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Entomophagy- A Sustainable and Cultural Practice: Insights from Communities in Raimona National Park, BTR, Assam

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Abstract

In Assam, India, entomophagy is a widespread practice among various ethnic groups, contributing significantly to the region's cultural heritage. Assam's diverse ecosystem hosts a rich variety of insect species highly valued for their nutritional content, including proteins, minerals, and antioxidants. Traditionally, communities in the Bodoland Territorial Region (BTR) have depended on insect collection for sustenance and commercial purposes. Raimona National Park serves as a vital habitat for many insect species, providing an additional source of income for local residents. This study sampled ten villages within Raimona National Park to document wild edible insects and assess their cultural and commercial significance. The study identified twenty species from eight orders and fifteen families, with Orthoptera, Hymenoptera, being the most prevalent, primarily found in terrestrial habitats, particularly bushy forests. The findings underscore the commercial and sustainable potential of edible insects in BTR, Assam. Leveraging these resources sustainably could significantly benefit the local economy and promote eco-sustainability in the region along with their health benefits.

Key-words: Entomophagy, Raimona National Park, edible insects, ethnic communities, eco-sustainability.

1. Introduction

Entomophagy, or the practice of consuming insects at various stages of life (larva, adult, pupa) for sustenance, has a long history in many cultures and food habits, with reports primarily from Africa, Asia, and Latin America (Bodenheimer, 1951). Over 2,000 insect

species from 18 orders are consumed worldwide (Mitsuhashi 2017). Palatability, taste, availability, nutritional value, food restrictions, local traditions, and religious conventions influence selection and preference of edible insects (Chakravorty *et al*. 2011). Insects are possible food sources that could reduce the high risk of food insecurity (Meyer-Rochow, 1975). Since insects are packed with several essential elements and biochemical components, these are crucial in terms of nutrition. These ingredients significantly increase the amount of nutrients consumed by groups that are at risk of malnutrition and undernourishment (Riggi *et al*., 2013). When compared to the cultivation of other animal protein sources, the farming of insects is more environmentally friendly and has a higher nutritional value (FAO, 2013). Eating edible insects has been shown to enhance the intake of vital nutrients, including lipids, unsaturated fatty acids, iron, zinc, and vitamins (thiamine and riboflavin), in addition to being a rich source of proteins. Studies showing a higher calorific value than most commonly used cereals and pulses, the majority of insects and their larvae contain more protein than equal amounts of meat and fish (Illegner and Nel, 2000; Paoletti *et al*., 2003; Kruse and Kwon, 2004; Banjo *et al*., 2006; Yhoung-Aree, 2010; Chakravorty *et al*., 2011, 2014). Because of this, scientists, business people, and decision-makers throughout the globe have been paying increasing attention to edible insects nowadays.

In India, entomophagy establishes a strong connection between harmonious coexistence of natural resources and biodiversity. But the scientific community of the nation has given less attention to investigate the traditional knowledge that the tribal community has acquired about eating edible insects. There is a pressing need to document and access this rich body of knowledge. About 255 distinct species of edible insects from various regions of India where tribes predominate were documented by Chakravorty *et al*. (2014). The consumption of insects has long been a part of the cultural traditions of the rural populations in North East India (Borgohain *et al*., 2014). The ethnic communities who inhabit north-eastern part of this country mostly depend on entomophagy to meet their nutritional needs. Every tribal community in the Bodoland Territorial Region (BTR) in Assam engages in a profusion of entomophagic behaviours. This region has four administrative districts viz. Kokrajhar, Chirang, Baksa and Udalguri and inhabitants are predominated by communities belonging to schedule tribe (ST) and schedule cast (SC), other backward caste (OBC). In this area, entomophagy is a very popular practice which is not solely practiced by tribal communities; but for non-tribal people also, it is a common habit. With a wealth of biodiversity, the territory is bordered by West Bengal, Bhutan, and Arunachal Pradesh. To date, reports from this region have included 25 species, spanning 8 orders and 17 families (Kalita *et al*., 2022). Raimona National Park is the 6th National Park of Assam which was

