ovate-lanceolate, about 1 mm long. Leaf apex narrow acuminate, leaf margin dentate at the leaf tip, costa short, double and faint. Leaf cells narrow rhomboid with irregular wall thickenings at the leaf apex area, leaf cells becomes linear lower down, a row of rectangular cells at the extreme base with some irregular smaller cells above it, alar not so distinct.
Habitat: found growing on rock.
Locality: Nangtan village (1121 Vap Mon)
Range: Eastern Himalayas

Isopterygium minutirameum (C. Muell.) Jaeg. in Ber. S. Gall. Naturw. Ges. 1876-1877 : 434 (1878)

Plants yellowish green in colour, slender, tufted in thin mats, feathery, main stem creeping which gives rise to pinnate short branches. Leaves erect-spreading when moist, shrunk but not much change when dry, concave, ovate-lanceolate, about 1 mm long. Leaf apex narrow long acuminate, leaf margin smooth, costa not distinct. Leaf cells linear, some rectangular to quadrate cells at the extreme leaf base.
Habitat: found growing on rock.
Locality: Longleng town (1168 Vap Long)
Range: Eastern Himalayas

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Table 1: Showing the different Saxicolous Moss taxa under different families and orders.

Sl No.	Name	Family	Order
1.	*Campylopus fragilis*	Dicranaceae	Dicranales
2.	*Campylopus introflexus*		
3.	*Bryoerythrophyllum gymnostomum*	Pottiaceae	Pottiales
4.	*Bryoerythrophyllum yunnanense*		
5.	*Hyophila involuta*		
6.	*Leptodontium handelii*		
7.	*Oxystegus cylindricus*		
8.	*Semibarbula orientalis*		
9.	*Anomobryum filiforme var. concinnatum*	Bryaceae	Eubryales
10.	*Bryum paradoxum*		
11.	*Bryum salakense*		
12.	*Mniobryum ludwigii*	Mniaceae	
13.	*Mnium integrum*		
14.	*Pohlia ampullacea*		
15.	*Claopodium prinophyllum*	Thuidiaceae	Hypnobryales
16.	*Thuidium cymbifolium*		
17.	*Thuidium meyenianum*		
18.	*Brachythecium buchananii*	Brachytheciaceae	
19.	*Brachythecium formosanum*		
20.	*Brachythecium plumosum*		
21.	*Eurhynchium hians*		
22.	*Eurhynchium riparioides*		
23.	*Eurhynchium swartzii*		
24.	*Rhynchostegiella assamica*		
25.	*Rhynchostegium celebicum*		
26.	*Rhynchostegium duthiei*		
27.	*Rhynchostegium herbaceum*		
28.	*Stereophyllum lingulatum*	Plagiotheciaceae	
29.	*Stereophyllum tavoyense*		
30.	*Brotherella dixonii*	Sematophyllaceae	
31.	*Taxiphyllum taxirameum*		
32.	*Vesicularia montagnei*		
33.	*Ectropothecium compressifolium*	Hypnaceae	
34.	*Ectropothecium sikkimense*		
35.	*Hypnum subimponens*		
36.	*Hypnum submolluscum*		
37.	*Isopterygium micans*		
38.	*Isopterygium minutirameum*		

Conclusion

38 species of Saxicolous Moss taxa belonging to 24 Genera, 10 Families and 4 Orders were studied and described in the recent investigation (as shown in table 1). This recent investigation also reveals that 23 species viz., *Isopterygium minutirameum* (C. Muell.) Jaeg., *Isopterygium micans* (Sw.) Kindb., *Hypnum submolluscum* Besch., *Ectropothecium compressifolium* (Mitt.) Jaeg., *Vesicularia montagnei* (Bel.) Broth., *Brotherella dixonii* Herz., *Stereophyllum tavoyense* (Hook.) Jaeg., *Rhynchostegium herbaceum* (Mitt.) Jaeg., *Rhynchostegium duthiei* C. Muell. ex Dix., *Rhynchostegium celebicum* (Lac.) Jaeg., *Rhynchostegiella assamica* Card. & Dix., *Eurhynchium swartzii* (Turn.) Curnow in Rabenh., *Eurhynchium riparioides* (Hedw.) Richs., *Eurhynchium hians* (Hedw.) Lac., *Brachythecium plumosum* (Hedw.), *Brachythecium formosanum* Takaki., *Brachythecium buchananii* (Hook.) Jaeg., *Thuidium meyenianum* (Hamp.), *Bryum paradoxum* Schwaegr., *Semibarbula orientalis* (Web.) Wijk. & Marg., *Oxystegus cylindricus* (Brid.) Hilp., *Leptodontium handelii* Ther. and *Bryoerythrophyllum gymnostomum* (Broth.) Chen. are new to the Moss Flora of Nagaland. Therefore, this recent study has added to the Moss diversity of Nagaland State of India.

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TRADITIONAL BURIAL PRACTICES AMONG THE ANGAMI TRIBE OF THE NAGA COMMUNITY

Reviewed

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Abstract: Grieving is expressed over any emotional loss. The more you care about something, the greater the trauma of losing it. Grieving is a process, and every culture has its rituals and traditions to facilitate mourning. The Angami Nagas had also developed methodologies to express their grieving on the loss of a loved one. The Angamis are known for the kind of rituals they practiced and how they have lived in strict accordance with it.

Keywords: Angami, Traditions, Thanatology, Corpse, Spirits, Rituals, Grieving, Taboo, Christianity, Head-hunting, Excommunication.

Introduction

Death fundamentally determines our existence as human beings. Death is the total cessation of life processes that eventually occurs in all living organisms. The state of human death has always been obscured by mystery and superstition, and its precise definition remains controversial, differing according to culture and legal systems. During the latter half of the 20th century, death became a strangely popular subject. Thanatology, the study of death—delves into matters as diverse as the cultural anthropology of the notion of soul, the burial rites and practices of early civilizations, the location of cemeteries in the Middle Ages, and the conceptual difficulties involved in defining death in an individual whose brain is irreversibly dead but whose respiration and heartbeat are kept going by artificial means. It encompasses the biological study of programmed cell death, the understanding care of the dying, and the creation of an informed public opinion as to how the law should cope with the stream of problems generated by intensive-care technology. Ritual**,** the performance of ceremonial acts prescribed by tradition or by sacerdotal decree. Ritual is a specific, observable mode of behaviour exhibited by all known societies. Rituals are inherently tied to the human experience and countless rituals have existed in human history. The oldest known ritual is more than 70,000 years old and consisted of early humans worshipping a stone python (Frazer, 2016). The analysis and understanding of mortuary practices provide rich data on the behaviour of kin and community. It leads to people's notions of gods, souls, witches, spirits, and after worlds. It promises access to their belief and value systems, to their conceptions of the social and moral worlds. It informs that ritual has consequences for both the individual and society.

Objectives

The objective of the study is as follows;

1) To document the traditional burial practices, among the Angami Nagas.

2) To understand the significance behind the rituals and other associated burial practices.

3) To highlight the factors why such traditional practices are rapidly dying out.

Methodology and study area

The research method employed for the field study was through observation and interview methods. All the information was collected only after the consent of the informant. The Angami Nagas have been divided into 4 regions, including the Chakhro Angami's. The following Villages were selected keeping in mind its historical background and the availability of informants from each village; Southern Angami (Viswema, Jakhama), Northern Angami (Kohima village, Chiechama),

Western Angami (Jotsoma, Khonoma). The informants were selected keeping in mind their knowledge of their local burial practices to make sure that those individuals with the most valuable and important information pertaining specifically to the research topic were selected. Secondary data has also been used to strengthen and cross-check the data/information collected. Though secondary references have been used, the main content of this paper mostly reflects and talks about the current status and knowledge in burial rituals.

Angami religion

Though the major religion followed by the Angami tribe (98%) today is Christianity, the Angamis were one of the last Naga tribes with an animistic population (2011 census). They (Angamis) believe that spirits are embodied in several objects and have sharply drawn the distinctions between Gods and the soul of the human bodies (www.indianmirror.com). The Angami animists practice a religion known as *Pfutsana*, and according to the 1991 census, there were about 1,760 Angami practitioners which came down to just 884 people after a decade. Today the Angami Christians are composed of five major denominations; Baptist, Revival, Roman Catholic, Pentecostal and Seventh-day Adventist. The Baptists constitute more than 80% of the total Angami Christian population (Angami Naga-Wikipedia).

Burial rituals and practices

Traditional burial practices are simple yet meticulous step-by-step rituals followed by the Angami tribe of Naga community. Out of the 6 villages studied almost all the informants explained about practicing similar burial rituals with some slight differences. The belief that life, in one way or another, continues after death is perhaps the most common understanding of death (Colman, 1997). Of all the burial customs among the Angami tribe of the Naga community, one of the most widespread had been the practice of burying items along with the body such as tools, weapons, traditional ornaments including the most used and loved belonging of the deceased person etc. When asked as to why such grave goods are put in graves, all the informants stated that items are buried with the body with the belief that the items would be *needed* in the next life and also the grave goods will pacify potential ghosts. We can also safely say that burying items was also a way to honour a person and express affection towards their loved ones who have died.

A variety of step-by-step rituals are carefully followed to achieve a proper burial performance. The first step is washing (cleaning) the body of the deceased, followed by putting the corpse in a wooden slab or plank (sometimes on top of stones) after which other important burial rites are performed. Usually, each village has a ritual leader who performs and leads the burial. In some villages such as Viswema and Jakhama village, dogs and freshly hatched chickens are buried alive along with the body of the deceased with the belief that it will guide, accompany and/or serve as a meal for the departed soul.

Another widely spread practice is the distribution of meat when a person dies which is locally known as *Thepri* (names may vary slightly depending on the village*)* which if not done is considered as *Kenyü* (taboo). The meat used as *Thepri* is not cooked from the original fireplace as it is considered forbidden. Therefore a temporary fireplace is constructed. Here, everyone who comes to pay homage to the deceased person gets a piece of the slaughtered meat (cows, pigs, etc), and how much one gets depends on what you bring (Kohima Village). For example, the one who brings rice beer will get lesser meat as compared to the one who brought a chicken to the funeral. Generally in all the villages, the leftovers of the *Thepri* are either thrown away after the next day of the burial or they are distributed to nearby villages or are given to the ritual leader. Grieving depends on the closeness of the dead person with others. Sometimes it can go for a long period lasting up to 8-10 years. In this type of extreme case, the grieving person does not even take bath or cut their hairs etc.

The grave goods buried differ for men and women. When a male dies, traditional hunting weapons and ornaments such as *rüngou*

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(spear), *zhie* (dao), and shawls are buried along with him. For women, traditional ornaments such as necklaces, shawls, baskets etc are buried along with her. *Siaki* (grave houses) are also built permanently or temporarily after the person is buried. Various traditional ornaments are also displayed on the grave which again is different for both males and females. Some ornaments are expensive and in such cases are shared by relatives of the deceased (Khonoma village).

An interesting ritual practiced among the Viswema people was, before the burial takes place the uncle of the deceased person (maternal/paternal) performs a ritual in which the thigh part of the buffalo or any animal which is slaughtered is used. On top of the meat, they put the metal part of the spade without the handle. The uncle then removes the spade with his feet and after the spade is on the ground he takes the metal spade with him and uses it like any other spade. Unless this person comes, even after all the funeral rites have been done, the body cannot be buried. A possible explanation for this is that since metal was a rare commodity in the past, it may have been used to show how much they care and honour their loved ones who have died.

The grave goods displayed can also say a lot about the person who has died. In Kohima village, if a person (irrespective of gender) was able to hunt large animals when they were alive then drawings of such wild animals are drawn on their graves showing the bravery of the deceased person. The presence of epitaph is not found among the Angami Nagas, however, this did not stop them from distinguishing certain people from others while burying them. For instance, different types of shawls are displayed on the grave depending on the status of the deceased person. When a head-hunter dies, for some villagers the number of heads slayed by him are displayed on his grave, the way the skulls are erected also has meanings. For example, if a person was able to slay heads while fighting face to face then the skull is nailed straight with the face facing forward, while in cases where if a person slays the victim's head while he/ she (victim) was asleep or in any other situation other than face to face encounter, then the skull is nailed upside-down (Viswema village). Another example can be when a person sees a grave outside the village gate, even without knowing the person they can know that the person has died an unfortunate or accidental death based on the locations (outside the village gate) they have been buried. It is most likely that they don't allow such accidental deaths to be buried inside the gate due to fear of bad luck or other sorts of calamities befalling the village. Though the definition of the epitaph in this context is from a western concept, the practice of difference in displaying traditional ornaments and weapons to distinguish people can be considered as a form of traditional epitaph. All these practices indicate their rational and reasonable thinking and ability were quite impressive.

Adherence to strict burial norms can be seen in Kohima village where the people believe that sometimes some spirits come and communicate with the living person through certain individuals called *Themou mia* (séance) for many reasons. Incorrectly performed rituals can result in re-digging of the grave where they would try to correct the ritual. Sometimes if the shawls covered on the dead body is done incorrectly then it is re-done. The positions in which the bed sheet of the dead person is spread are also different from that of a living person and all these should be done correctly.

In Jotsoma some people tend to bury their family members in the fields or sometimes a little away from the main village. If there is flooding or other calamities that result in the exposure of the grave meaning the body being exposed then they will repeat all the rituals and rebury the corpse.

In Jakhama and Kohima village, the people once used to practice an open burial system locally known as '*Shadze'* and '*jha*' respectively. Among the Jakhama people, earlier they do not bury the dead and instead, they will stack up wood up to 5 feet or so and put the body on top of it and these platforms are known as corpse-platforms. Observing the loved ones of the deceased cry the whole day without working in their fields, fearing the consequences of hunger if such practices continued, the open burial system was abandoned. In Kohima village, in the past bamboos were stacked up to

form platforms outside the village gate, usually in the village pathways. This was where the dead bodies were kept to rot. If the deceased person has close loved ones then they would frequently come and make fire below to speed up the process of decomposition, and for the others who do not have any close family or relatives, their bodies are left to rot for many days. Once the body completely decomposes, the bones are taken away and buried on the ground. Both the villages probably followed this because they were reluctant to part with their loved ones.

Conclusion

Rituals and norms associated with burials among the Angami Nagas have been long practiced for several generations. Earlier their day-to-day activities were tied directly or indirectly with rituals of various forms and deities. Along with taboo, rituals were so important that failure to follow such rituals can even lead to ex-communication of the person from the village. The way the Angamis have relied on animistic rituals to maintain, control and keep all the societal norms on track cannot be ignored. In a true sense these rituals are practiced to promote the relationship among the family members, relatives and also with the entire village. Such as when a beloved person dies, not only the family members of the deceased person but the entire village do not work or go to fields for that day. This indicates a kind of intimacy and bond they shared in the past. As per the observation and based on the subjects interviewed, many of the burial rituals are slowly being forgotten, and most of the informants could not remember the meaning behind the practice of certain important rituals. They can't be blamed for this, because of the known fact that Christian norms strongly limited the practice of animism. Today, as the majority of the Angami's have become Christians, there is scarcely any passing down of ancestral history on burials and therefore the general population knows very little about the burial rituals of one's society. Burial rituals are one of the foundation key factors to understand ancestral thinking and relationship among people, which can tell us a lot about a cultural community, which is why quite a lot of similar type of research has been done across the globe today. For some people, certain burial rituals from the different cultural communities can come as a shock. However, when studied further, a thorough understanding of the meaning of practicing such rituals makes sense in the end. Although Christianity was the main reason behind the leap from animism to monotheism, other possible reasons behind this conversion may be;

1. Conversion, because everyone in their community began to convert and they did not want to be the odd one.
2. Because they didn't have any partner to practice the rituals with.
3. For some, they converted because after they die, they will be buried with no norms/rituals performed on them. Therefore, if they convert to Christianity they will be buried with the Christian funeral rites.

Most of what we know of our rich ancestral history and the lifestyle of our forefathers are just fractions of the actual frame that is there, and that a lot of crucial and significant details that could have been a prized possession on knowledge today have been lost through the process of shift in religion as well as due to westernization. It is quite staggering to note that just about 50 years ago, a good number of the Angami population practiced animism. *Pfutsana*, also known as the traditions of the elders has always been a prime feature of the early Angami society and it is from these norms and regulations that we are who we are today. We cannot afford to obliterate such rich and meaningful practices that have been followed by our forefathers. Such rituals and practices are known only by a few elderly people and this knowledge will fade along with them too. Therefore, there is a need to extensively interview potential informants across Nagaland and such crucial details and particulars should be documented with utmost urgency.

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PRELIMINARY STUDY OF ORTHOPTERA AND THEIR OCCURRENCE FROM KOHIMA DISTRICT, NAGALAND

Reviewed

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Abstract: During the study period, 61 species of orthopterans belonging to 9 families were recorded. 14 species were new records to Nagaland. Among the different sites where the study was carried out, mixed cultivation and forest canopy site comprises the highest occurrence of orthopteran.

Keywords: Orthoptera, Kohima, Nagaland

Introduction

The grasshoppers (Orthopteran) insect fauna generally are grouped as short-horned grasshopper (Caelifera) and long-horned grasshopper (Ensifera) (Ander, 1939). Orthoptera species and assemblages vary enormously in biology, abundance, population variability and geographic range. This means that some are major pests, but others are threatened with extinction or are extinct through human agency. Most pest species are in the Acrididae, yet proportionately more threatened species are in the less speciose families; continental species of Acrididae and Tettigoniidae are the ones principally threatened. Landscape structure, changing environmental conditions, cropping patterns and farming systems greatly influenced the distribution and variety of the grasshopper species in different parts of the world (Shishodia *et al*., 2010). Many of the threatened Orthoptera species are confined to a small geographical area and are highly threatened by anthropogenic impacts that coincide with their small ranges. Yet some formerly widespread pest taxa have become extinct. Preservation of orthopteran biodiversity is a complex and paradoxical task (Samways and Lockwood, 1998).

The major work on Indian Orthoptera was published by Kirby (1914) in 'Fauna of British India', including Ceylon and Burma, Orthoprtera (Acrididae) wherein 329 species belonging to 124 genera and 8 subfamilies, under family Acrididae were reported. Grasshoppers of India were published by Tandon (1976) and Shishodia *et al*. (2010), and of different states of India viz., Kerala by Priya and Narendran (2003), Madhya Pradesh, Himachal Pradesh by Shishodia and Gupta (2009), Northeast India by Usmani and Khan (2010), Jharkhand by Nayeem and Usmani (2012), Haryana by Kumar and Usmani (2015) and Bihar by Nayeem *et al*. (2013) respectively. Chandra *et al.* (2010) reported the checklist of Orthoptera of India included 1033 species/ subspecies belonging to 398 genera and 21 families of Orthoptera from India. Works on orthopteran fauna in North East India has been carried out by Vasanth (1993), Shishodia *et al.* (2003, 2010), Srinivasan and Prabakar (2012), Senthil kumar (2010), Hajong (2014), Nagar and Swaminathan (2015) and Khan *et al.* (2018). Shishodia M. S. and Dey Anita (2006) study on the Acridoidea fauna of Nagaland has been made so far.

Materials and Methods

Kohima district, situated in the southern part of Nagaland, at an altitude of 1444 m above the sea level i.e., with an average elevation of 1261 meters; the coordinate of Kohima is 25°74'71''N, 94°11'04''E longitude. Kohima is a hilly landscape covering an area of 1463 sq. km which lies north of the Japfü Barail intersection. It is bounded by Dimapur on the west, Wokha district in the north, Zunheboto and Phek district on the east and Manipur state on the south. All the study sites were located in Kohima district in the state of Nagaland, India. The selection of the sites is to measure the maximum representation of different environmental conditions and levels of disturbances. Site-1: Paddy cultivating field.

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Site-2: Forest roadside area. Site-3: Water terrace cultivation. Site-4: Mixed cultivation and forest canopy. The study of Orthopterans was conducted from October 2020 to June 2021 through field manual exploration and observation to record the various types of Orthopterans present at the study site. The collection is done with hand-picking method (Sanjayan, 1994).

Result and Discussions

During the study period 61 species of orthoptera belonging to 9 families and 48 genera were recorded (**Table-1**). The family Acrididae shows the maximum number with 25 species, family Tettigoniidae with 14 species, family Gryllidae with 8 species, family Pyrgomorphidae with 6 species, family Tetrigidae with 3 species, family Chorotypidae with 2 species, family Gryllotalpidae, Rhaphidophoridae and Gryllacrididae with 1 species each.