declared as national park by Indian Government on 9th June, 2021. Located on the Indo-Bhutan region of Kokrajhar district and spreading over an area of 422 sq. km., the park holds treasure of both aquatic and terrestrial flora and fauna, many of which are remain unexplored. Many tribal villages are located in the outskirts or within the periphery of this newly declared National Park. For the inhabitants of these villages, entomophagy is a popular practice. But till date, no study has been carried out that record the diversity of these edible insects and their usefulness. Therefore, this study aims to uncover the various species of edible insects consumed by tribal communities residing in villages within the vicinity of Raimona National Park.

2. Methodology

2.1. *Study Area*

The present study was conducted within Raimona National Park, Kokrajhar Assam for the period of one year from April, 2023 to April, 2024. Raimona National Park is located at latitude of $26^0 36' 00'' N$-$26^0 53' 00'' N$ and longitude of $89^0 54' 00'' E$-$90^0 24' 00'' E$ and shares its borders with the Indo-Bhutan international boundary to the North, the Sankosh River and the Assam-West Bengal interstate border to the West, the Saral Bhanga River to the East, and the Ripu Reserve Forest to the South. The park is characterized by its integration with the Himalayan foothills, Phibsoo Wildlife Sanctuary of Bhutan, and Buxa Tiger Reserve Forest of West Bengal and Assam, India.

2.2. *Selection of area and collection of data*

Ten villages were randomly selected within Raimona National Park, primarily located in the north-west direction and falling under three forest blocks: Athiabari Forest Range, Safan Forst Range, and Central Forest Range. Information on entomophagy was gathered through scheduled surveys conducted in 100 households within these villages. The majority of respondents belonged to the Bodo community, followed by the Santhal and Rabha communities. Additionally, three nearby markets; Jaleswari Bazar, Jalu Bazar, and Bhowraguri Bazar were surveyed to supplement our understanding of the variety of edible insects available.

2.3. *Site Identification for Insect Collection*

Based on the indigenous knowledge shared by respondents regarding the natural occurrence of edible insects, specific insect harvesting sites were identified within the villages. These

sites were categorized into swampy-pond areas, open fields, agricultural zones, and bushy-forest areas, facilitating the systematic collection of insects for further analysis.