Table-1: List of Orthoptera species recorded from Kohima district, Nagaland

Sl. no.	Family	Scientific name	Distribution
1	Acrididae	*Oxya hyla* (Serville, 1831)	Nagaland, Andaman and Nicobar Island, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Goa, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Orissa, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttarkhand, Uttar Pradesh and West Bengal.
2	Acrididae	*Oxya fuscovittata* (Marschall,1836)	Nagaland, Andhra Pradesh, Arunachal Pradesh, Assam Bihar, Chhattisgarh, Delhi, Goa, Himachal Pradesh, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Orissa, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttarkhand, Uttar Pradesh and west Bengal
3	Acrididae	**Oxya japonica* (Thunberg, 1815)	Nagaland, Andaman & Nicobar Islands, Assam, Arunachal Pradesh, Bihar, Goa, Karnataka, Kerala, Maharashtra, Manipur, Meghalaya, Tripura and Uttar Pradesh.
4	Acrididae	*Oxytauchira sp*.	Nagaland, Andhra Pradesh, Meghalaya, Uttar Pradesh
5	Acrididae	*Spathosternum prasiniferum* (Walker, 1871)	Nagaland, Andaman and Nicobar Island, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Goa, Himachal Pradesh, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Orrisa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh and West Bengal
6	Acrididae	**Dittopternis venusta* (Walker, 1870)	Nagaland, Andhra Pradesh, Chhattisgarh, Kamataka, Madhya Pradesh, Manipur, Meghalaya, Odisha, Tamil Nadu, Tripura and West Bengal

7	Acrididae	*Trilophidia annulata* (Thunberg, 1815)	Nagaland, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Goa, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Odisha, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh and West Bengal.
8	Acrididae	**Oedipoda himalayana* (Uvarov, 1925)	Nagaland, Himachal Pradesh, Gujarat, Jammu & Kashmir and Uttarakhand.
9	Acrididae	*Ceracis nigricornis* (Walker, 1870)	Nagaland , Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Haryana, Himachal Pradesh, Maharashtra, Manipur, Meghalaya, Sikkim, Uttarakhand, Tamil Nadu, Tripura, West Bengal
10	Acrididae	*Ceracris* sp.	Nagaland
11	Acrididae	*Gastrimargus marmoratus* (Thunberg, 1815)	Nagaland, Andhra Pradesh, Assam, Karnataka, Maharashtra, Meghalaya, Sikkim, Uttar Pradesh, Tamil Nadu, West Bengal.
12	Acrididae	*Xenocantantops humilis* (Servile, 1839)	Nagaland , Arunachal Pradesh, Andaman and Nicobar Island, Assam, Bihar, Chhattisgarh, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Sikkim, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh and West Bengal.
13	Acrididae	*Diabolocatantops innotabilis* (Walker, 1870)	Nagaland , Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Goa, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Lakshadweep Island, Madhya Pradesh, Maharashtra, Meghalaya, Manipur, Odisha, Rajasthan, Sikkim, Tamil Nadu, Uttarakhand, Uttar Pradesh and West Bengal.
14	Acrididae	*Choroedocus robustus* (Serville, 1838)	Nagaland , Arunachal Pradesh, Andhra Pradesh, Assam, Manipur, Mizoram, Meghalaya, Sikkim, Tripura, West Bengal
15	Acrididae	*Apalniacris varicornis* (Walker, 1870)	Nagaland, Arunachal Pradesh. Assam, Nagaland, Sikkim, Tripura, West Bengal (mainly found in N. E, India)
16	Acrididae	*Stenocatantops splendens* (Thunberg, 1815)	Nagaland , Andaman and Nicobar Island, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Haryana, Delhi, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Manipur, Orissa, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, Uttarakhand, West Bengal.
17	Acrididae	**Eucoptacra praemorsa* (Stål, 1860)	Nagaland , Andhra Pradesh, Arunachal Pradesh, Assam, Chhattisgarh, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Orissa, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, Uttarakhand and West Bengal.
18	Acrididae	*Acrida sp*. nymph	Nagaland

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19	Acrididae	*Acrida exaltata* (Walker, 1859)	Nagaland , Andaman & Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Goa, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Odisha, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh and West Bengal.
20	Acrididae	*Phlaeoba infumata* (Bruner Von Wattenyl, 1893)	Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Goa, Haryana, Himachal Pradesh, Madhya Pradesh, Manipur, Meghalaya, Odisha, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal.
21	Acrididae	**Phlaeoba panteli (*Bolívar, 1902)	Nagaland , Andhra Pradesh, Arunachal Pradesh, Bihar, Himachal Pradesh, Madhya Pradesh, Manipur, Meghalaya, Tripura, Tamil Nadu, Uttarakhand and West Bengal.
22	Acrididae	*Chondracris rosea* (De Geer, 1773)	Nagaland , Andhra Pradesh, Arunachal Pradesh, Assam, Goa, Himachal Pradesh, Kerala, Madhya Pradesh, Manipur, Meghalaya, Mizoram, Odisha, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, Uttarakhand and West Bengal.
23	Acrididae	*Pantaga succinata* (Uvarov, 1923)	Nagaland, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Goa, Himachal Pradesh, Jammu & Kashmir, Kerala, Lakshadweep Island, Maharashtra, Manipur, Meghalaya, Orissa, Rajasthan, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh and West Bengal.
24	Acrididae	*Pachyacris vinosa* (Walker, 1870)	Nagaland, Assam, Bihar, Goa, Himachal Pradesh, Nagaland, Karnataka, Mizoram, Meghalaya, Orissa, Rajasthan, Uttar Pradesh and West Bengal.
25	Acrididae	**Eyprepocnemis rosea* (Urarov, 1942)	Nagaland, Andhra Pradesh, Himachal Pradesh, Jammu & Kashmir, Madhya Pradesh, Meghalaya, Uttarakhand and Uttar Pradesh.
26	Pyrgomorphidae	**Aularches millaris* (Stål, 1873)	Nagaland, Andhra Pradesh, Assam, Haryana, Himachal Pradesh, Jammu and Kashmir, Jharkhand, Manipur, Meghalaya, Orissa, Sikkim, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh and West Bengal
27	Pyrgomorphidae	*Atractomorpha crenulata* (Fabricus, 1793)	Nagaland, Andaman & Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Goa, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Jharkand, Karnataka, Kerala, Lakshadweep Islands, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Odisha, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh, West

			Bengal.
28	Pyrgomorphidae	*Atractomorpha burri* (Bolívar, 1905)	Nagaland, Arunachal Pradesh, Assam, Manipur, Meghalaya, North Mizoram, Orissa, Sikkim, Tripura and West Bengal.
29	Pyrgomorphidae	*Atractomorpha* sp.	Nagaland
30	Pyrgomorphidae	*Tagasta indica* (Bolivar, 1905)	Andaman and Nicobar Island, Arunachal Pradesh, Meghalaya, Nagaland, Sikkim, Tripura and West Bengal
31	Pyrgomorphidae	**Chlorizeina unicolor* (Bunner von Wattenwyl, 1893)	Assam, Manipur and Tripura
32	Chorotypidae	**Erianthinus affinus* (Westwood, 1843)	Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Tripura
33	Chorotypidae	*Erianthinus sp.*	Nagaland
34	Tetrigidae	*Hedotettix sp*.	Nagaland
35	Tetrigidae	*Euparatettix sp.*	Nagaland
36	Tetrigidae	*Saussurella sp*.	Nagaland
37	Tettigoniidae	*Ducetia japonica* (Thunberg, 1815)	Andaman and Nicobar Islands, Arunachal Pradesh, Assam, Bihar, Himachal Pradesh, Jammu & Kashmir, Madhya Pradesh, Maharashtra, Meghalaya, Nagaland, Odisha, Rajasthan, Sikkim, Tamil Nadu, Uttarakhand, Uttar Pradesh and West Bengal
38	Tettigoniidae	*Ducetia sp.*	Nagaland
39	Tettigoniidae	*Elimaea securigera* (Brunner Von Wattenwyl, 1878)	Nagaland, Andaman & Nicobar Islands, Assam, Himachal Pradesh, Karnataka, Manipur, Meghalaya, Nagaland, Sikkim, Tripura and West Bengal, Andhra Pradesh, Kerala, Madhya Pradesh, Orissa and Rajasthan
40	Tettigoniidae	*Elimaea subcarinata* (Stål, 1861)	Nagaland, Mizoram (Aizawl) and West Bengal
41	Tettigoniidae	**Letana megastridula* (Ingrisch, 1990)	Nagaland, Bihar, Chhattisgarh, Himachal Pradesh, Maharashtra and Tamil Nadu
42	Tettigoniidae	*Trigonocorypha sp.*	Nagaland
43	Tettigoniidae	*Conocephalus maculates* (Le Guillou, 1841)	Nagaland, Andaman and Nicobar Island, Arunachal Pradesh, Chhattisgarh, Himachal Pradesh, Jammu and Kashmir, Kerala, Madhya Pradesh, Maharashtra, Manipur, Mizoram, Orissa, Sikkim, Tamil Nadu, Tripura, Uttarakhand and West Bengal.
44	Tettigoniidae	*Erechthis sp.*	Nagaland
45	Tettigoniidae	*Eucocephalus incertus* (Walker, 1869)	Nagaland, Andaman & Nicobar Islands, Chhattisgarh, Madhya Pradesh, Meghalaya, Orissa, Pondicherry, Rajasthan, Sikkim and West Bengal
46	Tettigoniidae	**Eucocephalus pallidus* (Redtenbacher, 1891)	Nagaland, Andaman & Nicobar islands, Assam, Himachal Pradesh, Kerala, Meghalaya, Mizoram, Tamil Nadu, Uttar Pradesh and West Bengal
47	Tettigoniidae	*Neoconocephalus sp.*	Nagaland
48	Tettigoniidae	*Mecopoda elongata* (Linnaeus, 1758)	Nagaland, Andaman and Nicobar Island, Arunachal Pradesh, Assam, Chhattisgarh, Himachal Pradesh, Karnataka, Madhya

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			Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Orissa, Sikkim, Tripura, Tamil Nadu, Uttar Pradesh, and West Bengal
49	Tettigoniidae	*Pseudophyllus sp.* (white, 1846)	Nagaland
50	Tettigoniidae	**Sathrophyllia rugosa* (Linnaeus, 1758)	Nagaland, Chhattisgarh, Karnataka, Madhya Pradesh, Manipur, Meghalaya, Sikkim, Tamil Nadu and West Bengal
51	Gryllidae	*Teleogryllus occipitalis* (Serville, 1838)	Nagaland, Arunachal Pradesh, Assam, Manipur, Meghalaya, Sikkim, W. Bengal , Bihar, Orissa, M.P., U.P., Himachal Pradesh, Karnataka, Tamil Nadu, Andaman Islands
52	Gryllidae	*Teleogryllus sp.*	Nagaland
53	Gryllidae	**Loxoblemmus macrocephalus* (Chopard, 1967)	Nagaland, Arunachal Pradesh, Assam, Himachal Pradesh, Jammu & Kashmir, Uttarakhand and West Bengal
54	Gryllidae	*Acheta domesticus* (Linnaeus, 1758)	Nagaland, Chhattisgarh, Chandigarh, Delhi, Himachal Pradesh, Jammu & Kashmir, Kerala, Maharashtra, Madhya Pradesh, Punjab, Rajasthan, Uttarakhand, Uttar Pradesh and West Bengal.
55	Gryllidae	**Gryllus bimaculates* (De Geer, 1773)	Nagaland, Arunachal Pradesh, Meghalaya, Sikkim, West Bengal, Bihar, U.P., Himachal Pradesh, Punjab, Jammu & Kashmir, Rajasthan, Gujarat, Maharashtra M.P., Karnataka, Andhra Pradesh, Tamil Nadu, Pondicherry, S. Andaman and Nicobar Islands
56	Gryllidae	*Gryllus sp.*	Nagaland
57	Gryllidae	*Velarifictorus sp.*	Nagaland
58	Gryllidae	*Xenogryllus sp.*	Nagaland
59	Gryllotalpidae	*Gryllotalpa* sp.	Nagaland
60	Gryllacrididae	*Brachyntheisogryllacris sp.*	Nagaland
61	Rhaphidophoridae	*Rhaphidophora sp.*	Nagaland

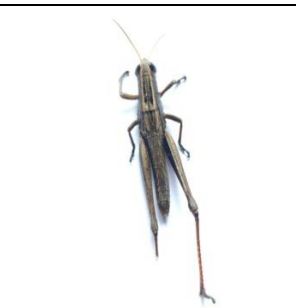
*New record of Nagaland.

In the present study 14 species are new records to Nagaland (**Plate-1**), these are - *Oxya japonica (*Thunberg, 1815), *Dittopternis venusta* (Walker, 1870), *Oedipoda himalayana* (Uvarov, 1925), *Diabolocatantops innotabilis* (Walker, 1870), *Eucoptacra praemorsa* (Stål, 1860), *Phlaeoba panteli (*Bolívar, 1902), *Eyprepocnemis rosea* (Urarov, 1942), *Chlorizeina unicolor* (Bunner von Wattenwyl, 1893), *Aularches millaris* (Stål, 1873), *Erianthinus affinus* (Westwood, 1843), *Letana megastridula (*Ingrisch 1990), *Eucocephalus pallidus (*Redtenbacher, 1891), *Sathrophyllia rugosa* (Linnaeus, 1758), *Loxoblemmus macrocephalus* (Chopard, 1967), *Gryllus bimaculates* (De Geer, 1773).

Conclusion

Apart from entomophagy, the study on Orthopterans in Kohima district, Nagaland, has been left barren for more than a decade; the present study which is carried out in four sites; where site-4 (mixed cultivation and forest canopy) recorded the highest occurrence of orthopterans with 52 species; followed by site-1 (paddy cultivation field) with 18 species; site-3 (water terrace cultivation) with 11 species, and site-2 recorded the lowest with 10 species. It suggests that the area with rich and varieties of flora species mixed with the agricultural area and good forest canopy cover give richness for species niches and abundances in the area.

Plate-1

			
Oxya japonica	*Dittopternis venusta*	*Oedipoda himalayana*	*Eucoptacra praemorsa*
			
Phlaeba panteli	*Eyprepocnemis rosea*	*Chlorizeina unicolor*	*Aularchis millaris*
			
Erianthinus affinus	*Letana megastridula*	*Euconocephalus pallidus*	*Sathrophyllia rugosa*
			
Loxoblemmus macroceplalus	*Gryllus bimaculatus*		

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TENYIDIE MU KEKRADIE NU KHUNUO ZAKO (NAMES OF ANIMALS IN TENYIDIE AND ENGLISH)

Reviewed

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Puomho (Abstract): National Education Policy kesau medzi liro u krü die ha se kenieputho chü bacü la süu pemvü di Kekradie nu khunuoko za u krü die nu kimhie di kieya shi süko pfhü kengu se parliewe. Khunuo kekreikecü kekra baya derei u kijü nu ngulieyakezha kro puo thushüzhie.

Caü (Keywords): Kiriko, Ketsa nu khunuo, Dzü nu mu Keso nu khunuo,Khunuo kecü, Perako.

Sededie (Introduction)

Tsie teiu leshümhasi chatsa mehoshü ro ba hurei u Seyie nu leshükiko die se kepfhesiyakezhau (Medium of Language) liro Kekradie secü la themia pete khre rei u krü dieko pejüwatazhie. Süla mhathu hanu khunuo zako u die nu, Kekradie nu mu Scientific zako sa di thushüzhie. Tenyidie liro kekhokeke pfhephra (Tonal Language) geinu diecau krei partayacü la mhathu hau nu diecako kekhokeke pfhephra zasiko sa khashüzhie. Kepethamia mu Kephrünuomia bu hau phrü di mhasi sakelie menguyawe.

Mhathu Dorhüko (Methodology)

Mhathu hau thu kevo nu phichümiako kesiephi (Interview) di khunuo zako pfhülie. U die nu mu Scientific zako liro khunuo dze kephrü tsatie kepethamia kro puo mu Internet nunu rei kekhruohi ngulie.

KIRIKO (DOMESTIC ANIMALS)

Sl. No.	Tenyidie	English	Scientific za
1.	Gadā	Donkey	*Equus asinus*
2.	Hāshù	Duck	*Anas platyrhynchos domesticus*
3.	Hāshù Vochā	Swan	*Cygnus cygnus*
4.	Kièr	Horse/Gura	*Equus caballus*
5.	Mithù	Cow	*Bos taurus*
6.	Nyiěnuo	Cat	*Felis catus*
7.	Tefű	Dog	*Canis lupus familaris*
8.	Tekuŏ	Sheep	*Ovis aries*
9.	Tekuŏ- nuo	Lamb	*Ovis aries*
10.	Temvű	Goat	*Capra aegagrus hircus*
11.	Thevò	Pig	*Sus scorfa domesticus*
12.	Thevù	Chicken	*Gallus gallus domesticus*
13.	Thevù- nuo	Chick	*Gallus gallus*
14.	Thudŏ	Bull/Ox	*Bos taurus (male)*
15.	Thukrű	Cow	*Bos taurus (female)*
16.	Toūphrà	Goose	*Anser anser*
17.	Vüdzŭ	Cock/Roaster	*Gallus gallus*
18.	Vükrű	Hen	*Gallus gallus*
19.	Wī	Mithun	*Bos frontalis*

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20.	Zogăzù	Rabbit	*Oryctolagus cuniculus*
21.	Zudi	Hare	*Oryctolagus cuniculus domesticus*

KETSA NU KHUNUOKO (WILD ANIMALS)

Sl. No.	Tenyidie	English	Scientific za
1.	Chiêkrŭ	Porcupine	*Erethizon dorsatum*
2.	Chüzhiě	Deer	*Cervus nippon*
3.	Dzűvò	Hippopotamus	*Hippopotomua amphibius*
4.	Kêfŭ	Civet cat	*Paradoxurus hermaphroditus*
5.	Kêlí	Sqiurrel (red)	*Sciurus vulgaris*
6.	Khurhŭ	Leopard	*Panthera pardus*
7.	Kònuô	Badger	*Meles meles*
8.	Krēdiā	Rhinoceros	*Diceros bicornis (black)*
9.	Lòshā	Lion	*Panthera leo*
10.	Menyī	Boar	*Sus scrofa*
11.	Meseru	Fox	*Vulpes vulpes*
12.	Rülĭ	Buffalo	*Bubalus bubalis*
13.	Socie	Wolf	*Canis lupus*
14.	Tekhrā	Antelope	*Antilocapridae antilocapridae*
15.	Tekhú	Tiger	*Panthera tigris*
16.	Tênyâ	Wild cat	*Felis silvestris*
17.	Tepfí	Monkey	*Catarrhini catarrhini*
18.	Têphoù	Pangolins	*Manidae manidae*
19.	Thegă	Bear	*Ursua americanus(black bear)*
20.	Theloú	Antelope	*Bovidae sp.*
21.	Tsó	Elephant	*Elephas maximus indicus*
22.	Ut	Camel	*Camelus dromedarius*

DZÜ NU MU KESO NU KHUNUOKO (LAND & WATER ANIMALS)

Sl.No.	Tenyidie	English	Scientific za
1.	Ciě	Python	*Python molurus*
2.	Dzűnyhü	Water snake	*Nerodia sipedon*
3.	Gépfű	Cricket	*Gryllotalpa gryllotalpa*
4.	Guôgû	Black crab	*Scylla serrata*
5.	Guôrünuô	Frog	*Rana temporaria*
6.	Guosă	Hyla	*Holarctic tree frogs*
7.	Guôthiē	Red rock Crab	*Grapsus grapsus*
8.	Khruôhî	Tortoise	*Testudinidae sp.*

9.	Khuō	Fish	*Vertebrata sp.*
10.	Khuôdzünuô	Tadpole	*Acris crepitans*
11.	Khuōkêriè	Crocodile/Alligator	*Crocodylus palustris*
12.	Khuôleìnuô	Water bettle family	*Hydrophilidae sp.*
13.	Noûkuŏ	Prawn	*Fenneropenaeus indicus*
14.	Noûlà	Snail	*Cornu aspersum*
15.	Noûlàmhiē	Slug	*Arien distinctus*
16.	Nyhübvū	Viper	*Echis carinatus*
17.	Nyhüsĭ	Cobra	*Naja naja*
18.	Pfüteio	Cricket	*Caelifera caelifera*
19.	Priêlê	Green viper	*Trimeresurus gramineus*
20.	Rüvà	Leech	*Hirudinea sp.*
21.	Seguó	Crab	*Brachyura sp.*
22.	Sôcô	Mole (India)	*Bandicota bengalensis*
23.	Terhŭphikha	Planaria	*Dugesia tigrina*
24.	Theyu-u	Toad	*Bufo bufo*
25.	Thêzù	Rat (brown)	*Rattus norvegicus*
26.	Tiêdzénuô	Nymph of dragonfly	*Gomphidae sp.*
27.	Tînyhü	Snake	*Serpentes sp.*
28.	Tînyhü khuô	Eel	*Anguilliformes sp.*
29.	Tsüchaü	Nymph of dragonfly	*Gomphidae sp.*
30.	Zhâkrâ Khruohi	Turtle	*Testudinus sp.*
31.	Zharū	Centipede	*Chilopoda(Scutigera coleoptrata)*
32.	Zochú	Earthworm	*Lumbricina terrestris*
33.	Zukhrănuo	House Mouse	*Mus musculus*

KHUNUO KECÜKO (INSECTS)

Sl. No.	Tenyidie	English	Scientific za
1.	Bouluŏ	Crokroach (American)	*Periplaneta americana*
2.	Boungē	Beetle	*Onthophagus gazella*
3.	Chüriē	Firefly/Glow-worm	*Lampyris noctiluca*
4.	Ciévü	Cicada	*Cicadidae cicadidae*
5.	Dzieraü	Praying-mantiz	*Mantis montodea*
6.	Keloú	Woodworm	*Anobium punctatum*