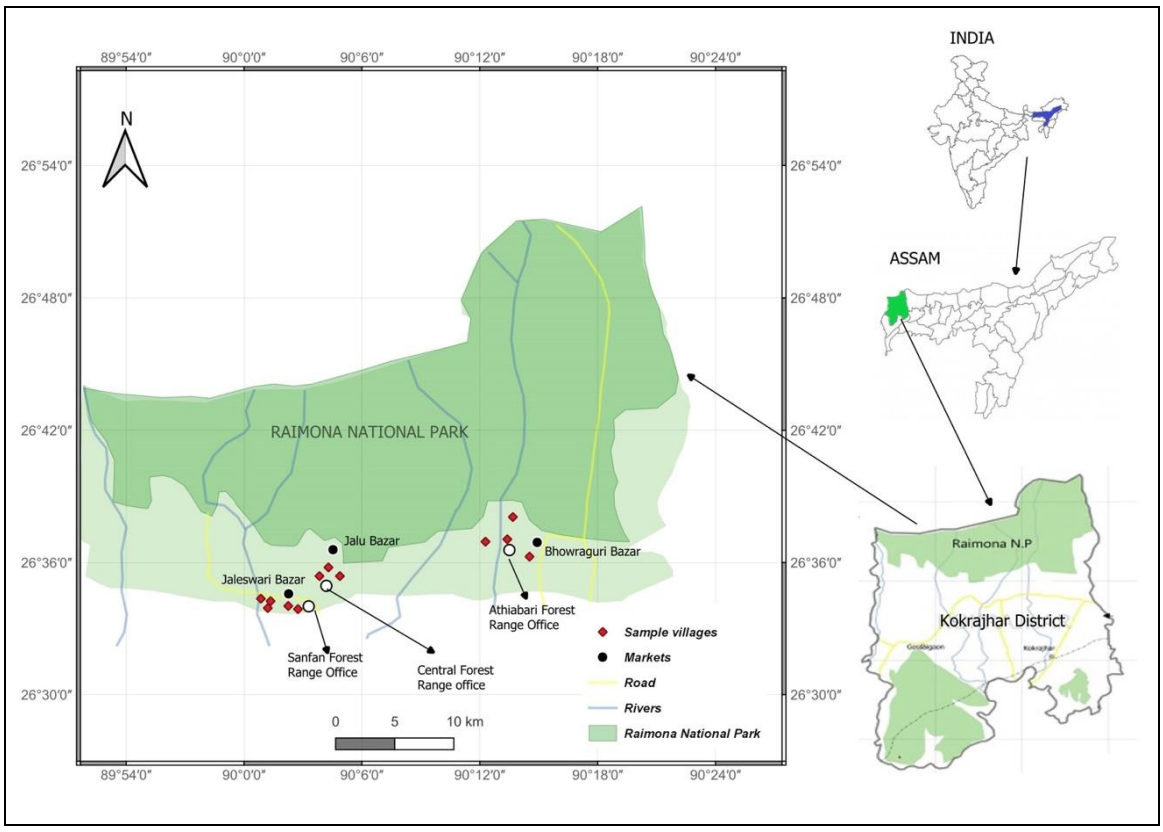


Figure 1: Maps of Kokrajhar district, Bodoland Territorial Region (BTR), Assam showing locations of Raimona National Park, selected forest blocks, sampled villages and markets.

2.4. *Collection, preservation and identification of edible insects*

Insects were collected from their natural habitats using various techniques. Terrestrial insects were collected using entomological nets, sweep nets, beating trays, water trays, spades for digging, and manual picking, as outlined by Musundire *et al.* (2014). Nocturnal insects were captured using light traps, following the method described by Kalita *et al.* (2022). Aquatic insects were collected using long-handled aquatic nets, kick nets, and traditional tools such as jakoi and chaloni. Additionally, nearby markets were visited twice a week during morning hours to gather further information on entomophagy. After collection, preservation of the insects was conducted using both dry and wet methods as described by Krogmann and Holstein (2010). The specimens were then identified and confirmed by comparison with specimens from the entomological museum at the Zoology Department of Barama College, Baksa, Assam, India. Some specimens were additionally identified with assistance from the Zoological Survey of India located in Shillong, Meghalaya, India.

3. Results

From scheduled surveys; the study recorded, 20 different species of edible insects belonging from 8 orders and 15 families (Table 1). Most of the species recorded were land-dwellers and predominates the sampled areas. Among the four collection sites; most of the edible insects were collected from bushy-forest areas followed by agricultural and open-field areas. Insects under order: orthoptera, hymenoptera, hemiptera and coleoptera predominates the total order-wise distribution within the sampled areas (Figure 2).