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7.	Khoŭdoù	Dragonfly	*Anax indicus*
8.	Kípfhēnuô	Wall lizard	*Podarcis muralis*
9.	Kŭ	Grasshopper	*Omocestus viridulus*
10.	Loútsă	Silkworm moth	*Bombyx mori*
11.	Mekhrű	Termite/white ant	*Cryptotermes dudleyi*
12.	Mepfhĭ	Bee	*Apis mellifera*
13.	Mezùkrŭü	Stick-insect	*Carausius morosus*
14.	Nhicó	Ant	*Formicidae sp.*
15.	Nyosakrü	Cricket (House)	*Acheta domesticus*
16.	Pfhisó	Wasp	*Vespula vulgaris*
17.	Rümvù	Bed-bug	*Cimex lectularius*
18.	Sămtou	Butterfly	*Rhopalocera sp.*
19.	Sebā	Scorpion (Indian)	*Hottentotta tamulus*
20.	Shülĕ	Mayfly	*Larvae sp.*
21.	Shürò	Spider	*Poecilotheria regalis*
22.	Sôkrû	Garden Lizard	*Calotes versicolor*
23.	Sôprô/Ziêpruô	Moth	*Gynnidomorpha alisman*
24.	Teiziē	Fly/Flies	*Musca domestica*
25.	Têkhrü	Body-louse	*Pediculus humanus humanus*
26.	Telhiĕ	Flea	*Pulex irritans*
27.	Terheì	Lice	*Pediculus humanus capitis*
28.	Thôbeü	Earwig	*Forficula auricularia Linnaeus*
29.	Ziêlô	Nebulo	*Musca nebulo*
30.	Zierú	Mosquito	*Culicidae sp.*
31.	Zôpĕ	Caterpillar	*Lepidoptera*

PERAKO (BIRDS)

Sl. No.	Tenyidie	English	Scientific za
1.	Boukhruŏ/Púchüü	Owl	*Bubo bangalensis*
2.	Buōürhū̄	Hoopoe (eurasian)	*Upupa epops*
3.	Chùrhùü	Vulture	*Gyps indicus*
4.	Ciekhrie	Sparrow	*Passer domesticus*
5.	Dzűkhú	Heron	*Ardea cinerea*
6.	Dzűra	Stork (white)	*Ciconia ciconia*
7.	Dzűra Kezhau	Crane (commom)	*Grus grus*
8.	Háho	Bat	*Chiroptera sp.*
9.	Kekié	Parrot	*Psittacula krameri*
10.	Kitié	Swift	*Apus apus*
11.	Mekhrŭ	Dove	*Spilopelia senegalensis*
12.	Moupfhű	Falcon	*Falcon jugger*
13.	Ngoú	Blyth's tragopan	*Tragopan blythü*
14.	Niĕvùnuo	Tailor bird	*Orthotomus sutorius*
15.	Paruōnuo	Pegion	*Columba livia domestica*
16.	Peü	Quail	*Coturnix coturnix*
17.	Peziĕ	Perch bird	*Passeriformes*
18.	Rümoŭ	Hawk	*Hierococcyx varius*

19.	Rüü	Peacock	*Pavo cristatus*
20.	Seiduraü	Wood pecker	*Picidae sp.*
21.	Shüshaü	Swallow (Indian cliff)	*Petrochelidon fluvicola*
22.	Shüshülhe	Flying Squirrel	*Petaurista philippensis*
23.	Shüzhà	Crow	*Corvus brachyrhynchos*
24.	Terhă	Great Hornbill	*Buceros bicornis*
25.	Terheì	Pheasant	*Phasianus colchicus*
26.	Tsŭü	Eagle	*Clanga hastata*
27.	Vüprū	Jungle fowl	*Gallus gallus*
28.	Zàkhriènuo	Kite	*Milvus migrans*

Mhathuu Geinu Mhasa Pfhükelie
(Result & Discussion)

Mhathu hau thu kevo ki khunuo puo krü puo chü zako si kekreilie. Süsie scientific zako si salie. Khunuo pete za pfhü mu ketsopie thu tsoshülie mote derei kemeyietho kro puo thukeshü zo, Pfhükelie hako pekrupie siekelhoumia bu silie di pie u vie chü mu u khruohilie morokesuo nounyü se thulie . U mhitsie puo liro u die si kemomia bu rei u die nu khunuo zako sileketuo kele se di thushü.

Thekhadie (Conclusion)

U Tenyimia u rakhenu Kepenuopfü thuo pelhoupie u ketsü khunuo bu themia peza chü di lhouketuo la phruokeshü nyi phiwe. Süla khunuo zako u die nu mu kekradie nu rei si ba ro thie thie kelhou nu rei themia khruohilie vi. Süsie rei leshü phrü rükrie kho ro mhasa pfhükecü (Research) thoko rei kekhruohi salieketuo kele se thulie. Siro hasie khriekesamiako la sier liro hanu thu tsolie kemoko pfhüpie thulieketuo merüyawe.

Kekhruohikeshüko (References)

Rünako nu phichümiako ze kesiephi (Interview) di thedzeko pfhülie.
Kekradie nu khunuo zako pfhü kekhruohikeshüu:
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GENERALIZED RICCI RECURRENT SP-SASAKIAN MANIFOLD

Reviewed

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Abstract: The object of the present paper is to study a generalized Ricci recurrent SP-Sasakian manifold with respect to semi-symmetric non-metric sp-connection with a concrete example.
Mathematics Subject Classification AMS 2000: 53C15 and 53C25

Keywords: SP-Sasakian manifolds, generalized Ricci recurrent manifold and semi-symmetric non-metric sp-connection

Introduction

Friedmann and Shouten (Hyden, 1932) introduced the idea of semi-symmetric linear connection on a differentiable manifold. Hayden (Friedmann and Schouten, 1924) introduced the idea of a metric connection with torsion in a Riemannian manifold. Yanno (1970) initiated the systematic study of semi-symmetric metric connection in Riemannian manifold and later on, it was followed by many geometers. In 1992, a semi-symmetric non-metric connection had been introduced by Agashe and Chafle and further studied by De and Kamilya (1995), De and Biswas (1997), Prasad (2002) and several other investigators. Recently De and Biswas (1997), Sular, Özgür and De (2000), De and Mondel (2009), Mondel and De (2010) and Kumar, Bagewadi and Venketesha (2011) defined and studied quarter-symmetric metric connection in SP-Sasakian manifold, Kenmotsu manifold, Sasakian manifold, 3-dimensional quasi-Sasakian manifold and K-contact manifold respectively. In 2000, Prasad and Kumar defined a semi-symmetric non-metric sp-connection in SP-Sasakian manifold.

In the present paper, the existence of generalized Ricci recurrent SP-Sasakian manifold with respect to semi-symmetric non-metric sp-connection have been established by an example.

Preliminaries

An n-dimensional differentiable manifold M is called an almost para contact manifold if it admits an almost contact structure (ϕ,ξ,η,g) consisting of a (1, 1) tensor field ϕ, a vector field ξ, a 1-form η and Riemannian metric g satisfying

(2.1) $\phi^2 X = X - \eta(X)\xi,\ \eta(\xi)=1,\ \phi\xi=0$

(2.2) $\eta(\phi X)=0, \eta(X)=g(X,\xi),$
$g(\phi X,\phi Y)=g(X,Y)-\eta(X)\eta(Y)$

If we define $F(X,Y) = g(\phi X,Y)$, then in addition to the above relation, the following are satisfied

(2.3) $F(X;Y) = F(Y;X)$.

If in M the relation

(2.4) $(\nabla_X F)(Y,Z) = -g(X,Z)\eta(Y)$
$-g(X,Y)\eta(Z)+2\eta(X)\eta(Y)\eta(Z)$

and

(2.5) $\nabla_X \xi = \phi X,$

hold good, then (M, g) is called para-Sasakian or P-Sasakian manifold.

Further, if in (M, g) the following relation satisfying

(2.6) $F(X,Y) = (\nabla_X \eta)(Y)$
$= -g(X,Y)+\eta(X)\eta(Y),$

which can be written as

$(\nabla_X F)(Y,Z) = F(X,Y)\eta(Z)+F(X,Z)\eta(Y)$
$\Leftrightarrow (\nabla_X \phi)(Y) = \eta(Y)\phi X + F(X,Y)\xi,$

along with (2.1), (2.2) and (2.6), then it is called SP-Sasakian manifold (Sato, 1976).

In SP-Sasakian manifold, we have (Mishra, 2010)

(2.7) $`R(X,Y,Z,\xi) = \eta(R(X,Y)Z)$
$= g(X,Z)\eta(Y)-g(Y,Z)\eta(X)$

(2.8) $\eta(R(\xi,X)Y) = \eta(X)\eta(Y)-g(X,Y),$

(2.9) $\eta(R(X,Y)\xi)=0,$

(2.10) $R(X,Y)\xi = \eta(X)Y-\eta(Y)X,$

(2.11) $R(\xi,X)Y = \eta(Y)X-g(X,Y)\xi,$

(2.12) $R(\xi,X)\xi = X-\eta(X)\xi,$

(2.13) $S(X,\xi) = -(n-1)\eta(X)$,

(2.14) $Q\xi = -(n-1)\xi$

and

(2.15) $S(\phi X,\phi Y) = S(X,Y) + (n-1)\eta(X)\eta(Y)$.

A semi-symmetric non-metric sp-connection in SP-Sasakian manifold is defined by Prasad and Kumar (2002) as follows

(2.16) $(\bar{\nabla}_X Y) = \nabla_X Y + \eta(X)\phi Y + F(X,Y)\xi$

If g be metric, then

(2.17) $(\bar{\nabla}_X g)(Y,Z) = -2(X)F(Y,Z) - F(X,Y)\eta(Z) - F(Y,Z)\eta(Y)$.

Let $\bar{R}$ and R be the curvature tensors of the connections $\bar{\nabla}$ and ∇ respectively. Then we have

(2.18) $\bar{R}(X,Y)Z = R(X,Y)Z + g(Y,Z)X - g(X,Z)Y + 2[g(X,Z)\eta(Y) - g(Y,Z)\eta(X)]\xi + 2[\eta(X)Y - \eta(Y)X]\eta(Z.)$

From (2.1), (2.2), (2.10), (2.12) and (2.18), we get

(2.19) $\bar{R}(X,Y)\xi = 2[\eta(X)Y - \eta(Y)X]$.

(2.20) $\bar{R}(\xi,X)Y = 2[\eta(Y)X - g(X,Y)\xi]$.

(2.21) $\bar{R}(\xi,X)\xi = 2[X - \eta(X)\xi]$.

Contracting (2.18)

(2.22) $\bar{S}(Y,Z) = S(Y,Z) + (n-3)g(Y,Z) - 2(n-2)\eta(Y)\eta(Z)$

where $\bar{S}$ and S are the Ricci tensors of the connection $\bar{\nabla}$ and ∇ respectively.

Again contracting (2.22), we have

(2.23) $\bar{r} = r + (n-1)(n-4)$.

From (2.1), (2.2), (2.5), (2.6), (2.13), (2.16), (2.17) and (2.22), we have

(2.24) $\bar{\nabla}_X \xi = \nabla_X \xi = \phi X$.

(2.25) $(\bar{\nabla}_X g)(Y,\xi) = g(X,Y) - \eta(X)\eta(Y)$.

Generalized Ricci recurrent SP-Sasakian manifold with respect to the semi-symmetric non-metric connection $\bar{\nabla}$

A non-flat *n*-dimensional Riemannian manifold is called generalized Ricci recurrent manifold if its curvature tensor R satisfies the following condition (De, Guha and Kamilya, 1995)

(3.1) $(\nabla_X S)(Y,Z) = A(X)S(Y,Z) + B(X)g(Y,Z)$,

where A and B are two non-zero 1-form defined by

$g(X,\rho_1) = A(X)$ and $B(X) = g(X,\rho_2)$.

Analogous to (3.1), we define generalized Ricci recurrent SP-Sasakian manifold with respect to the semi-symmetric non-metric sp-connection $\bar{\nabla}$ as follows

(3.2) $(\bar{\nabla}_X \bar{S})(Y,Z) = A(X)\bar{S}(Y,Z) + B(X)g(Y,Z)$.

Putting ξ for Z in (3.2) and using (2.2), (2.13) and (2.22), we get

(3.3) $(\bar{\nabla}_X \bar{S})(Y,\xi) = [B(X) - 2(n-1)A(X)]\eta(Y)$.

Now

(3.4) $(\bar{\nabla}_X \bar{S})(Y,\xi) = \bar{D}_X \bar{S}(Y,\xi) - \bar{S}(\bar{D}_X Y,\xi) - \bar{S}(Y,\bar{D}_X \xi)$.

In consequences of (2.1), (2.2), (2.5), (2.6), (2.22), (2.24), (2.25) and (3.4), we get

(3.5) $(\bar{\nabla}_X \bar{S})(Y,\xi) = 2(n-1)[\eta(X)\eta(Y) - g(X,Y)] - S(Y,\phi X) - (n-1)g(Y,\phi X)$.

From (3.3) and (3.5), we find

(3.6) $[B(X) - 2(n-1)A(X)]\eta(Y) = 2(n-1)[\eta(X)\eta(Y) - g(X,Y)] - S(Y,\phi X) - (n-1)g(Y,\phi X)$.

Y is replaced by ϕY in (3.6), we get

$S(\phi Y,\phi X) = -(n-3)g(\phi Y,\phi X)$.

Using (2.2) and (2.15) in above equation, we get

$S(X,Y) = (3-n)g(X,Y) + (-2)\eta(X)\eta(Y)$.

Hence, we can state the following theorem:

Theorem 3.1 *A generalized Ricci recurrent SP-Sasakian manifold with respect to the semi-symmetric non-metric sp-connection is η-Einstein, where $a = 3-n$ and $b = -2$.*

Again putting ξ for Y in (3.6) and using (2.1) and (2.2), we get $B(X) = 2(n-1)A(X)$.

Hence, we have the following theorem:

Theorem 3.2 *Let M be a generalized Ricci recurremt SP-Sasakian manifold with respect to the semi-symmetric non-metric sp-connection. Then $B = 2(n-1)A$ hold on M.*

Example

Let us consider the 3-dimensional manifold $M = \{(x,y,z) \in R^3, z \neq 0\}$, where (x,y,z) are standard co-ordinates of R^3.

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The vector fields

$$e_1 = -z\frac{\partial}{\partial y},\ e_2 = z\left(\frac{\partial}{\partial x} - \frac{\partial}{\partial x}\right),\ e_3 = -z\frac{\partial}{\partial z}$$

are linearly independently at each point of M.

Let g be the Riemannian metric defined by

$$g(e_1, e_3) = g(e_1, e_2) = g(e_2, e_3) = 0$$

and $$g(e_1, e_1) = g(e_2, e_2) = g(e_3, e_3)$$

Let η be the 1-form, defined by

$\eta(U) = g(U, e_3)$ for any $U \in \chi(M)$.

Let ϕ be the (1. 1) tensor field defined by

$\phi e_1 = -e_1,\ \phi e_2 = -e_2,\ \phi e_3 = 0$.

Then using the linearity of ϕ and η, we have

$$\eta(e_3) = 1,\ \phi^2 U = U - \eta(U)e_3$$

and $$g(\phi U, \phi W) = g(U, W) - \eta(U)\eta(W)$$

for any $U, W \in \chi(M)$.

Then for $e_3 = \xi, (\phi, \xi, \eta, g)$ defines an almost para contact structure on *M*. Let ∇ be the Levi-Civita with respect to metric *g*. Then we have

$$[e_1, e_3] = e_1e_3 - e_3e_1 = e_1.$$

Similarly

$$[e_1, e_2] = 0 \text{ and } [e_2, e_3] = e_2.$$

Taking $e_3 = \xi$ and using Koszul's formula for the Lorentzian metric *g*, we can easily calculate

$$\nabla_{e_1} e_3 = e_1, \nabla_{e_1} e_2 = 0, \nabla_{e_1} e_1 = -e_3,$$

(4.1) $$\nabla_{e_2} e_3 = e_2, \nabla_{e_2} e_2 = -e_3, \nabla_{e_2} e_1 = 0,$$

$$\nabla_{e_3} e_3 = 0, \nabla_{e_3} e_2 = 0, \nabla_{e_3} e_1 = 0$$

Hence (4.1) tells us that the manifold satisfies (2.5) for $\xi = e_3$.

Therefore, the manifold is an SP-Sasakian manifold.

We know that

(4.2) $$R(X,Y)Z = \nabla_X\nabla_Y Z - \nabla_Y\nabla_X Z - \nabla_{[X,Y]}Z$$

.

From (4.1) and (4.2), it can be easily verified that

$$R(e_1, e_3)e_3 = 0, R(e_2, e_3)e_3 = -e_2,$$

$$R(e_1, e_3)e_3 = -e_1,$$

$$R(e_1, e_2)e_2 = -e_1, R(e_2, e_3)e_2 = e_3,$$

(4.3) $$R(e_1, e_3)e_2 = 0,$$

$$R(e_1, e_2)e_1 = e_2, R(e_2, e_3)e_1 = 0,$$

$$R(e_1, e_3)e_1 = -e_3,$$

$$R(e_1, e_1)e_1 = R(e_2, e_2)e_2 = R(e_3, e_3)e_3 = 0. \quad .$$

From above expression of the curvature tensor, we obtain

(4.4) $$S(e_1, e_1) = g(R(e_1, e_2)e_2, e_1) + g(R(e_1, e_3)e_3, e_1) = -2$$

Similarly

(4.5) $S(e_2, e_2) = -2$ and $S(e_3, e_3) = -2$.

Similarly, we can obtain the non-vanishing component of the curvature tensor $\bar{R}$ with respect to semi-symmetric non-metric connection $\bar{\nabla}$ in SP-Sasakian as follows

$$\bar{R}(e_1, e_2)e_2 = 0, \bar{R}(e_1, e_2)e_2 = 0,$$

$$\bar{R}(e_1, e_2)e_3 = 0,$$

$$\bar{R}(e_2, e_3)e_1 = 0, \bar{R}(e_2, e_3)e_2 = 2e_3,$$

$$R(e_2, e_3)e_3 = -2e_2,$$

$$\bar{R}(e_3, e_1)e_1 = -2e_3, \bar{R}(e_3, e_1)e_2 = 0,$$

$$\bar{R}(e_3, e_1)e_3 = -2e_1.$$

and $$\bar{S}(e_1, e_2) = -2,\ \bar{S}(e_2, e_2) = -2$$

and $$\bar{S}(e_3, e_3) = -4.$$

Since $\{e_1, e_2, e_3\}$ forms a basis of the SP-Sasakian manifold any vector field $X, Y \in \chi(M)$ can be written as

$$X = a_1e_1 + b_1e_2 + c_1e_3$$

and $$Y = a_2e_1 + b_2e_2 + c_2e_3,$$

where $a_i, b_i, c_i \in R^+$ (the set of all positive real numbers), i = 1, 2, 3. This implies that

$$S(X,Y) = -2(a_1a_2 + b_1b_2 + 2c_1c_2).$$

and $$g(X,Y) = a_1a_2 + b_1b_2 + c_1c_2$$

In view of the above equations, we have

$$(\bar{\nabla}_{e_1}\bar{S})(X,Y) = -2(c_1a_2 + a_1c_2),$$

$$(\bar{\nabla}_{e_2}\bar{S})(X,Y) = -2(c_1b_2 + b_1c_2),$$

and $$(\bar{\nabla}_{e_3}\bar{S})(X,Y) = -4(a_1a_2 + b_1b_2).$$

Consequently, the manifold under consideration is not Ricci symmetric. Let us now consider 1-forms

$$A(e_1) = \frac{-(a_1c_2 + a_2c_1)}{a_1a_2 + b_1b_2}, B(e_1) = \frac{-4(a_1c_2 + a_2c_1)}{a_1a_2 + b_1b_2}$$

$$A(e_2) = \frac{(b_1c_2 + b_2c_1)}{a_1a_2 + b_1b_2}, B(e_2) = \frac{4(b_1c_2 + b_2c_1)}{a_1a_2 + b_1b_2}$$

$A(e_3) = -2$ and $B(e_3) = -8$,

at any point $x \in M$. From (3.1), we have

$$(4.6)\quad (\bar{\nabla}_{e_i}\bar{S})(X,Y) = A(e_i)\bar{S}(X,Y)Z + B(e_i)g(X,Y), \quad i=1,2,3.$$

It can be easily shown that the manifold with these 1-forms satisfies the relation (4.6). Hence the manifold under consideration is a generalized Ricci recurrent SP-Sasakian manifold with respect to semi-symmetric non-metric sp-connection, which is neither Ricci recurrent nor Ricci symmetric.
Hence, we have the following theorem:

Theorem 4.1 *There exists a generalized Ricci recurrent SP-Sasakian manifold (M^3, g) with respect to semi-symmetric non-metric connection which is neither Ricci recurrent nor Ricci symmetric*.

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ISOLATION AND SEPARATION OF BIOMOLECULES (DNA AND RNA) USING AGAROSE GEL ELECTROPHORESIS

Reviewed

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Abstract: Agarose gel electrophoresis is a widely used procedure in various areas of biotechnology. This simple, but precise, analytical procedure is used in research, biomedical and forensic laboratories. Of the various types of electrophoresis, it is a powerful separation method frequently used to analyses DNA and RNA in determining the size of DNA and RNA molecules in the range of 500 to 30,000 base pairs. Gel electrophoresis has become an increasingly important method to choose and carry out for specific separation problems. Various parameters have been applied to improve the current electrophoresis method using agarose gel concentration for better separation and visualization of DNA and RNA base pairs according to the size. By applying an agarose gel concentration, electrophoresis can be conducted with a voltage and adjusting the time. It also provide a better resolution of DNA and RNA fragments. With agarose gel electrophoresis, high separation efficiency can be achieved and also help in understanding the migration of molecules which leads to better separation of the bands.