Table 1: Taxonomy and common English names of the collected edible insects

Sl. No.	Scientific Name	English Name	Order	Family
1	*Lethocerus indicus*	Giant water bug	Hemiptera	Belostomatidae
2	*Laccotrephes ruber*	Water scorpion	Hemiptera	Nepidae
3	*Diplonychus rusticus*	Water beetle	Hemiptera	Belostomatidae
4	*Oxya multidentate*	Short-horned grasshopper	Orthoptera	Acridae
5	*Altractomorpa crenulata*	Short-horned grasshopper	Orthoptera	Acridae
6	*Heiroglyphus banian*	Short-horned grasshopper	Orthoptera	Acridae
7	*Mecopoda elongate*	Long-horned grasshopper	Orthoptera	Tettigoniidae
8	*Gryllus bimaculatus*	Field cricket	Orthoptera	Gryllidae
9	*Acheta domesticus*	House cricket	Orthoptera	Gryllidae
10	*Gryllotalpa affricana*	Mole cricket	Orthoptera	Gryllotalpidae
11	*Hydrophilus olivaceus*	Water scavenger	Coleoptera	Hydrophilidae
12	*Oryctes rhinoceros*	Rhinoceros beetle	Coleoptera	Scarabaeidae
13	*Plectoderma scalator*	Wood borer	Coleoptera	Cerambycidae
14	*Microtermis obesi*	Termite	Isoptera	Termitidae
15	*Oecophylla smaragdina*	Weaver ant	Hymenoptera	Formicidae
16	*Vespa affinis*	Potter wasp	Hymenoptera	Vespidae
17	*Polistis olivaceus*	Paper wasp	Hymenoptera	Vespidae
18	*Apis indica*	Indian honey bee	Hymenoptera	Apidae
19	*Apis dorsata*	Rock bee	Hymenoptera	Apidae
20	*Ictinogomphus rapax*	Dragon fly	Odonata	Gomphidae