Key words: Agarsoe gel electrophoresis, DNA, RNA, *Nicotiana benthamiana*, *Malus domestica* cetyltrimethylammonium bromide (CTAB), Polvinyl pyrrolidone, TrisHcl, Nacl, EDTA, β-mercapethanol, TAE, Bromophenol dye, Ethidium, UV Transilluminator.

Introduction

Agarose gel electrophoresis is based on the principle of electrophoresis; hence it is important to understand the principle and technique of electrophoresis in general. Electrophoresis is the separation of charged molecules in an applied electric field. The relative mobility of individual molecules depends on several factors. Positive or negative electrical charges are frequently associated with biomolecules. When placed in an electric field, charged biomolecules move towards the electrode of opposite charge due to the phenomenon of electrostatic attraction. For the present study, agarose gel electrophoresis has been employed which is a routinely used technique for separating proteins, DNA or RNA that is able to form pores with sizes ranging from 100 to 300 nm in diameter, with the size of the pore correlating with the concentration of the agarose gel. The separation medium is a gel made from agarose, which is a polysaccharide derivative of agar. Originating from seaweed, agarose is highly purified to remove impurities and charge. It is derived from the same seaweed as bacterial agar used in microbiology, as well as a food product called agar-agar, which is used to prepare a gelatin-like dessert in Asian cuisine. Because agarose comes from the same source as the food product agar, it is a non-toxic substance. However, the gel contains buffer for conductivity, and as with any laboratory materials, it is highly toxic.

It works on electro-kinetic phenomena. It is based on the migration of any charged molecules or ions migrate when placed in an electric field. The rate of migration depends on the net charge, shape, size and applied current.

Based on Coulomb's force,

$E = F_e / q$ where, E is Electric field

$F_e = E \times q$ …… (1) q is Charged of particles

F_e is Coulomb force

Equation (1) is the force expressed by moving particles in fluid during electrophoresis.

According to Drag force,

$F_d = F \times V$…….. (2) F_d is Force due to friction

Force due to electric field and force due to friction should have a Zero net movement, if not the electrophoresis fails. Thus, F_e is directly proportional to F_d.

Taking equation (1) and (2),

$$F_e = F_d$$

$$q \times E = F \times V$$

$$\frac{q}{F} = \frac{V}{E} = \mu \quad \text{.....(3)}$$ where, μ is Electrophoretic mobility.

Therefore, the mobility of molecules is directly proportional to the charged density, where the molecules with different charged ratio migrate under the electric field at different rates, hence gets separated.

Using agarose gel electrophoresis, DNA and RNA form pores with sizes ranging from 100 to 300 nm in diameter. The size of the pores correlates with the concentration of the agarose gel. The higher the concentration of the agarose gel the smaller is the pore size. The migration flow is determined solely by the molecular weight where small weight molecules migrate faster than larger ones (Sambrook & Russel 2001). Agarose gel electrophoresis also used to separate DNA and RNA fragments of different length. This technique involved the movement of charged molecule in an electric field with positive and negative electrode (i.e. anode and cathode), allowing the negatively charged DNA and RNA molecules to migrate from the negative electrode to the positive electrode. The molecules are separated based on their length, size and structure. Agarose gel electrophoresis helps in purification of a band of interest. The gel with the spread band is viewed with a UV transilluminator. EtBr was used to stain DNA and RNA in agarose gels and when exposed to UV light, electrons in the aromatic ring of the ethidium molecule were activated, which leads to the release of energy (light) as the electrons return to zero point energy (ground state). Thus, allowing estimation of the amount of DNA and RNA in the particular band based on its intensity. The loading dye (Bromophenol dye) which was used in gel electrophoresis added density to the sample, allowing it to sink into the gel. The dye also provided colour and simplified the loading process allowing the estimation of the distance that DNA and RNA fragments have migrated. The DNA and RNA bands were determined in such a way that the DNA and RNA standard contains a mixture of fragments of pre-determined sizes that were compared against the unknown DNA samples. It has been noted that the different forms of DNA and RNA moved through the gel at different rates.

Materials and methods

For the present study, agarose gel electrophoresis was employed for detecting DNA and RNA in the sample. Eppendrof (2ml), micropipette, tips, centrifuge, vortex mixer, nanodrop spectrophometer, Gel Doc were used. The plants used were *Nicotiana benthamiana* and *Malus domestica* for DNA and RNA respectively.

Reagents used for DNA and RNA extraction were 2% cetyltrimethylammonium bromide (CTAB), 1% polyvinyl pyrrolidone, 100 mMTris Hcl, 1.4 M Nacl, 20mM EDTA, β-mercapethanol, 50X TAE, Bromophenol dye (loading dye), Ethidium bromide (Etbr), distilled water, 70% alcohol, mili Q water and liquid nitrogen.

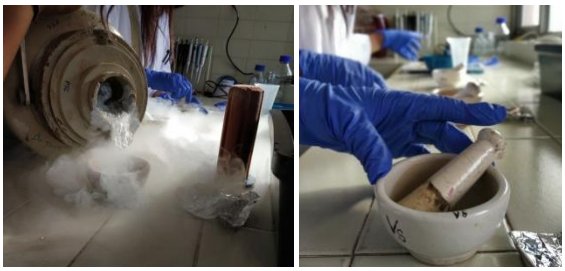

Figure 1: Grinding of samples using liquid nitrogen

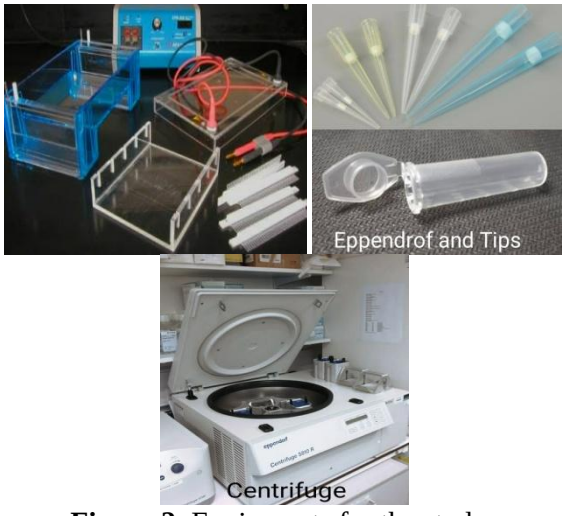

Figure 2: Equipments for the study.

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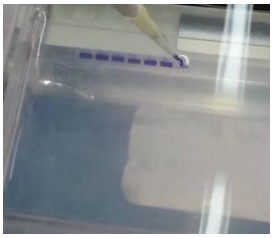

Figure 3: Loading of gel

Figure 4: Gel Doc for gel documentation

Figure 5: Discarding of gel

DNA and RNA were extracted from the leaves sample of *Nicotiana benthamiana* and *Malus domestica* which were prepared by grinding using liquid nitrogen. For each 100mg of tissue use 500 µl of CTAB extraction buffer (β-mercapethanol + CTAB) were used. The sample was thoroughly vortex for mixing, where the homogenate was transferred to 60℃ bath for 45 minutes and centrifuge the homogenate for 10 minutes at 4,000 rpm after incubation. An equal volume (750 µl) of Chloroform: Isoamyl alcohol (24:1) (for DNA) and phenol: Chloroform: Isoamyl alcohol (25:24:1) for RNA were used. It was vortex for 5 minutes and centrifuged the sample for 10 minutes at 14,000 rpm. The samples were repeatedly vortexes and centrifuged until the upper phase is cleared. The upper aqueous phase (750 µl) was transferred to a new tube. The DNA and RNA were precipitated by adding equal volume of cold isopropanol and were incubated at -20℃ for overnight. The samples were centrifuged at 14,000 rpm for 10 minutes. Then, the supernatants were decant without disturbing the pellet and were subsequently washed with 500 µl of 70% ethanol. Further the ethanol was decant and kept for drying at room temperature to remove the residual ethanol, but without completely drying the DNA and RNA sample. The pellet was then dissolved in 30µl of mili-Q. RNase (0.3µl) was added in case of DNA and 0.3µl of DNase was added for RNA. In order to check the quantity of extracted DNA and RNA spectrophotometrically using Nano drop 2000.

The isolated DNA and RNA samples were run in agarose gel electrophoresis, where different concentrations of gel were used. 1.00% of agarose was weighed and dissolved in 1XTAE separately. Agarose gels were prepared using a weight per volume percentage. The mixture was heated until the agarose was dissolved and 3µl of Ethidium Bromide (EtBr) was added in the mixture. Then, the agarose gel was poured into the electrophoresis tray with the inserted comb. After the gel solidified, the comb was carefully removed. The tank was then filled with running buffer 50XTAE. For separation of RNA in the agarose gel, NaOCl was added so as to avoid smearing of RNA and prevent coiling up as RNA is single stranded.

Results and Discussion

Before running an agarose gel, it was necessary to check the concentration for both DNA and RNA by using Nanodrop spectrophotometer. The Table I shows concentration range corresponding to the observance range.

Samples	Concentration (µl)	A260/A280 nm
DNA	841.71	1.79
	843.76	1.80
	840.21	1.78
RNA	188.31	1.99
	187.30	1.99
	183.00	1.97

Table I: Measured sample of DNA & RNA in Nanodrop spectrophotometer.

The actual quantification value for DNA is 1.80 nm within the DNA absorbance range A260/A280 nm. The present study shows 1.79 nm, 1.80nm and 1.78 nm which were close to the actual value. This indicates that there was no condemnation of RNA/protein materials thus

provided a good sample for proper gel separation of DNA.

Similarly, in case of RNA, the actual quantification value is around 2.0 nm within the indicated value of absorbance range A260/A280 nm. The present study shows 1.99 nm, 1.97 nm and 1.99 which are close to the actual value. The results indicated that there was no condemnation of protein/DNA materials and has provided a good sample for proper gel separation of RNA.

After quantifying the samples, separation of RNA and DNA were run separately using 1% agarose gel and 3µl of DNA and RNA samples were added into the wells. 2µl of loading dye (Bromophenol dye) and one tracking dye of ladder 10,000 to 250bp (Figure-7) for each DNA and RNA separation has helped in visual monitoring of how far the DNA and RNA have been migrated into the gel and how far the electrophoresis has been done. After adding enough running buffer to cover the surface of the gel and after running the gel for about 1.5 hours at a voltage of 70 volts the targeted result has been obtained. Another important aspect was to slowly and carefully load the DNA and RNA samples into the gel (Figure-3). An appropriate DNA and RNA size marker were loaded along with experimental samples. After completing the electrophoresis, cutting off of power supply and removing gel from the gel box has been done. In order to document the DNA and RNA samples, the gel tray has been exposed to UV light and the bands separation was observed in UV Transilluminator.

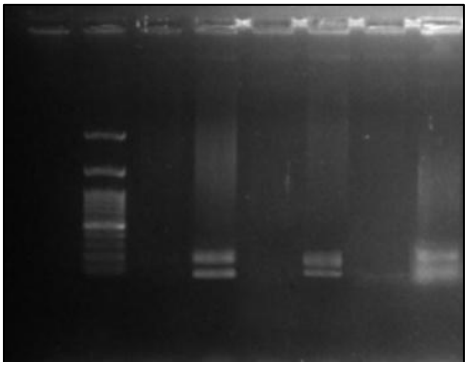

Figure 5: 1% Agarose gel (DNA)

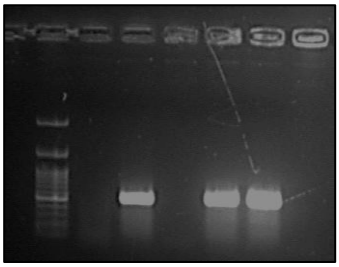

Figure 6: % Agarose gel (RNA)

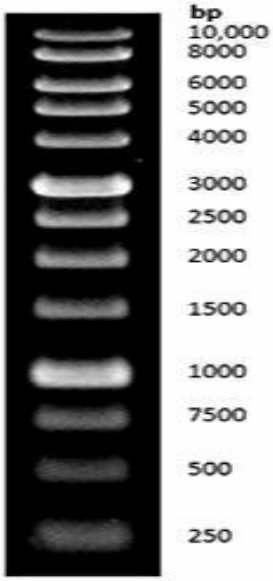

Figure 7: Band size in 1% TAE Agarose gel (10,000 – 250bp)

Agarose gel electrophoresis was performed using two different gel preparations (1% agarose) for DNA and RNA under the conditions – gel concentration, voltage, and time. 1% of agarose gel for DNA (Figure-5) and 1% of agarose gel for RNA (Figure-4) were prepared with same conditions. It was observed that in 1% of agarose gel, separation of smaller fragments for both DNA and RNA were different i.e. in case of DNA the fragments have migrated about a distance of 170 bp. In case of RNA, the base pair have migrated to about 540 bp.

It was observed that different forms of DNA and RNA moved through the gel at different rates. It was also observed that while running the DNA fragments (extracted from *Nicotina benthamiana)*in the agarose gel, the base pair was about 170 bp which shows that *Nicotina benthamiana* plant have been infected by 'Tomato yellow leaf curl virus' because of the similarity in base pair. In case of RNA fragments (extracted from *Malus domestica*) the base pair was about

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540 bp which indicates that the plant have been infected by 'Cucumber Moasic Virus', as in both the cases, the base pair shows similarity. The DNA and RNA bands were determined in such a way that the DNA and RNA strands contains a mixture of fragments of pre-determined sizes that can be compared against the unknown DNA and RNA samples as noted above.

Conclusion

The present study shows that agarose gel electrophoresis has proven to be an efficient and effective technique for separating DNA and RNA fragments. Through this experiment it was observed that DNA and RNA strands contains a mixture of fragments of pre-determined sizes that could be compared against the unknown DNA and RNA samples. For instance, the DNA fragments extracted from *Nicotina benthamiana* which has a base pair of 170 bp appears to be infected by 'Tomato yellow leaf curl virus' as there is similarity in base pair of these plants. In case of RNA the similarities has been established between *RNA* fragments extracted from *Malus domestica*) to that of the 'Cucumber Moasic Virus' which has a base pair of 540 bp showing its similarity. Agarose gel electrophoresis has greatly helped in determining separation, isolation and migration of DNA and RNA fragments in an established conducting medium.

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FAMILY ENTODONTACEAE (MUSCI): FIVE NEW ADDITIONS TO THE MOSS FLORA OF NAGALAND, INDIA

Reviewed

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Abstract: Five species of genus *Entodon* C. Muell. viz., *Entodon chloropus* Ren. & Card., *Entodon flavescens* (Hook.) Jaeg., *Entodon laetus* (Griff.) Jaeg., *Entodon rubicundus* (Mitt.) Jaeg., and *Entodon myurus* (Hook.) Hamp. were reported first time from Nagaland, India. During the recent study on the Moss flora of Nagaland, nine species from 3 genera viz., *Campylodontium*, *Entodon* and *Erythrodontium* belonging to family Entodontaceae Kindb. were observed and studied. It was also observed that Nagaland has a rich diversity of mosses and bryophytes in general.

Keywords: Entodontaceae, Musci, Nagaland.

Introduction

Nagaland is situated in the North Eastern region of India with the state of Assam in the west, Arunachal Pradesh and part of Assam in the north, Burma in the east and Manipur in the south. Nagaland is covered with evergreen tropical and sub tropical forest. The only work recorded on the moss flora of Nagaland was by Gangulee (1969 – 80) in "Mosses of Eastern India and Adjacent Regions" where he described some of the Moss taxa to be found in Naga Hills but no localities were specified. The other record on Mosses of Nagaland is an abstract by Lal *e*t *al.* (2003) on new distributional records of a rare and endemic moss *Fabronia assamica* Dix. (Fabroniaceae) from Nagaland. Bansal *et al.* (2010) published a paper on Morpho-taxonomic study on the genus *Brachymenium* Schwaegr. from Nagaland (North-Eastern Hills), India. Chaturvedi *et al.* (2011) also published papers on Morpho-Taxonomic study of some corticolous Mosses of Longkhum Reserve Forest, Mokokchung District, Nagaland and on Diversity of Genus *Fissidens* Hedw. (Musci) of Kohima District, Nagaland. On the records, of the family Entodontaceae Kindb. from Nagaland, Bansal *et al.* (2011) published a paper on "Epiphytic Bryophtyes on Thuja orientalis in Nagaland, North-Eastern India" where *Entodon scariosus* Ren. & Card. and *Erythrodontium julaceum* (Schwaegr.) Par. were reported. Another record is the Ph.D. thesis "Studies on Mosses of Mokokchung and Kohima Districts, Nagaland. 2012" by Vaphuno Sale (2012) where *Campylodontium flavescens* (Hook) Bosch & Lac., *Entodon pulchellus* (Griff.) Jaeg., and *Erythrodontium julaceum* (Schwaegr.) Par. were recorded. Only Fragmentary works were carried out under Bryophytes of Nagaland. Therefore, presently, there is no detailed account on mosses of Nagaland.

Materials and Methods

Specimens were collected from different localities in Nagaland in the year 2018 and 2019. Field pictures were taken with the help of Canon camera EOS 1100D. The fresh specimens collected from the natural habitats were spread between sheets of blotting papers and made to absorb off the moisture. After drying, the specimens were put in small paper packs and then kept in brown paper herbarium packets mentioning the important details on the herbarium labels (Specimen number, date, name of locality, collector's name, specimen name and family). For the study, the plant materials were soaked in water for hours for proper stretching of the specimen and mounted in plain water for quick examination or observation. Observations and photographs of the specimens were carried out with the help of Coslab trinocular microscope and Vision USB camera.

Results and Discussion

Campylodontium flavescens (Hook.) Bosch & Lac. in Bryol. Jav., 2 : 128 (1865) **(Fig. 1)**

Plants golden green in colour, densely matted, branching present, main stem creeping, giving rise to irregular pinnate branches, secondary branches short and erect. Leaves densely arranged on the stem, erectopatent when moist, appressed to the stem when dry, imbricate, concave, ovate lanceolate, plicate, about 2.5 mm long. Leaf apex apiculate, leaf margin smooth, slight dentation on the leaf tip, costa absent. Leaf cells linear rhomboid, cells at the base angles are rectangular to quadrate forming two triangular patches.
Habitat: found growing on tree.
Locality: Wokha town (1066 Vap Wokha)
Range: Eastern Himalayas, South India and Gangetic plains

Entodon chloropus Ren. & Card. in Bull. Soc. R. Bot. Belg., 38 (1) : 34 (1900)

Plants yellowish green in colour, tufted, branching present, main stem creeping which gives rise to pinnate complante branches. Leaves erectopatent to erct-spreading when moist, oblong-lanceolate, about 1.5 mm long. Leaf base of the branch leaves are narrower than the stem leaves, leaf apex acuminate, leaf margin smooth, slight dentation at the leaf tip, costa absent, sometimes two short costa are seen the stem leaf. Leaf cells narrow rhomboid, becoming wider towards the leaf base, cells at the leaf base angles quadrate to rectangular.
Habitat: found growing on tree and soil.
Locality: Kiphire town (1179 Vap Kip)
Range: Eastern Himalayas.

Entodon flavescens (Hook.) Jaeg. in Ber. S. Gall. Naturw. Ges. 1876-77 : 293 (1878)

Plants yellowish green in colour, in dense mats, branching present, main stem creeping which gives rise to pinnate branches. Leaves erectopatent when moist, appressed to the stem when dry, concave, ovate-lanceolate, about 2 mm long in stem leaves, about 1.5 mm long in branch leaves, stem leaves are usually complanately arranged on the stem. Leaf base broader in stem leaves and narrower in the branch leaves, leaf apex acute, leaf margin smooth, costa absent, usually two short veins in the stem leaves. Leaf cells linear rhomboid, leaf cells at the basal angular region quadrate to rectangular.
Habitat: found growing on tree.
Locality: Niropen, Wokha town (1203 Vap Wokha)
Range: Western Himalayas

Entodon laetus (Griff.) Jaeg. in Ber. S. Gall. Naturw. Ges. 1876-77 : 295 (1878) **(Fig. 2)**

Plants yellowish green in colour, tufted, branching present, main stem creeping which gives rise to erect dendroid pinnate branches. Leaves arranged complanately in many rows on the stem, somewhat imbricate, erectopatent when moist, appressed to the stem when dry, concave, ovate-elliptical, about 1.5 mm long. Leaf base narrow, leaf apex acute, leaf margin crenulated at the leaf tip and incurved in some places, costa double and short. Leaf cells linear elongated, broader towards the leaf margin, shorter at the extreme leaf tip, leaf cells at the basal angular region quadrate to rectangular.
Habitat: found growing on tree.
Locality: Dzuleke (1304 Vap Koh), Dzuleke (1299 Vap Koh)
Range: Eastern Himalayas and South India.

Entodon myurus (Hook.) Hamp. in Linnaea, 20 : 82 (1847) **(Fig. 3)**

Plants golden green in colour, robust, densely tufted, branching present, main stem creeping which gives rise to erect branches, leaves densely and complantely arranged on the stem. Leaves erectopatent when moist, appressed to the stem when dry, concave, ovate, about 1 mm long. Leaf apex broad which suddenly narrows into a short point, leaf margin dentate at the leaf tip and crenulated at the lower region of the leaf, costa absent. Leaf cells linear rhomboid, becoming broader and shorter towards the leaf base, leaf cells at the basal angular region quadrate to rectangular.
Habitat: found growing on tree.
Locality: Dzuleke (1297 Vap Koh)
Range: Eastern Himalayas and Western Himalayas.

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Entodon pulchellus (Griff.) Jaeg. Ber. S. Gall. Naturw. Ges. 1867-77 : 294 (1878)

Plants yellowish green in colour, laxly tufted, branching present, main stem creeping which gives rise to short erect pinnate branches, leaves turgid and puffed, densely arranged on the stem. Leaves erectopatent when moist, appressed to the stem when dry, imbricate, concave, ovate-lanceolate, about 1.5 mm long. Leaf apex acute, leaf margin smooth and incurved on both sides, sometimes mildly dentate at the leaf tip, costa short and double. Leaf cells linear-elongated, leaf cells at the basal angular region quadrate to rectangular.
Habitat: found growing on tree.
Locality: Toimei village (1205 Vap Mon), Kohima town (1272 Vap Koh)
Range: Eastern Himalayas

Entodon rubicundus (Mitt.) Jaeg. in Ber. S. Gall. Naturw. Ges. 1876-77 : 285 (1878) **(Fig. 4)**

Plants yellowish green in colour, in dense mats, branching present, main stem creeping which gives rise to pinnate branches. Leaves erectopatent when moist, appressed to the stem when dry, concave, ovate-lanceolate, about 1.5 mm long in stem leaves, about 1mm long in branch leaves. Leaf base narrow, leaf apex apiculate, leaf margin mildly crenulated at the leaf tip, costa absent, usually two short veins in the branch leaves. Leaf cells linear rhomboid, shorter at the extreme leaf tip, leaf cells at the basal angular region quadrate to rectangular.
Habitat: found growing on tree.
Locality: Dzuleke (1301 Vap Koh)
Range: Eastern Himalayas, Western Himalayas and South India

Entodon scariosus Ren. & Card. in Bull. Soc. R. Bot. Belg., 34 (2) : 75 (1896) **(Fig. 5)**

Plants golden green in colour, robust, tufted in mats, branching present, main stem creeping which gives rise to short erect branches, leaves densely arranged in many rows on the stem, sometimes the leaves are compressed complantely arranged. Leaves erectopatent when moist, appressed to the stem with outspread leaf tips when dry, ovate-lanceolate, plicate, about 2 mm long. Leaf base narrow, leaf apex acute, leaf margin mildly crenulated or dentate, costa faint short and double. Leaf cells linear elongated, leaf cells at the basal angular region quadrate, becoming longer at the extreme base.
Habitat: found growing on tree.
Locality: Jotsoma (1048 Vap Koh), Tuensang town (1139 Vap Tuen), Toimei village (1208 Vap Mon), Mokokchung town (1212 Vap Mkg), Mokochung town (1227 Vap Mkg), Mokokchung town (1229 Vap Mkg), Mokokchung town (1233 Vap Mkg), Dikhu (1248 Vap Mkg), Sungratsu (1266 Vap Mkg), Tuli (1270 Vap Mkg), Tuli (1271 Vap Mkg), Kohima town (1275 Vap Koh), Kidima (1286 Vap Koh), Phek town (1324 Vap Phek)
Range: Eastern Himalayas

Erythrodontium julaceum (Schwaegr.) Par. in Index. Bryol. : 436 (1896) **(Fig. 6)**

Plants golden green in colour, robust, in densely tufted, branching present, main stem creeping which gives rise to short erect julaceous branches, leaves densely arranged on the stem. Leaves erectopatent when moist, appressed to the stem with out-spread leaf tips when dry, concave, ovate, imbricate, about 1.5 mm long. Leaf base broad, leaf apex suddenly narrowed into short points, leaf margin smooth and flat, maybe slightly crenulated at the leaf tip, costa absent. Leaf cells linear, narrow and smooth, leaf cells at the basal angular region ovate to rectangular forming a distinct triangular patch.
Habitat: found growing on tree.
Locality: Saptiqa (1081 Vap Zunhe), Kiphire town (1177 Vap Kip), Mokokchung town (1213 Vap Mkg), Longleng town (1224 Vap Long), Jotsoma (1056 Vap Koh)
Range: Eastern Himalayas, Western Himalayas, South India and Central India.

Conclusion

From the present investigation, Nine species under 3 genera belonging to family Entodontaceae Kindb. were identified viz., *Campylodontium flavescens* (Hook.) Bosch & Lac., *Entodon chloropus* Ren. & Card., *Entodon flavescens* (Hook.) Jaeg., *Entodon laetus* (Griff.) Jaeg., *Entodon myurus* (Hook.) Hamp., *Entodon pulchellus* (Griff.) Jaeg., *Entodon rubicundus*

Fig 1: Campylodontium flavescens

Fig 2: Entodon laetus

Fig 3: Entodon myurus

Fig 4: Entodon rubicundus

Fig 5: Entodon scariosus

Fig 6: Erythrodontium julaceum

(Mitt.) Jaeg., *Entodon scariosus* Ren. & Card., *Erythrodontium julaceum* (Schwaegr.) Par. Five species belonging to family Entodontaceae Kindb. viz., *Entodon* viz., *Entodon chloropus* Ren. & Card., *Entodon flavescens* (Hook.) Jaeg., *Entodon laetus* (Griff.) Jaeg., *Entodon rubicundus* (Mitt.) Jaeg., and *Entodon myurus* (Hook.) Hamp. were found to be new to the Moss Flora of Nagaland. The recent study is a good addition to the Moss flora of Nagaland.

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A REVIEW ON MULTILINGUAL ELECTRONIC DICTIONARY IN THE NAGA DIALECTS

Reviewed

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Abstract: Computers or E-Dictionary/digitization can be a tool for making the survival of languages. Computers can help preserve both vanishing native languages and language diversity. The dictionary is one of the important tools that can be used for learning new languages. A word is basically an association of linguistic sound and meaning. The spelling does not always easily correlate with the sound of a word. A dictionary helps us both with the spelling and pronunciation of such words. Electronic dictionaries are very popular nowadays and many users can be accessed simultaneously on Online. This paper describes the review on Multilingual Naga Dialects Electronic Dictionary. The Dictionary is a user friendly dictionary and user can easily look up the meanings of words and other related information of the words like Word_Id, POS, synonyms and examples from Naga Dialects on Online. This dictionary will be beneficial for Naga society as well as other people living in India.

Keywords: E-Dictionary, Multilingual, linguistic, Dialects, Word_Id, POS, Synonyms

Introduction

Electronic Dictionary is a very important component of any Natural Language Processing system. The word 'Dictionary' is derived from Latin word 'Dictionarium'. A dictionary is a book of words with one or more specific languages and the words are listed alphabetically with their meaning, synonyms, phonetics, POS, and examples. There are mainly two types of dictionary, namely (i) Paper Dictionary: This dictionary is also known as hard or printed dictionary and (ii) Electronic Dictionary: This dictionary is also known as digital or Internet dictionary. An Electronic Dictionary (E-Dictionary) is one kind of dictionary whose data exists in digital form and can be accessed through a number of different media. The E-Dictionary is a very important and powerful tool for any person who is learning a new language using Computer on both Online and Offline. It has the advantage of providing the user to access much larger database than a single book. The most important advantage of an E-Dictionary is that it is very convenient to use. In modern electronic form, electronic dictionaries have tremendous potential. According to the languages involve, the dictionaries are found in three categories as below:

I. Monolingual Dictionary: In this dictionary, user can search the meaning of word and other related information of the word from one language to same language.

II. Bilingual Dictionary: In this dictionary, user can search the meaning of word and other related information of the word from one language to another language. Assamese English and English-Bengali are some of the examples of Bilingual dictionary.

III. Multilingual Dictionary: In this dictionary, user can search the meanings of words and other related information of the words from one language to several languages. Assamese-English and Bengali and English-Assamese and Hindi are some of the examples of multilingual dictionary. According to Al-Rabi'i, the E-Dictionary can be divided into two different types

I. Online E-Dictionary: This type of dictionary is provided on the World Wide Web and is also known as Internet dictionary. It is directly used in digital form through the Internet using web browsers from anyplace in the world. The advantage of using this dictionary is that it can be used at any place as long as there is Internet connection. Many users can be accessed simultaneously on Online.

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II. Offline E-Dictionary: This type of dictionary can be used in digital Computer, PDA (Personal Data Assistant), and mobile phone. This dictionary is also known as portable digital dictionary. We can carry and backup Offline E-Dictionary using CD, DVD, HD and pen drive. We can also download this type of dictionary from Internet and users can install or setup in his/her own Computer or in other devices. The advantage of using this type of dictionary is that users are free from the interruption of Internet connection and the disadvantage is that it requires expensive tools.

Objectives

A language is one of the most important and effective modes of communication between the people belonging to different communities and cultures. UNESCO has recognized over 6,900 languages worldwide. Amongst 900 Indian languages, 197 are endangered, of which 80 are from northeast India. In the 20th century, 5-6 Indian languages became extinct. One such case is from our neighboring state- Assam, where Ahom or Tai Ahom, the language spoken by the great Ahom Dynasty has fallen into disuse. In this list, most Naga languages are classed as vulnerable, where most children speak the language but restricted to certain domains. With globalization and shift in socio-cultural-political dynamics, Naga languages and dialects are going through the initial stage of endangerment and on the verge of extinction. Moreover due to various external factors like migration or inter-tribal marriage, the original word of a particular dialect gets infused into the lexicon of other dialect.

The following are some of the main objectives of this work:

- User can easily look up the meaning of word and other related information of the word like word Id, lexical item (POS), synonyms of Naga dialects.
- Automatic Guessing and suggestion of the required words to get the meaning
- Using the dictionary as a database for spell checking since it includes all the words.
- Automatic word pronunciation on click of a button.
- Enhance the content of the dictionary to be as a visual, audible dictionary.
- Putting simple grammatical information for the words (i.e. v for verb, n for nouns, etc)
- Uploading of electronic dictionary using on-line database on website.
- Analysis of the impact of the dictionary through questionnaire (both in traditional hard copy and online mode).

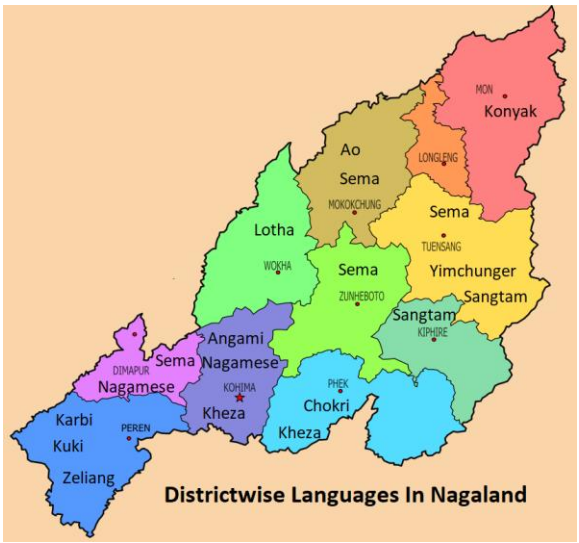
Methodology

- Perform literature review thoroughly and assess related work that focus on developing a multi-language dictionary system.
- Study the natures and behaviours of the Ao, Angami and Chokri languages.
- Identifying system requirements. This includes identifying the appropriate data sources to be used as well as identifying functional and non-functional requirements of the application.
- Designing the system based on the identified requirements.
- Actual implementation and development of the system using the chosen programming languages and development tools.
- Testing and validating the developed system according to the identified requirements

Overview of the Naga Languages

Nagaland is a state in Northeast India. It borders the state of Assam to the west, Arunachal Pradesh and part of Assam to the north, Myanmar to the east and Manipur to the south. The state capital is Kohima, and the largest city is Dimapur. It has an area of 16,579 square kilometres (6,401 sq mi). Nagaland is the home to 16 indigenous tribes namely Ao, Angami, Chang, Konyak, Lotha, Sumi, Chakhesang, Khiamniungan, Dimasa Kachari, Phom, Rengma, Sangtam, Figure 1. Nucleus Vowel Duration Nucleus Vowel /a/ 316 Yimchunger,Kuki, Zeme-Liangmai (Zeliang) and Pochury as well as a number of sub-tribes. Each tribe is unique in character with its own distinct customs, language and dress. Nagaland is one of three states in India where most of the population is Christian As per Grierson's classification system, Naga languages can be grouped into three groups Western, Central and Eastern Naga Groups. The Western Group includes Angami,

Chokri and Kheza. The Central Naga group consists of Ao, Lotha and Sangtam, whereas Eastern Group comprises of Konyak and Chang. In addition, there are Naga-Bodo group illustrated by Mikir language, and Kuki group of languages illustrated by Sopvama (also called Mao Naga) and Luppa languages. These languages belong mostly to the Sino-Tibetan language family. Since most of these languages are mutually unintelligible, people depend on a pidgin language called Nagamese for communication. English has been used as the official language of the Nagaland state and it is quite popular among the educated mass of Nagaland. But Nagamese is used as the lingua franca among the various ethnic groups in the state. The languages of Nagaland state are not included in the scheduled list of twenty two languages in India, many of them spoken by dwindling number of speakers



Ao Language

Ao language is one of the important languages in Nagaland, Ao is spoken by a large number of people in the state. The Ao or Ao-Naga language falls in the Tibetan - Burmese group of languages. Some regional dialects like the Mongsen, Chungli, Chanki etc. are prominent among the Ao-Naga language family. Among all the dialects, Chungli is the most widely spoken one and efforts are on to make it the standard Ao-Naga language. The inhabitants of the Mokokchung District mainly converse in this language. It is also quite popular in Southern part of the state of Assam. Ao-Naga has written script that maintains its own codes of grammar. Three types of tones constitute the Ao language of Nagaland - the falling tone, the rising tone and the level tone. Wide use of the Copula is a notable characteristic of the language.

Tenyidie

Tenyidie is one of the common languages in Nagaland. The Tenyidie language of Nagaland is also known as the Angami. Mostly spoken by the natives of the Angami tribes, Tenyidie have a number of dialects like Dzuna, Kohima, Kehena, Chakroma, Khonoma, Nali, Mima, Tengima, Mozome.The Tenyidie is considered as the standard dialect among the Angami dialects. It has emerged as the most popular language among the Angami tribes. It falls in the Sino Tibetan language family.

Tenyidie is a 'lexical tone language' spoken by the Angami tribe in the state of Nagaland, India. The language has four level tones and mostly disyllabic words with open syllables.

Angami alphabet and pronunciation

Ü ü	Üi üi	A a	Ai ai	I i	Ie ie	U u	Uo uo	E e
ü	üi	a	ai	i	ie	u	uo	e
[ə]	[əi]	[a]	[ai]	[i]	[ie]	[u]	[uo]	[e]
Ei ei	O o	Ou ou	K k	Kh kh	G g	Ng ng	C c	Ch ch
ei	o	ou	ka	kha	ga	nga	ca	cha
[ei]	[o]	[ou]	[k]	[k^h]	[g]	[ŋ]	[tʃ]	[$tʃ^h$]
J j	Jh jh	Ny ny	T t	Th th	D d	N n	Ts ts	Tsh tsh
ja	jha	nya	ta	tha	da	na	tsa	tsha
[dʒ]	[$dʒ^ɦ$]	[ɲ]	[t]	[t^h]	[d]	[n]	[ts]	[ts^h]
Dz dz	P p	Ph ph	B b	M m	Pf pf	Bv Bv	Y y	Yh yh
dza	pa	pha	ba	ma	pfa	bva	ya	yha
[dz]	[p]	[p^h]	[b]	[m]	[pf]	[bv]	[j]	[ʃ]
R r	Rh rh	L l	Lh lh	F f	V v	W w	Wh wh	S s
ra	rha	la	lha	fa	va	wa	wha	sa
[ɹ]	[ɹ̊]	[l]	[l̥]	[f]	[v]	[w]	[w̥]	[s]
Sh sh	Z z	Zh zh	H h					
sha	za	zha	ha					
[ʃ]	[z]	[ʒ]	[h]					

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Chokri

Chokri, (also known as Chakru, Chakhesang and Eastern Angami) is one of three languages spoken by the Chakhesang Naga of Phek district, Nagaland state, India. Cheswezumi is the most important Chokri village in Nagaland. There are also some Chokri speakers residing in Senapati district, Manipur.

Search techniques in e- dictionaries

Search techniques in electronic dictionaries are divided into three elements that we have found to be present in every search: the *query*, the *resource*, and the *result*. By differentiating the query, the resource, and the result, we are able to reflect clearly and coherently all the search possibilities offered by each dictionary.

The query is the expression introduced by the user when searching in a dictionary. It is normally an exact word. In some cases, the user may introduce a partial word, for example, part of a word. The types of queries we have discerned in electronic dictionaries fall into a range of search technique types and subtypes: 1) an exact word, 2) a partial word, 3) an approximate expression, (inflectional form, or spelling similarity).

The search by an exact word consists of introducing a complete word in the same form as it is included in the dictionary. This search can be used to obtain the dictionary entry containing information about the introduced word

A partial word is an incomplete word. The omitted part of the word can be the start, the middle or the end of the word. This omitted part of the word is replaced by a wildcard. The most frequent wildcards are the asterisk '*', and the question mark '?'. The question mark '?' normally replaces only one character. For example, *analy?ed* retrieves **analyzed** and **analysed**. The asterisk (*) normally replaces one or more characters. For example, *house** retrieves **house**maid, **house**wife, **house**breaking, **house**hold, **house**keeper, etc.

An approximate expression is a word or sequence of characters that is similar to an exact word included in the dictionary. The approximate expression can be an inflected form of a word, or a word or sequence of characters that is pronounced or spelled similarly to other word. This search technique can be useful to obtain a list of words included in the dictionary that are similar to the word or sequence introduced by the user.

Conclusions

The paper entitled "Development of Multilingual Naga Dialects Electronic Dictionary" is carried out to find the meaning of the word from English language to Angami, Ao and Chokri languages through Online. This Multilingual E-Dictionary is developed in such a way that it makes the concepts of knowledge and provides to look up the accurate meaning of the English words in corresponding Angami, Ao and Chokri words. The Multilingual E-Dictionary plays an important role in not only translating the words from a source language to target languages, but also helping the learners to learn several new languages. It is also developed basically to solve some of the problems faced by the Naga language learners. The Multilingual Naga Electronic Dictionary is developed in four languages, namely English, Angami, Ao and Chokri on Online. The E-dictionary is developed basically for North-East people as well as for other people living in India. It plays an important role to improve the knowledge of English Angami, Ao and Chokri languages. The E-AAC is one kind of dictionary from which user can find the meanings of words and other related information about the words like word Id, POS, synonyms, and examples in English Angami, Ao and Chokri languages. Using E-AAC Dictionary, user can easily look up the meanings of words and other related information of the words on Online. It is an important part of Natural Language Processing tasks and computational linguistic work. This dictionary will save time and money in comparison to traditional paper dictionaries. It will be beneficial for students, research scholars, teachers, travelers and other people. Since, India is a multilingual country in the world; therefore the E-AAC will be helpful for people of Nagaland and for the educational institution.

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ICHTHYOFAUNAL DISTRIBUTION IN YUNGNYÜ RIVER (DIKHU) OF LONGLENG DISTRICT, NAGALAND

Reviewed

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Abstract: 15 Fish species belonging to 4 orders (Perciformes, Cyprinodontiformes, Cypriniformes and Siluriformes), 7 families (Mastacembelidae, Nandidae, Channidae, Belonidae, Cyprinidae, Balitoridae and Sisoridae and 14 genera were ecorded during the sampling period. Cyprinidae family with 8 species collected the highest count. One endangered species (*Chagunius chagunio*) was also recorded.

Key-words: Diversity, Species-Richness, Ecosystem, Yungnyü.

Introduction

According to di Castri and Younes (1996), biodiversity should not be construed as a 'simple umbrella covering a mosaic of heterogeneous activities', but should represent a composite entity shaped by the interactions. This includes fish diversity. According to Gorman and Karr (1978) fish diversity comprises of species richness (number of species in a defined area), species abundance (relative number of species) and phylogenetic diversity (Relationship between different groups of species). About 21,723 living species of fish have been recorded out of 39,900 species of vertebrates (Jayaram, 1999). Of these, 8,411 are freshwater species and 11,650 are marine. Freshwater constitutes less than 0.3% of available global water; however there are more than 15,000 species found there.

Riverine ecosystems have tremendously suffered over the last century due to intense human intervention with many fish species becoming highly endangered, particularly in freshwater rivers. According to Chovance *et al*. (2003) the main cause for diminishing of fish species are habitat destruction and defragmentation, while Dawson *et al.* (2003) attributes it to water abstraction, industries and private use. Other factors include exotic species introduction (Copp *et al*., 2005), pollution (Lima-Junior *et al.*, 2006) and global climate change impacts (Leveque *et al.*, 2005). Freshwater fish are one of the most threatened taxonomic groups (Darwall and Vie, 2005) because of their high sensitivity to the quantitative and qualitative alteration of aquatic habits.

India is an exceptional hotspot of freshwater fish diversity with a high degree of endemism contributing to the World's biological resources (Kottel *et al*.,1996). It occupies the ninth position in terms of freshwater megabiodiversity (Mittermeier and Mittermeier, 1997) and has about 2,500 species of fishes; of which 930 live in freshwater and 1570 are marine (Kar, 2003).

The Northeastern region of India namely, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura is considered to be one of the hotspots of freshwater fish biodiversity in the world (Kottelat and Whitten, 1996). Sinha (1994) had enlisted 230 species of fishes from north-eastern India. Karmakar and Das (2006) under the fauna of India series of Zoological survey of India (ZSI) has already published a list of 108 fish species of Nagaland (Including Govt. farm and exotic fish) consisting of their own field collection (81 spp) as well as from earlier records (27 spp).

Nagaland is a hilly mountainous state of the North East corner of the country with a unique topography, diverse physiographic features and water shed pattern. Acharjee *et al.* (2012), Odyuo and Nagesh (2012), Imnatoshi and Ahmed (2012), Humtsoe and Bordoloi (2014) and Ezung *et al.* (2020) have all done works on fish diversity in various rivers of Nagaland but not specifically in Longleng.

Hence, this paper attempts to document the ichthyofaunal distribution in the stretch of Yungnyü (Dikhu River), Kangching (Longleng), Nagaland, India.

Study Sites

Yungnyü (Dikhu) river is located approximately 6 km from Kangching village, Longleng, Nagaland. It has a dense forest area with perfect boulder edge, very rich in fauna and flora.

The three study sites are located at 26.6255 °N and 94.7199°E at an Elevation of 225 m (site-A), 26.6394°N and 94.7411° E at an Elevation of 218 m (site-B) and at 26.6455°N and 94.7465°E at an Elevation of 200 m (site-C).

Materials and Methods

The fishes were collected using baits with 8-9 cm long hook double coiled thread tied with bamboo or cane stick (usually 2 or 2 and half meter long) depending on the river current, local crossbow and Dip or Cast net. The specimens were photographed by Nikon D850. The collected fish were identified following Fish and Fisheries of Nagaland (Ao, Dey and Sarmah, 2008). The coordinates of the study sites were recorded through Google earth pro, version 7.3.3.7786 (64 bits).

The sampling period was from December, 2020 to May of 2021 with regular monthly field visits.

Statistical analysis

(a) Shannon-Weiner index of diversity
$H = - \sum pi \ln pi$
Where,
Pi is the proportion of each species in a sample (percentage in decimal form)
Ln(x) is the natural logarithm
(b) Species richness (S)=No. of different species represented
(c) Maximum diversity possible (Hmax) =Ln(S)
(d) Species evenness (E) =H/Hmax
(f) Simpson's index of diversity
$SDI = D = 1 - \sum n (n-1)/N (N-1)$
Where, n is the no. of individuals
N is the total no. of individuals

Result and discussion

Total 15 species (Plate 1) of Fishes belonging to 4 order (Perciformes, Cyprinodontiformes, Cypriniformes and Siluriformes), 7 families (Mastacembelidae, Nandidae, Channidae, Belonidae, Cyprinidae, Balitoridae and Sisoridae and 14 genera (*Mastacembelus, Badis, Channa, Xenontodon, Garra, Chagunius,Neolissochilus, Barillius, Punctius, Crossocheilus, Danio, Nemachelius, Silurus and Glypthothorax*) and 15 species (*M. armatus, B. badis, C. stewartii, X. cancila, G. gotylagotyla, G. mcclellandi, C. chagunio, N. hexagonolepis, B. vagra, P. conchonius, C. burmanicus, D. aequipinnatus, N. manipurensis, S. indicus* and *G. platypogonoides* were recorded in Yungnyu river from three Sites during the sampling period. The cyprinidae has the most abundant fishes at family level while the rest has only one representative each (Table 1). This conformed to similar findings in Doyank river by Rongsenkumzuk *et al*. (2019). Five different species were recorded in Site-A, with *Nemachelius manipurensis* being the most dominating species (5.25 no.s) during the survey while *Danio aequipinnatus* recorded the least with an average of 0.5 no.. In Site-B, twelve species were recorded while Site-C recorded 15 species. The *Neolissochilus hexagonolepis* averaged 18.5/month in Site B and 25.75/ month in site-C indicating it to be most dominant species in both the sites. *Neolissochilus hexagonolepis* are omnivorous, eating not only algae, crustaceans, insects, frogs and other smaller fishes but also fruits that fall from the tree resulting in its optimal count. In Site-B, *Matacembelus armatus* recorded the least with an average of 3.5 no.s/month and in Site-C, *Glypthothorax platypo gonoides* was the lowest recorded species with an average of 3.25 no.s/Month (Figure 4).

Altogether five species viz. *Badis badis, Garra mccelellandi, Neolissochilus hexagonolepis, Danio aequipinnatus* and *Nemachelius manipurensis* were found to be common in all the three sites. Interestingly, twelve species were common to both Site-B and Site-C (Table 1). According to Bunn and Arthington (2002) many types of river ecosystem have been lost and populations of many riverine species have become highly fragmented due to human intervention. Values of evenness were high among undisturbed sites (Site-C and Site-B) while low at disturbed sites (Site-A) which favour the finding of Specht and Paller (2004).

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Fishing is more rampant in site-A where chemical poisons, insecticides, poisons of plant origin, dynamites and electro fishing techniques are used, threatening the fish diversity. The record also exhibit dominancy of omnivorous fishes in all sites followed by carnivorous and herbivorous fish conforming to the observations of Fu *et al.* (2003) from Yangtze River basin of China. Das and Chakrabarty (2007) also showed similar results in two tropical rivers of India. Based on the study of trophic level of fishes, it appears that omnivores are often the most tolerant to degradation or ecosystem dysfunction because they are able to consume food from a wide variety of sources in a changing ecosystem (Wichert and Rapport, 1998) and this may be useful to assess quality of the fish habitat also. Dominancy of carnivorous fishes was noticed in the Western Ghats (Das and Chakraborty, 2007) and Ganga basin (Sarkar *et al.,* 2010) but no such observations were made from rivers of Nagaland including the present study.

The comparative analysis of the monthly total and average counts in the three sites indicate that Site- C is more diverse and rich than Site-A and Site-B.

Community analysis

Simpson's diversity index as shown in Table 2 indicates maximum richness in the low-lying site-C area (0.918), followed by site-B (0.8969) and site-A (0.763) which are considerably sloppy.

The Shannon–Weiner diversity index also showed similar results on diversity (Table 4). The highest fish diversity was recorded in Site C (H=2.589) followed by Site-B (H=2.359) and Site-A (H=1.453). This finding conforms to the results of Lakra et al., (2010). Evenness recorded is 0.95 in site-C, 0.94 in site-B and 0.90 in site-A as shown in Table 3.
The overall species composition is shown in Figure 1 with *Neolissochilus hexagonolepis* showing maximum covering 17% and *Silurus indicus* as the lowest covering only 2%.

The low fish diversity at Site-A may be due higher altitude (218m) there as compared to Site-C (200m). Negi and Mamgain (2013) also indicated that altitude plays a role in fish distribution. Hence, it may be inferred that there is inverse relationship between fish diversity and the altitude of the river. The present finding also conforms to the observations made by Tripe (1998) and Reves-Gavilan *et al.* (1996) who also opined that altitude of the streams or the rivers shows inverse relationship with the fish biodiversity. Another possible reason for high species richness in Site-C and Site-B may be attributed to minimal human interference due to its distance from the road-side. Similar pattern has been documented by Nautiyal (2001) wherein he suggested that the fish abundance and the distribution are highly influenced by altitudinal and the longitudinal zonation of any particular river system. Bayley and Li (1994) and Grando (2000) has also documented that fish community in riverine system typically follow a system of increasing species richness, diversity and abundance from upstream to downstream.

Site-A is exposed, the volume of water is low and the boulder edge perfectly situated is suitable for human activities. Thus only few tolerant species were collected from this site.

Conclusion

From the study Cyprinidae emerged as the most abundant family with a total of 8 species under it, thereby totaling 53.33% (Figure 3) and the rest of the families Mastacembelidae, Nandidae, Channidae, Belonidae, Balitoridae and Sisoridae consitituted 6.67% each. At species level *Neolissochilus hexagonolepis* recoreded the highest (17%), followed by *Nemachelius manipurensis* (12%) and *Garra mccelellandi* (11%).

One endangered species (*Chagunius chagunio*) , two near threatened species (*Nemachelius manipurensis and Xenontodon cancila)* and six vulnerable species (*Matacembelus armatus, Garra gotyla gotyla, Neolissochilus hexagonolepis, Barilius vagra, Punctius conchonius and Crossocheilus burmanicus*) were recorded. Interestingly, *Neolissochilus hexagonolepis*- a vulnerable species under the IUCN was abundantly found in the study sites.

Datas show that human intervention is negatively impacting fish population in the area which needs to be mitigated with proper research.

Table 1: Fish diversity in Yungnyu of Kangching with IUCN status. The ichthyo-species are listed below systematically

Sl. No.	Order	Family	Genus	Species	IUCN STATUS
1	Perciformes	Mastacembelidae	*Mastacembelus*	*armatus*	Vulnerable
2	Perciformes	Nandidae	*Badis*	*badis*	Not known
3	Perciformes	Channidae	*Channa*	*stewartii*	Least concern
4	Cyprinodontiformes	Belonidae	*Xenontodon*	*cancila*	Threatened
5	Cypriniformes	Cyprinidae	*Garra*	*gotyla gotyla*	Vulnerable
6	Cypriniformes	Cyprinidae	*Garra*	*mcclellandi*	Least concern
7	Cypriniformes	Cyprinidae	*Chagunius*	*chagunio*	Endangered
8	Cypriniformes	Cyprinidae	*Neolissochilus*	*hexagonolepis*	Vulnerable
9	Cypriniformes	Cyprinidae	*Barillius*	*vagra*	Vulnerable
10	Cypriniformes	Cyprinidae	*Punctius*	*conchonius*	Vulnerable
11	Cypriniformes	Cyprinidae	*Crossocheilus*	*burmanicus*	Vulnerable
12	Cypriniformes	Cyprinidae	*Danio*	*aequipinnatus*	Least concern
13	Cypriniformes	Balitoridae	*Nemachelius*	*manipurensis*	Natural threat
14	Siluriformes	Seluridae	*Silurus*	*indicus*	Least concern
15	Siluriformes	Sisoridae	*Glypthothorax*	*platypogonoides*	Vulnerable

Table 2: Table showing Simpson's Diversity Index of Site-A, Site-B and Site-C

Sl.No.	**Sites**	**Simpson's Diversity Index (SDI)**
1	Site-A	0.763
2	Site-B	0.8969
3	Site-C	0.918

Table 3: Table showing Shannon Weiner's Diversity index (H), Hmax and Evenness (E) of site-A, site-B and site-C

Sites	**Diversity(H)**	**Hmax**	**Evenness(E)**
Site A	1.453	1.61	0.90
Site B	2.3591	2.49	0.94
Site C	2.5886	2.71	0.95

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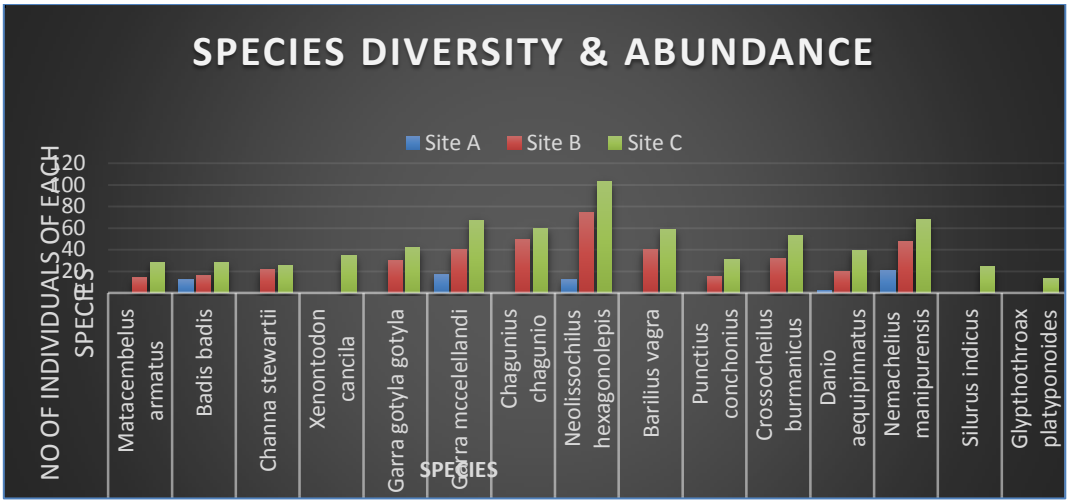

Figure 1: Column chart showing spot-wise species diversity

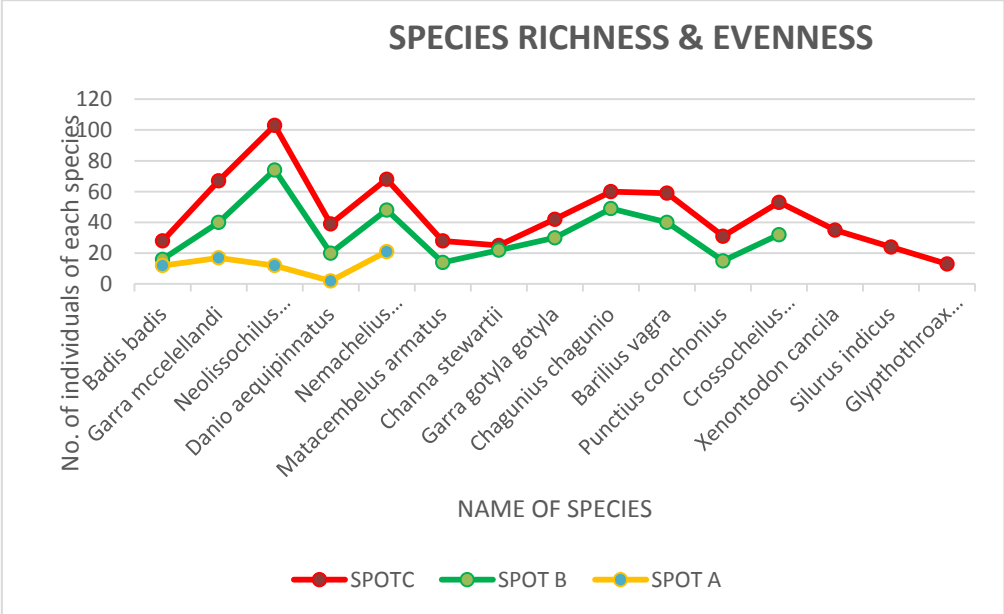

Figure 2: Line chart representing spot-wise species richness & evenness recorded from all 3 spots

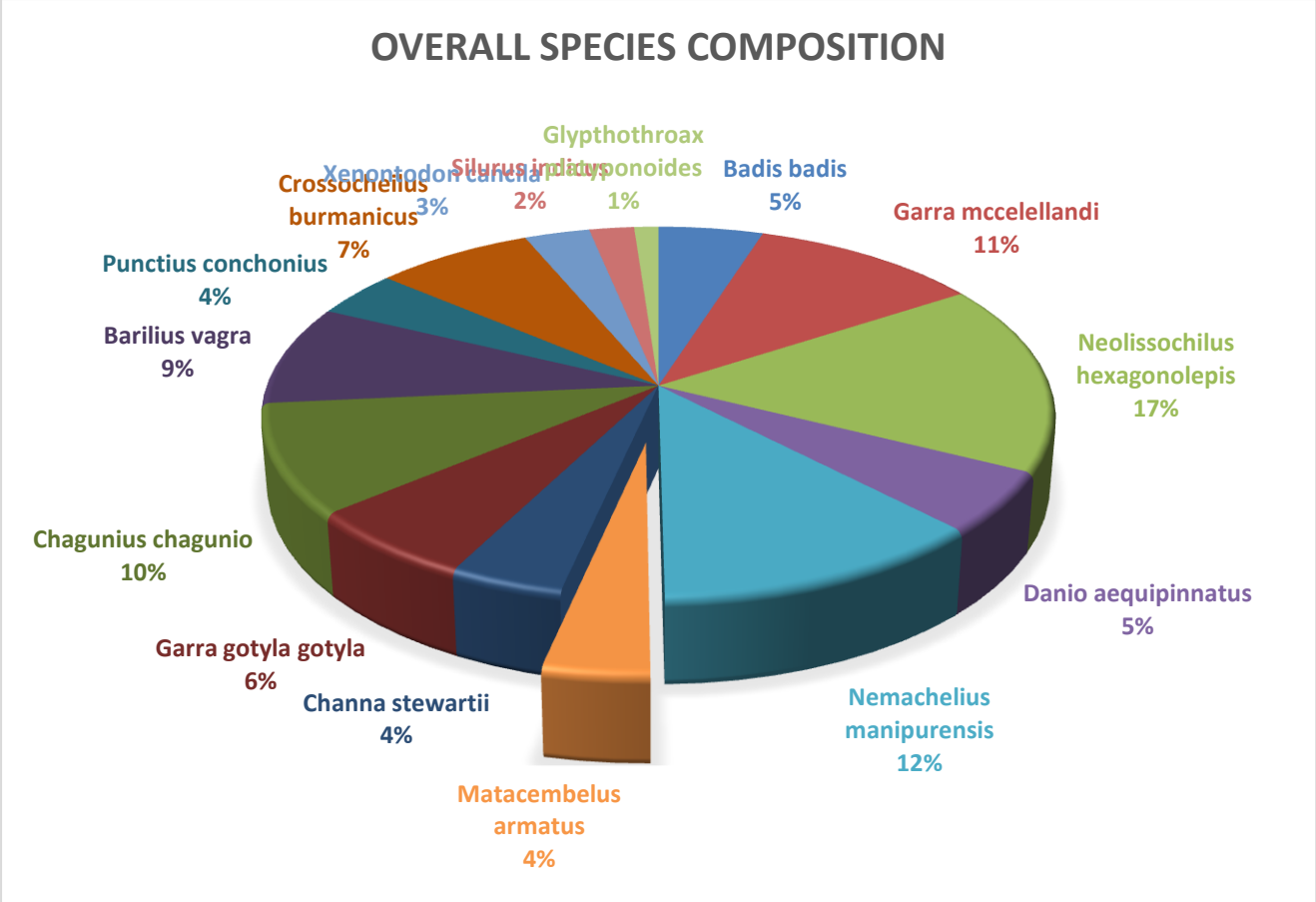

Figure 3: Pie chart showing overall composition

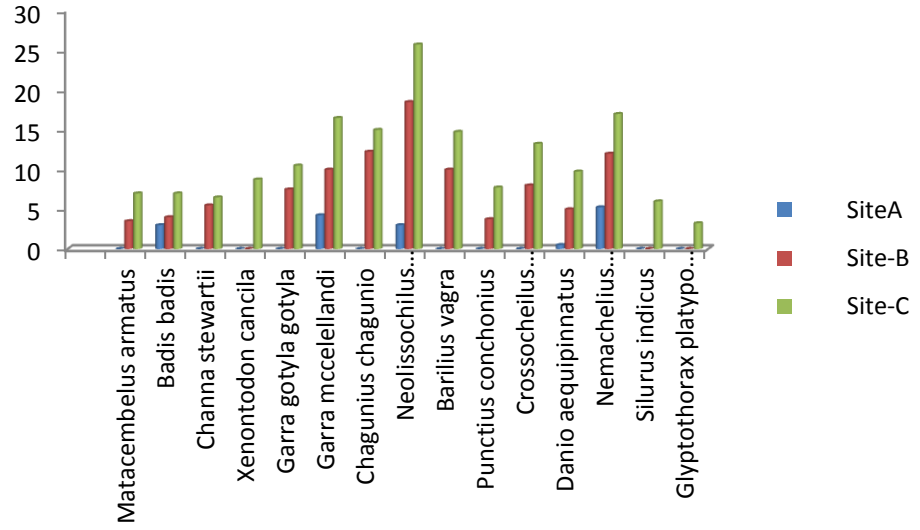

Figure 4: Fish records from the three study sites of Yungnyu River during six months survey

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Plate1

		
Matacembelus armatus	*Badis badis*	*Channa stewartii*
		
Xenontodon cancila	*Garra gotyla gotyla*	*Garra mccelellandi*
		
Chagunius chagunio	*Neolissochilus hexagonolepis*	*Barilius vagra*
		
Punctius conchonius	*Crossocheilus burmanicus*	*Danio aequipinnatus*
		
Nemachelius manipurensis	*Silurus indicus*	*Glyptothorax platypogonoides*

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A STUDY OF COLOUR VISION DEFICIENCY IN KOHIMA, NAGALAND

Reviewed

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Abstract: A study on prevalence, gender wise prevalence, and types of colour vision deficiency in Kohima was conducted on 482 subjects comprising of 300 females and 182 males. The study revealed 42 case of colour blindness with overall prevalence rate of 8.71%. Overall, Protanomaly (52.38%) type was found to be more prevalent as compared to deuteranomaly (38.09%) type of colour blindness. The subjects were tested for colour vision deficiency using Ishihara Colour Plates, 38 Plates Edition.

Keywords: Colour Vision Deficiency, Protanomaly, Deuteranomaly, Ishihara Colour Test, Kohima, Prevalence.

Introduction

Colour vision deficiency (CVD) is the inability to distinguish certain shades of colour. It is commonly inherited congenital non-progressive, and not treatable defect (Cumberland *et al.*, 2004), while there are also acquired colour vision defect (Shah *et al.*, 2013; Woldeamanuel and Geta, 2018). This condition is called as colour blindness which is caused by defective photoreceptor in the retina of the eyes known as cones. The defective photoreceptor inhibits the distinction of different colour shades. Such deficiency may cause inconvenience and negatively affect the quality of life of the individual. Most case of colour blindness remains undetected due to absence of awareness and proper screening (Woldeamanuel and Geta, 2018).

The most common type of colour deficiency is red-green where either the red or the green cones is missing. CVD does not cause complete blindness but only makes it harder for the individual to differentiate colours. CVD is one of the most common vision disorder and affects as many as 8% male and 0.5% female (Simunovic, 2010). It is a common X-linked recessive disorder and affects mostly men since men carry only one X chromosome (Woldeamanuel and Geta, 2018; Moudgil *et al*., 2016; Parmar *et al*., 2014). Since X chromosome carries the gene that produces photo pigments, a damaged or missing gene in the single X chromosome will produce colour blindness in men (Shah *et al.*, 2013). A female having normal vision can be a carrier if she has a single recessive gene for colour blindness.

Objective

1. To evaluate the prevalence of colour vision deficiency in Kohima.
2. To find out the prevailing types of colour vision deficiency.

Methods

This study is an outcome of Undergraduate 2021 batch dissertation of the Department of Anthropology under the supervision of Mr. Noune Teruno undertaken with the approval of the Department and the College. The study was conducted in Kohima town from where the samples were drawn. A community-based analytical study was undertaken on unrelated individuals and simple random sampling technique was used for the selection of the subject for the test. Informed consent of the participants was taken before administering the test. The samples were drawn only from Naga population and their community, occupation, age, and sex was recorded.

The subjects were tested for colour vision deficiency using Ishihara Colour Plates, 38 Plates Edition. A total of 482 subjects were tested for colour blindness out of which 300 were female and 182 were male between the age group of 8 years to 73 years. The test was conducted under optimal natural daylight condition in case of outdoor test and adequately lighted room in case of indoor test.

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The testing plates were held at 75cm from the subjects and they were asked to identify the number on the testing plates and their responses were recorded. The data collected were than compiled and analyzed to evaluate the prevalence of colour blindness, gender wise prevalence of colour blindness, and the types of colour blindness.

Results

The subjects were selected through simple random sampling technique between the age group of 8 years and 73 years to study the prevalence, gender wise prevalence, and prevailing types of colour blindness among the population of Kohima. A total of 482 subjects were tested for colour blindness using Ishihara Colour Plates. Out of the total subjects 300 were females and 182 were females (Table 1). A total of 42 subjects were found to have impaired colour vision, out of which 20 were female and 22 were male. Overall total of 42 subjects with impaired colour vision accounts for prevalence of 8.71% colour blindness. Although the number of subjects with impaired colour vision is similar for both female and male, the female total number of subject (300) is comparatively higher than the male total subjects (182). Taking this disparity in sample size between female and male into consideration the study shows that male shows a higher prevalence rate of 12.08% as compared to 6.67% prevalence rate among females. Out of 300 females only 20 were colour blind while out of 182 males only 22 were colour blind. (Figure 1). In this study two types of colour blindness were observed namely protanomaly and deuteranomaly. Protanomaly (52.38%) was found to be more prevalent as compared to deuteranomaly (38.09%) (Table 2). Out of 42 colour blind subjects protanomaly was observed on 22 subjects whereas deuteranomaly was observed on 16 subjects. Four subjects, two male and two female, remains unclassified, showing both the types. (Figure 2).

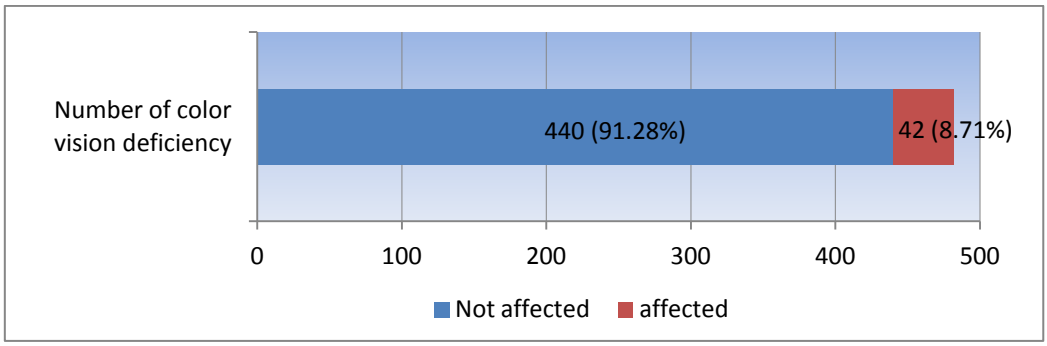

Figure 1

Number of color vision deficiency	Total
Affected	42(8.71%)
Not affected	440(91.28%)
Total	482

Table 1: Number of colour vision deficiency

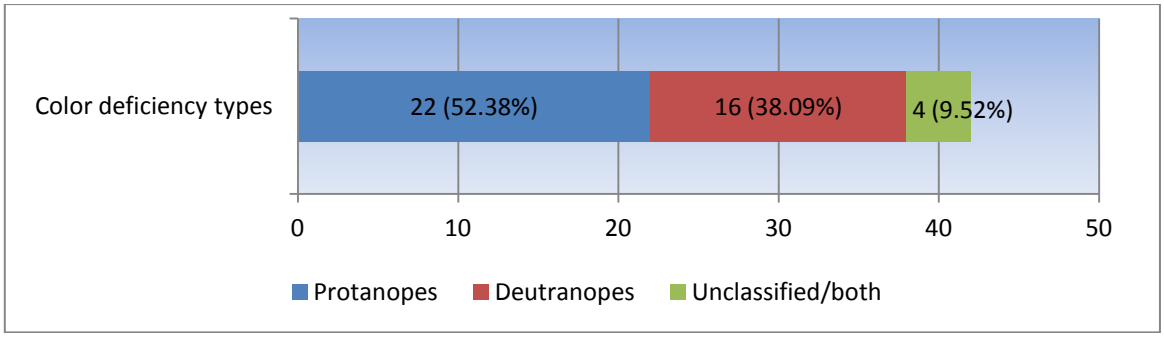

Figure 2

Color blindness type	Protanopes	Deuteranopes	Unclassified
Total (%)	22(52.38%)	16(38.09%)	4(9.52%)

Table 2: Colour blindness type distribution

Discussion

People with colour blindness face certain problem in their day to day lives due to their inability to recognize or distinguish certain shades of colours. Though colour blindness is not a life threatening disease it may affect the quality of life in a negative way. Its effect could range from minor inconvenience in differentiating colours to a more severe inconvenience such as inability to drive and getting rejected from certain jobs. It could cause emotional trauma on the individual who may not be aware of the problem. It is important to investigate the problem of colour blindness because it could handicap the life of those individuals without them knowing the cause of the problem. Unawareness of the problem could prevent taking any possible preventive or corrective measures to alleviate the negative impacts.

This study does not claim to be a comprehensive one but nonetheless sheds some light on the prevalence of colour blindness in the population of Kohima. This study did not take into consideration the association between colour blindness and age but simply evaluated the prevalence, and types of colour blindness. The authors are of the view that colour blindness is a problem that remains generally ignored among the Naga population due to lack of awareness. This study seeks to raise awareness of the problem of colour blindness among the population and inform the affected people of a problem they may be unaware about. Though congenital colour blindness is inherited and cannot be treated or cured and remains throughout life (Woldeamanuel and Geta, 2018), some therapeutic measures such as electrical eye stimulation, Iodine injections etc have been proposed (Shah *et al.*, 2013). In addition to this optometrist may recommend use of coloured spectacles as a corrective measure to improve colour discrimination (Shah *et al.*, 2013; Parmar *et al.*, 2014; Wemer *et al.*, 2020).

Colour blindness is an abnormality inherited as X- linked recessive trait and therefore is more common among males while female acts as carrier. The present study indicates that the prevalence rate of colour blindness is higher among male (12.1%) than female (6.67%). A study conducted by Shah *et al.* (2013), comparing different populations of Manipur also reported higher prevalence rate of colour blindness among the Manipuri male Nagas (3.75%). Similarly, the same study reported prevalence rate of colour blindness among the other Manipuri communities such as Meitei- male (14.93%), female (2.5%), Sheikh- male (8.99%), female (2.03%), Pathan- male (9.01%), female (1.32%), Syed- male (11.48%), female (1.82%), Mughal- male (5.56%), female (0.00%).

Moudgil *et al.* in their 2016 study in various schools of Jalandhar, between the age group of 6-15, reported a total of 61 case of colour blindness comprising of 55 male and 6 female out of 3259 sample size. This study

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showed a higher prevalence rate in male (1.69%) as compared to female (0.184%) (5). Similarly, Mengistu Zelalem *et al.* (2018), Gashaw Garedew and Teshome Gensa Geta (2018), H. B. Kim *et al.* (1989), Balasundaram *et al*. (2006), O. P. Mahajan and R. S. Gogna (1977) reported higher rate of prevalence of colour blindness among male as compared to female. Being an X-linked recessive trait, the present study also shows its increased prevalence among males showing significant association between sex and colour blindness.

The present study shows higher prevalence of protanomaly (52.38%) in both male and female as compared to deuteranopes (38.09%). In conclusion, the overall prevalence rate of colour vision deficiency was found to be 8.71%, while indicating a higher rate of prevalence among males and protanope type was observed to be more common.

Acknowledgement

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A PRELIMINARY STATUS OF HEMIPTERANS OF TUENSANG DISTRICT, NAGALAND

Reviewed

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Abstract: A total of 68 species of hemipterans belonging to 21 families were reported in the present study. 24 species were new report from this part of Nagaland. Family Coreidae was observed to be abundant among the other families of the Hemiptera. The study area has rich diversity of hemiptera, therefore it should be of great importance for conservation.

Keywords: Hemipteran, Tuensang district, Nagaland.

Introduction

The Hemiptera fauna in India was studied by different researchers. The Indian Membracidae has received attention through the pioneering contribution of Distant (1908, 1916) and later through the work Menon (1958) Ananthasubramanian and Ananthakrishnan (1975), Datta *et al.* (1985), Ghosh *et al.* (1997), Kailash Chandra *et al.* (2013), Altaf Hussain Sheikh (2017) and More *et al.* (2017).

The eastern part of the Indian sub-region is very rich and diverse. The study of hemipteran fauna in this region made practically no headway except some stray records of 125 species belonging to 92 genera in 4 families of Hemiptera. Ghosh and Raychaudhuri (1969) reported new subgenus *Pseudoacyrthosiphon* (Homoptera) from India. Aphids of NEFA, India by Ghosh (1970), Studies on the aphids from eastern India by Ghosh *et al.* (1971). Ghosh and Raychaudhuri (1971) reported further records of aphids from NEFA, Basu *et al.* (1972, 1974, 1977a, 1977b) reported new species and records of Coreidae from NEFA (Arunachal), Collection of Pentatomidae from Arunachal Pradesh by Datta and Chakraborty (1977), Hemiptera fauna of Delhi by Ghosh *et al.* (1997), The fauna of British India by Distant (1908, 1916), Hajong *et al.* (2013, 2018, 2021) reported *Chremistica ribhoi* sp, its mass emergence and new species *Platylomia kohimensis* from North-East and Thangjam *et al.* (2020) reported edible insects and their utilization in Northeastern Himalaya..

Nagaland is a relatively unexplored area having only few studies on the faunal diversity, especially concerning insects. So far, there has been no report on the study of Hemiptera from Nagaland, except report on Ptilomera (Ptilomera) (Hemiptera: Heteroptera: Gerridae) from India, with description of a new species by Jehamalar (2018) and of edible insects in which edible bugs are included by Pongener *et al.* (2019) and Mozhui *et al.* (2021).

Materials and Methods

Study was conducted in the Northern site of Tuensang district. It is located in the eastern part of Nagaland. It is bounded by Mon and Longleng Districts in the north and north east respectively, Mokokchung in the northwest, Zunheboto in the southwest, Kiphire in the south, and Noklak in the east. Tuensang town is located at 26.28°N 94.83°E has an altitude of 1,371.60 meters above sea level. It has an average elevation of 1371 metres (4498 feet). The climate of the district falls under sub-tropical type in the low land areas while higher areas have temperate climate. The annual rainfall is 2000mm and the maximum and minimum temperature recorded 30 and 5^{o}C respectively. The present study was conducted from November 2020 to June 2021. Majority of the species were collected during day time with the help of aerial insect net, beating net, and hand picking.

Results and Discussion

A total of 68 species of Hemipterans belonging to 21 families were recorded (Table 1). Of the 21 families collected, the family Coreidae observed to be abundant among the other families of the collected Hemipterans with 15 species. Pentatomidae with 12 species, Tessaratomidae 8 species, Pyrrhocoridae 4 species, Scutelleridae and Cicadidae 3 species

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each, Dinidoridae, Fulgoridae and Alydidae 2 species each, Cicadellidae, Nepidae, Cercopidae, Cydnidae, Lygaeidae, Miridae, Ricaniidae, Notonectidae, and Aphrophoridae with 1 species each.

Availability of species was poor during winter season (November, December and January) but maximum number of individuals of the species was recorded during the month of mid-March to May. The best season for the collection of bugs is between March to October as observed throughout this research study. Maximum species were collected during day time as they are attracted to light.

Table 1: List of Hemipterans recorded during the study period

Sl. No.	Family	Scientific name	Distribution
1.	Pentatomidae	*Eurydema spectabilis* (Horvath, 1882)	Nagaland (Tuensang district)
2.	Pentatomidae	*Eurydema oleracea* (Linnaeus, 1758)	Nagaland, Assam, Manipur, UP
3.	Pentatomidae	*Eurydema sp*	Nagaland (Tuensang district)
4.	Pentatomidae	*Murgantia histrionic* (Hahn, 1834)	Nagaland, Maharashtra, Tamil Nadu
5.	Pentatomidae	*Halyomorpha sp*	Nagaland (Tuensang district), Meghalaya, Jammu and Kashmir, Uttar Pradesh, Karnataka
6.	Pentatomidae	*Chinavia halaris* (Say, 1832)	Nagaland (Tuensang district)
7.	Pentatomidae	*Palomena prasina* (Linnaeus, 1761)	Nagaland (Tuensang district)
8.	Pentatomidae	*Plautia stali* (Scott, 1874)	Nagaland (Tuensang district)
9.	Pentatomidae	*Eysarcoris guttiger* (Thunberg, 1783)	Nagaland, Chhattisgarh, Maharashtra, Sikkim, Uttar Pradesh, West Bengal
10.	Pentatomidae	*Podisus maculiventris* (Say, 1832)	Nagaland (Tuensang district)
11.	Pentatomidae	*Alcaeorrhynchus grandis* (Dallas, 1851)	Nagaland (Tuensang district)
12.	Pentatomidae	*Edessa sp*	Nagaland (Tuensang district)
13.	Cicadellidae	*Bothrogonia addita* (F.Walker, 1851)	Nagaland (Tuensang district)
14.	Coreidae	*Savius sp*	Nagaland (Tuensang district)
15.	Coreidae	*Dalader acuticosta* (Amyot & Serville, 1843)	Nagaland, West Bengal, Sikkim, Assam, Meghalaya, Himachal Pradesh
16.	Coreidae	*Dalader planiventris* (Westwood, 1842)	Nagaland, Chhattisgarh, Assam, Maharashtra, Tamil Nadu Sikkim
17.	Coreidae	*Notobitus meleagris* (Fabricius, 1787)	Nagaland, Chhattisgarh, Tamil Nadu
18.	Coreidae	*Notobitus sp*	Nagaland (Tuensang district)
19.	Coreidae	*Notobitus sp*	Nagaland (Tuensang district)
20.	Coreidae	*Notobitus sp*	Nagaland (Tuensang district)

21.	Coreidae	*Cletomorpha Benita* (Mayr, 1866)	Nagaland (Tuensang district)
22.	Coreidae	*Mozena sp*	Nagaland (Tuensang district)
23.	Coreidae	*Physomerus grossipes* (Fabricius, 1794)	Nagaland (Tuensang district)
24.	Coreidae	*Molipteryx hardwickii* (White, 1839)	Nagaland, Assam, Sikkim
25.	Coreidae	*Molipteryx sp*	Nagaland, Assam, Sikkim
26.	Coreidae	*Ochrochira sp*	Nagaland (Tuensang district), Assam, Karnataka, Kerala, Maharashtra, Madhya Pradesh, Sikkim, West Bengal
27.	Coreidae	*Anoplocnemis phasianus* (Fabricius, 1781)	Nagaland, Sikkim, Meghalaya, Maharashtra, Karnataka, Kerala
28.	Coreidae	*Zicca stalii* (Berg, 1879)	Nagaland (Tuensang district)
29.	Dinidoridae	*Megymenum spinosum* (Burmeister, 1834)	Nagaland (Tuensang district)
30.	Dinidoridae	*Megymenum affine* (Boisduval, 1835)	Nagaland (Tuensang district)
31.	Nepidae	*Laccotrephes rubber* (Linnaeus, 1764)	Nagaland (Tuensang district)
32.	Scutelleridae	*Chrysocoris sp*	Nagaland (Tuensang district)
33.	Scutelleridae	*Chrysocoris sp*	Nagaland (Tuensang district)
34.	Scutelleridae	*Poecilocoris rufigenis* (Dallas, 1851)	Nagaland (Tuensang district), Uttarakhand, Assam
35.	Cercopidae	*Leptataspis sp*	Nagaland (Tuensang district)
36.	Cicadidae	*Ambragaeana sp*	Nagaland (Tuensang district)
37.	Cicadidae	*Cicadatra sp*	Nagaland (Tuensang district)
38.	Cicadidae	*Tosena fasciata* (Fabricius, 1787)	Nagaland (Tuensang district)
39.	Cydnidae	*Cydnus sp*	Nagaland (Tuensang district)
40.	Gerridae	*Aquarius conformis* (Uhler, 1878)	Nagaland (Tuensang district), Assam, Arunachal Pradesh
41.	Pyrrhocoridae	*Dindymus sp*	Nagaland (Tuensang district)
42.	Pyrrhocoridae	*Dindymus bifurcates* (Stehlík & Jindra, 2006)	Nagaland (Tuensang district), Kerala, Tamil Nadu, Orissa, Meghalaya
43.	Pyrrhocoridae	*Dysdercus cingulatus* (Fabricius, 1775)	Nagaland (Tuensang district), Assam
44.	Pyrrhocoridae	*Melamphaus faber* (Fabricius, 1787)	Nagaland (Tuensang district)
45.	Lygaeidae	*Spilostechus hospes* (Fabricius, 1794)	Nagaland (Tuensang district), Chhattisgarh, Karnataka, Madhya Pradesh, Maharashtra, Uttaranchal West Bengal
46.	Tessaratomidae	*Eusthenes rubefactus* (Distant, 1901)	Nagaland (Tuensang district), Assam
47.	Tessaratomidae	*Eusthenes saevus* (Stal, 1863)	Nagaland (Tuensang district), Assam, Sikkim

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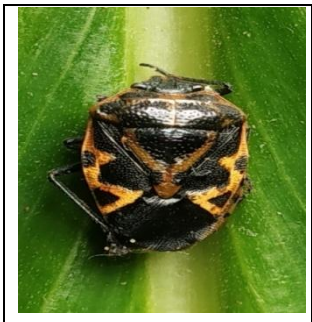
48.	Tessaratomidae	*Eusthenes femoralis* (Zia, 1957)	Nagaland (Tuensang district) and other Northeast India
49.	Tessaratomidae	*Eusthenes brianae* (Yang, 1935)	Nagaland (Tuensang district)
50.	Tessaratomidae	*Eusthenes sp*	Nagaland (Tuensang district)
51.	Tessaratomidae	*Eurostus validus* (Dallas, 1851)	Nagaland (Tuensang district), Assam, West Bengal
52.	Tessaratomidae	*Eurostus sp*	Nagaland (Tuensang district)
53.	Tessaratomidae	*Pycanum rubens* (Fabricius, 1794)	Nagaland and other Northeast India
54.	Reduviidae	*Triatoma sp*	Nagaland (Tuensang district)
55.	Reduviidae	*Zelus janus* (Stal, 1862)	Nagaland (Tuensang district)
56.	Reduviidae	*Zelus longipes* (Linnaeus, 1767)	Nagaland, West India, Kerala
57.	Reduviidae	*Zelus sp*	Nagaland (Tuensang district)
58.	Reduviidae	*Apiomerus sp*	Nagaland (Tuensang district)
59.	Reduviidae	*Apiomerus crassipes* (Fabricius, 1803)	Nagaland (Tuensang district)
60.	Miridae	*Lygus sp*	Nagaland (Tuensang district)
61.	Fulgoridae	*Pyrops sp*	Nagaland (Tuensang district), Andaman and Nicobar Island
62.	Fulgoridae	*Pyrops sp*	Nagaland (Tuensang district), Andaman and Nicobar Island
63.	Ricaniidae	*Ricanula stigmatica* (Stal, 1869)	Nagaland (Tuensang district), Sikkim
64.	Alydidae	*Riptortus linearis* (Fabricius, 1775)	Nagaland (Tuensang district), Assam, Madhya Pradesh Karnataka, Sikkim, Tamil Nadu, West Bengal
65.	Alydidae	*Leptocorisa oratorius* (Fabricius, 1794)	Nagaland (Tuensang district), Odisha, Andaman and Nicobar Island, Bihar, Uttar Pradesh
66.	Notonectidae	*Notonecta sp*	Nagaland (Tuensang district)
67.	Corixidae	*Micronecta sp*	Nagaland (Tuensang district)
68.	Aphrophoridae	*Philaenus spumarius* (Linnaeus, 1758)	Nagaland (Tuensang district)

Plate 1

			
Eurydema spectabilis	***Eurydema oleracea***	***Murgantia histrionica***	***Palomena prasina***
			
Plautia stali	***Podisus maculiventris***	***Alcaeorrhynchus grandis***	***Bothrogonia addita***
			
Cletomorpha Benita	***Physomerus grossipes***	***Megymenum affine***	***Poecilocoris rufigenis***
			
Tosena fasciata	***Aquarius conformis***	***Dindymus bifurcatus***	***Melamphaus faber***
			
Spilostechus hospes	***Eusthenes rubefactus***	***Eusthenes femoralis***	***Eusthenes brianae***

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Zelus janus	***Apiomerus crassipes***	***Ricanula stigmatica***	***Philaenus spumarius***

Conclusion

From the present study 24 species were new records from the state of Nagaland particularly from Tuensang district (Plate 1). The species are as follows - *Eurydema spectabilis, Eurydema oleracea, Murgantia histrionic, Palomena prasina, Plautia stali, Podisus maculiventris, Alcaeorrhynchus grandis, Bothrogonia addita, Cletomorpha Benita, Physomerus grossipes, Megymenum affine, Poecilocoris rufigenis, Tosena fasciata, Aquarius conformis, Dindymus bifurcates, Melamphaus faber, Spilostechus hospes, Eusthenes rubefactus, Eusthenes femoralis, Eusthenes brianae, Zelus longipes, Apiomerus crassipes, Ricanula stigmatica* and *Philaenus spumarius*.

A long-term study is needed to observe the species occurrence in all seasons and their interactions with the environmental changes for better results. More surveys will bring many newer species or new records of Hemipterans from this area in future.

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A CHECKLIST OF BUTTERFLIES (LEPIDIOPTERA- RHOPALOCERA) FROM PHEK TOWN, NAGALAND AND THEIR STATUS

Reviewed

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Abstract: Report on butterflies species which represents 7.5% of the total India's butterfly fauna. The study also confirms the status of very rare and rare categories (sighted less than 5 times) which requires conservation strategies in the study area. Out of 113 species, 14 species comes under legally protected schedules of the Indian Wildlife Protection Act, 1972 (WPA, 1972). 18 species were of newly recorded species in the district of Phek, Nagaland.

Keyword: Butterflies, Phek town, Nagaland.

Introduction

Nagaland is a mountainous state in northeast India, bordering Myanmar. The state is located between 25.6 and 27.4°N latitude and between 93.20 and 95.13°E longitudes. Nagaland falls in the eastern Himalaya region of the Himalaya Global Biodiversity Hotspot, one among the 34 global biodiversity hotspots.

In India a total of 1,504 butterfly species (Nair *et al*., 2014). The number of Indian butterflies amount to one-fifth of the world species (Kunte, 2000). Surveys and collections of butterflies from the Naga Hills are scanty. Literature reviews revealed that not much scientific studies about Lepidoptera and ecology has been documented or carried out in Nagaland. A few researchers have made significant contributions to the occurrence and distribution of butterfly fauna. An earliest publication on the butterflies of the Naga Hills includes the publication by Elwes based on the collections by Mr. W. Doherty during two expeditions in 1889 and 1890 (Elwes, 1891). Subsequent to Mr. Doherty's butterfly collection in the Naga Hills, Major Tytler, H. C. made collections and reported on the butterflies of the Naga Hills (Tytler, 1911, 1912). Moreover, Tytler had further collected butterflies from Manipur and Naga Hills (Tytler, 1914, 1915a,b). Naro, T. and Sondhi, S. (2014) documented on the butterflies of Chizami, Phek District, India over a period of three years (2011-2014). This represents the first list of butterfly records from Nagaland after publications by Tytler between 1911 and 1914.

Phek Town is itself diverse in flora and fauna, and holds rich butterfly diversity. The present study aims was to document and explore the butterflies in Phek Town, Nagaland which remains untouched and the conservation of butterflies has not been a target species. Therefore, the survey was undertaken with an aim to take conservation steps for its various ecological roles it portrays in an ecosystem.

Methods

Phek town is the district headquarters of the Phek district of Nagaland, India. It has the Coordinates of 25.6667°N and 94.50000°E and an elevation of 1,524 m (5,000 ft). Phek town experiences hot and dry summers and pleasant to chilly winters. The summers are moderately warm with the average temperature being 27°C without exceeding 32°C. Winters are cold with the temperature dropping to 0°C in the coldest months of January and February. The average rainfall is 1,527 mm. Phek town is a mountainous region accompanied with ridges and gorges with streams.

The present study was conducted from September 2020 to March 2021. Visual search and photography of specimens was made in the early hours of the day and at noon. Observation of butterflies was done in three sites namely; Site 1- Flowers and Kitchen gardens; Site 2- Evergreen forests; and Site 3- Water sources.

Result and Discussion

The present survey of the butterflies of Phek Town, Nagaland reveals the presence of 113 species (Table 1) of butterflies belonging to 6 families, 22 subfamilies and 78 genera.

Table 1: List of butterflies of Phek Town, Nagaland with their status and protection under the WLPA, 1972.

Sl. No	Scientific name (in italics) followed by the authors name.	Common name (Alternate name in bracket)	Species legally protected under Indian WPA, 1972
A.	**Family: Hesperiidae**		
1	*Badamia exclamationis* Fabricius, 1775	Brown Awl	-
2	*Hasara taminatus* Fruhstorfer, 1911	White Banded Awl	-
3	*Pelopidas mathias* Fabricius, 1798	Small Branded Swift	-
4	*Polytremis eltota* Hewitson, 1869	Yellow Spot Swift	-
5	*Potanthus sp.*	Dart sp.	-
6	*Ochlodes siva* Moore, 1878	Black-branded Darter (Assam Darter)	-
7	*Notocrypta paralysas* Fruhstorfer, 1911	Common Banded Demon	-
8	*Celaenorrhinus leucocera* Kollar, 1844	Common Spotted Flat	-
9	*Spialia galba* Fabricius, 1793	Indian Skipper	-
B.	**Family Papilionidae**		
10	*Graphium agamemnon* Linnaeus, 1758	Tailed Jay	-
11	*Lamproptera meges* Zinken-Sommer, 1831	Green Dragontail	-
12	*Papilio clytia* Linnaeus, 1758	Common mime	-
13	*Papilio epycides* Hewitson, 1862	Lesser Mime	WPA-II
14	*Chilasa agestor* Gray, 1831	Tawny mime	-
15	*Papilio helenus* Linnaeus, 1758	Red Helen	-
16	*Papilio memnon* Linnaeus, 1758	Great Mormon	-
17	Papilio protenor Fruhstorfer, 1908	Spangle	
18	*Byasa polyeuctes* Doubleday, 1842	Common Windmill	-
C.	**Family Pieridae**		
19	*Catopsilia pomonapomona* Fabricius, 1775	Common Emigrant	-
20	*Eurema blanda* Boisduval, 1836	Three-spot Grass Yellow	-
21	*Eurema hecabe* Linnaeus, 1758	Common Grass yellow	-
22	*Eurema laeta* Boisduval, 1836	Spotless Grass Yellow	-
23	*Appias albina* C. & R. Felder, 1865	Common Albatross	WPA-II
24	*Cepora nerissa* Fabricius, 1775	Common Gull	-
25	*Delias acalis* Wallace, 1867	Red-Breast Jezebel	-
26	*Ixias pyrene* Butler, 1874	Yellow Orange-Tip	-
27	*Pieris brassicae* Linnaeus, 1758	Large Cabbage White	-
28	*Pieris canidia* Evans, 1926	Indian Cabbage White	-
29	*Pieris melete* Moore, 1865	Green Vein White	-
30	*Prioneris thestylis* Doubleday, 1842	Spotted Sawtooth	-
31	*Aporia agathon* Gray, 1831	Great Blackvein	-
D.	**Family Lycaenidae**		
32	*Heliophorus brahma* Moore, 1858	Golden Sapphire	-

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33	*Heliophorus kohimensis* Tytler, 1912	Naga Sapphire	-
34	*Heliophorus moorei* Riley, 1929	Green Sapphire (Azure Sapphire)	WPA-II
35	*Acytolepis puspa* Fruhstorfer, 1910	Common Hedge Blue	-
36	*Celastrina lavendularis* Moore, 1879	Plain Hedge Blue	-
37	*Talicada nyseuskhasiana* Swinhoe, 1893	Red Pierrot	-
38	*Udara dilecta* Moore, 1879	Pale Hedge Blue	-
39	*Bothrinia chennelli* de Niceville, 1884	Hedge Cupid	WPA-II
40	*Catochrysops strabo* Fabricius, 1793	Forget-me-not	-
41	*Nacaduba kurava* Moore, 1858	Transparent 6-Line	-
42	*Jamides bochus* Stoll, 1782	Dark Cerulean	-
43	*Jamides celeno* Cramer, 1775	Common Cerulean	-
44.	*Jamides elpis* Butler, 1879	Glistening Cerulean	-
45	*Lampides boeticus* Linnaeus, 1767	Pea Blue	WPA-II
46	*Zizeeria karsandra* Moore, 1865	Dark Grass Blue	-
47	*Pseudozizeeria mahamaha* Kollar, 1844	Pale Grass Blue	-
48	*Poritia hewitsoni* Moore, 1865	Common gem	WPA-II
49	*Arhopala bazalusteesta* de Niceville, 1886	Powdered Oakblue	-
50	*Arhopala ganesa* Evans, 1912	Tailless Bushblue	WPA-II
51	*Rapala tara* de Niceville, 1889	Branded Flash (Assam Flash)	-
52	*Spindasis syama* Moore, 1884	Club Silverline	-
53	*Surendra quercetorum* Moore, 1857	Common Acacia Blue	-
E.	**Family Nymphalidae**		
54	*Mimathymaambica ambica* Kollar, 1844	Indian Purple Emperor	-
55	*Euripus nyctelius* Doubleday, 1844	Courtesan	-
56	*Hestinalis nama* Doubleday, 1844	Circe	-
57	*Ariadne ariadne* Linnaeus, 1763	Angled Castor	-
58	*Ariadne merione* Cramer, 1777	Common Castor	-
59	*Calinaga brahma* Butler, 1885	Orange-backed Freak	WPA-II
60	*Charaxes bharata* C. & R. Felder, 1867	Indian Nawab (Common Nawab)	-
61	*Charaxes dolon* Westwood, 1848.\	Stately Nawab	WPA-II
62	*Charaxes bernandus* C. & R. Felder, 1867	Tawny Rajah	WPA-II
63	*Cyrestis thyodamas* Boisduval, 1836	Common Map	-
64	*Danaus genutia* Cramer, 1779	Striped Tiger (Common Tiger)	-
65	*Euploea mulciber* Cramer, 1777	Striped Blue Crow	WPA-IV
66	*Parantica melaneus* Cramer, 1775	Chocolate Tiger	-
67	*Tirumala septentrionis* Butler, 1874	Dark Blue Tiger	-
68	*Acraea issoria issoria* Hubner, 1818	Yellow Coster	-
69	*Argynnis childreni* Gray, 1831	Large Silverstripe	-
70	*Argynnis hyperbius* Linnaeus, 1763	Tropical Fritillary (Indian Fritillary)	-
71	*Cethosia biblis* Fruhstorfer, 1912	Red Lacewing	-
72	*Cethosia cyane* Drury, 1770	Leopard Lacewing	-
73	*Cirrochroa aoris aoris*	Large Yeoman	-

	Doubleday, 1847		
74	*Cirrochroa tyche* C. & R. Felder, 1861	Common Yeoman	-
75	*Vindula erota* Fabricius, 1793	Cruiser	-
76	*Libythea myrrha* Moore, 1872	Common Beak	-
77	*Athyma opalina* Elwes, 1888	Himalayan Sergeant	-
78	*Athyma perius* Linnaeus, 1758	Common Sergeant	-
79	*Athyma cama* Moore, 1857	Orange Staff Sergeant	-
80	*Athyma selenophora* Kollar, 1844	Staff Sergeant	-
81	*Euthalia lubentina* Cramer, 1777	Gaudy baron	WPA-IV
82	*Euthalia patala* Kollar, 1844	Grand Duchess	WPA-II
83	*Neptis hylas* Linnaeus, 1758	Common Sailer	-
84	*Neptis sappho* Moore, 1872	Pallas's Sailer	-
85	*Aglais caschmirensis* Fruhstorfer, 1912	Indian Tortoiseshell	-
86	*Hypolimnas bolina* Drury,1773	Great Eggfly	-
87	*Junonia almana* Linnaeus, 1758	Peacock Pansy	-
88	*Junonia atlitesatlites* Linnaeus, 1763	Grey Pansy	-
89	*Junonia iphita* Cramer, 1779	Chocolate Pansy	-
90	*Junonia lemonias* Linnaeus, 1758	Lemon Pansy	-
91	*Junonia orithya* Linnaeus, 1758	Blue Pansy	-
92	*Kaniska canace* Linnaeus, 1763	Indian Blue Admiral	-
93	*Symbrenthia lilaea* Moore, 1875	Common Jester	-
94	*Vanessa cardui* Linnaeus, 1758	Painted Lady	-
95	*Vanessa indicaindica* Herbst, 1794	Indian Red Admiral	-
96	*Thaumantis diores* Doubleday, 1845	Jungleglory	-
97	*Elymnias malelas* Hewitson, 1863	Spotted Palmfly	-
98	*Lethe bhairava* Moore, 1858	Rusty Forester	-
99	*Lethe confusa* Aurivillius, 1898	Banded Treebrown	-
100	*Lethe verma* Fruhstorfer, 1911	Straight-banded Treebrown	-
101	*Melanitis leda* Linnaeus, 1758	Common Evening Brown	-
102	*Melanitis zitenius* Herbst, 1796	Great Evening Brown	WPA-II
103	*Telinga malsara* Moore, 1858	White-line Bushbrown	-
104	*Mycalesis francisca* Moore, 1858	Lilacine Bushbrown	-
105	*Neope pulaha* Moore, 1857	Veined Labyrinth	-
106	*Orinoma damaris* Gray, 1846	Tiger Brown	-
107	*Ypthima baldus* Fabricius, 1775	Common Five-ring	-
108	*Ypthima newara* Moore, 1875	Newar Three-ring	-
109	*Ypthima sakra* Moore, 1858	Himalayan Five-ring	-
F.	**Family Riodinidae**		
110	*Abisara flylla* Westwood, 1851	Dark Judy	-
111	*Abisara neophron* Hewitson, 1861	Tailed Judy	-
112	*Dodona ouida* Moore, 1866	Mixed Punch	-
113	*Zemeros flegyas* Cramer, 1780	Punchinello	-

The presence of 113 species of butterflies represents 7.5% of the total India's butterfly fauna. The family Nymphalidae dominated with 50% (56 species) followed by Lycaenidae with 19% (22 species); Pieridae with 11% (13 species); Papilionidae and Hesperidae with 8% each (9 species each) and Riodinidae with the least species composition representing 4% (4 species) (Figure 1).

Out of 113 species, 14 species (Figure 2-15) comes under legally protected schedules of the Indian Wildlife Protection Act, 1972 (WPA, 1972) namely *Papilio epycides, Appias albino, Heliophorus moorei, Bothrinia chennelli, Lampides boeticus, Poritia*

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hewitsoni, Arhopala ganesa, Calinaga brahma, Charaxes dolon, Charaxes bernandus, Euploea mulciber, Euthalia lubentina, Euthalia patala and *Melanitis zitenius*.

Conclusion

Out of 113 species recorded in the study, 95 species are also reported in Chizami, Phek District, Nagaland (Naro and Sondhi, 2014), 18 species were of newly recorded species in the district of Phek, Nagaland, namely *Spialia galba, Chilasa agestor, Cepora nerissa, Aporia agathon, Talicada nyseuskhasiana, Nacaduba kurava, Jamides celeno, Pseudozizeeria mahamaha, Rapala tara, Charaxes dolon, Charaxes bernandus, Libythea myrrha, Euthalia patala, Neptis hylas, Junonia atlites, Lethe bhairava, Abisara neophron*, and *Dodona ouida*.

Site 2 has disturbed forests clearings and agricultural forests; yet provides a higher abundance of butterflies. A majority of the recorded butterflies are seen to be abundant here in comparison to the other two sites. All the six families of butterflies were found occurring in higher number. However, in the long run, anthropogenic activities like deforestation which ultimately destroy the larval food plants, directly or indirectly may have a huge impact on the butterfly diversity. It is of high necessity for conservation measures to be taken in order to accelerate the butterfly occurrence.

The present study covers a majority of common butterfly species and a handful of rare species. The study also confirms the status of very rare and rare categories (sighted less than 5 times) which requires conservation strategies in the study area. The present findings of butterfly fauna are important for monitoring the diversity of butterflies, conservation and ecology. A long term study should be attempted to observe the seasonal species occurrence and its interaction with environment.

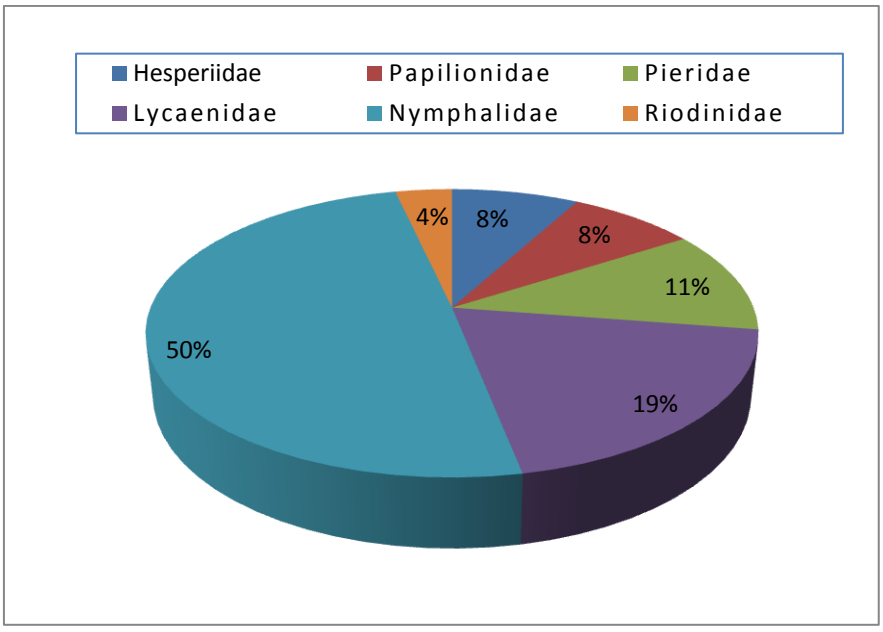

Figure 1: Family-wise composition of butterfly species of Phek Town, Nagaland.

Figure 2: *Papilio epycides*

Figure 3: *Appias albino*

Figure 4: *Heliophorus moorei*

Figure 5: *Bothrinia chennelli*

Figure 6: *Lampides boeticus* (L- female, R- Male)

Figure 7: *Poritia hewitsoni*

Figure 8: *Arhopala ganesa*

Figure 9: *Calinaga brahma*

Figure 10: *Charaxes dolon*

Figure 11: *Charaxes bernandus*

Figure 12: *Euploea mulciber*

Figure 13: *Euthalia lubentina*

Figure 14: *Euthalia patala*

Figure 15: *Melanitis zitenius*

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RÜSIE

Translation: 'A movement for a cause' is the literal translation of the Tenyidie word **'Rüsie'**. It is a movement of united action and efforts by a group or a community for a specific purpose.

The name 'Rüsie' befits the journal which is also a movement for a cause- of Science and Social issues. A forum to disseminate ideas and knowledge through united and collective efforts.

Name of the journal proposed by Dr Shürhozelie Liezietsu, President, Ura Academy.

FORMAT GUIDELINES

1. Length of the article- maximum 8 pages (A4 size paper), with a font size of 11 and a line spacing of 1.0 (single) in two columns (max. 1500 words).
2. Font style: Times New Roman (preferably typed in Microsoft Word)
3. Headings:
   i) Title
   ii) Abstract (max. 50 words)
   iii) Introduction
   iv) Objectives
   v) Methodology
   vi) Results (preferably with figures and tables in science section)
   vii) Conclusion
   viii) Acknowledgement
   ix) References
   x) Brief bio-data of the author(s)
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