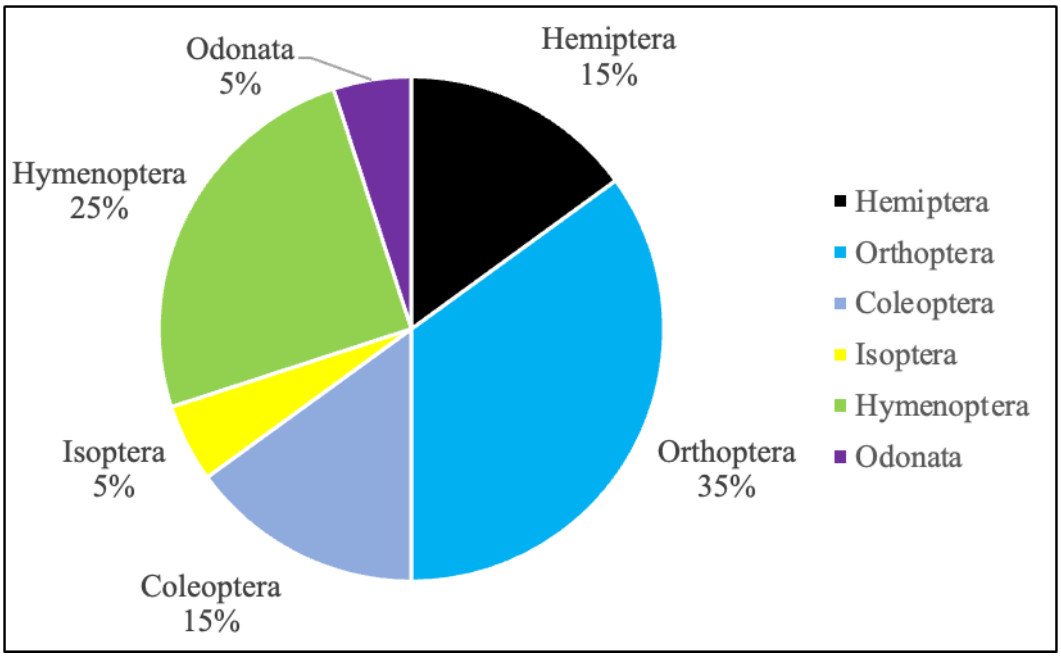


Figure 2: Order wise distribution of edible insect species

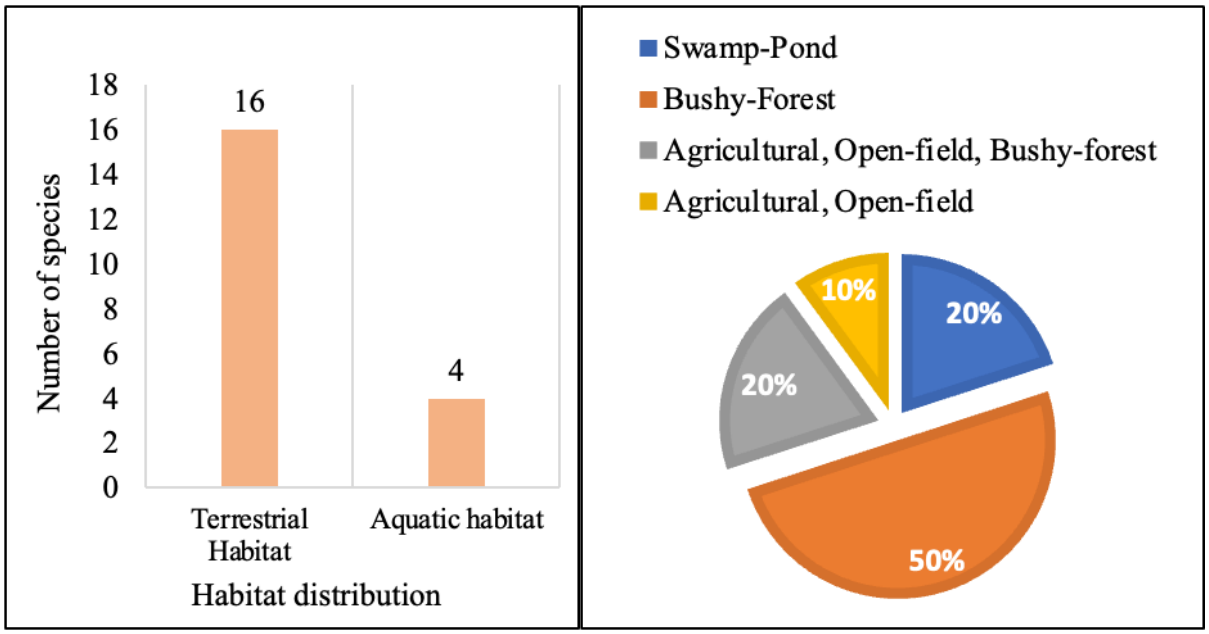
The findings indicated a diverse range of habitats, collection sites, seasonal availability, edible forms, and modes of consumption among the 20 recorded species of edible insects collected from various habitats in the sampled areas of Raimona National Park (Table 2). The majority of the species were terrestrial (16 species) rather than aquatic (4 species) (Figure 3a). Aquatic species viz. *Lethocerus indicus*, and *Hydrophilus olivaceus* were recoded to found in swamp-ponds throughout the year whereas other aquatic insects viz. *Laccotrephes ruber*, and *Diplonychus rusticus* were recorded prevalent in swamp-ponds (Figure 3b), throughout the year or specific seasons, primarily consumed as adults through frying or smoking. Terrestrial species recorded such as *Oxya multidentate*, *Altractomorpa crenulata*, and *Heiroglyphus banian* were abundant in agricultural areas, open-fields, and bushy forests from March to September, also consumed as adults by frying or smoking. Additionally, larvae of terrestrial species viz. *Oryctes rhinoceros*, *Plectoderma scalator*, and *Microtermis obesi* were found in bushy forests during particular seasons and consumed by frying. Various life stages of the collected insects including eggs, nymphs, and larvae were consumed in different forms, such as raw, roasted, or fried, depending on the species and seasonal availability.

Table 2: Habitat, collection site, seasonal availability, edible part and mode of consumption of the collected edible insects

Sl. No.	Scientific name	Habitat	Collection site	Seasonal availability	Edible form	Mode of consumption

1	*Lethocerus indicus*	Aquatic	Swamp-pond	Whole year	Adult	Fried, smoked
2	*Laccotrephes ruber*	Aquatic	Swamp-pond	June-October	Adult	Fried, smoked
3	*Diplonychus rusticus*	Aquatic	Swamp-pond	May-September	Adult	Fried, smoked
4	*Oxya multidentate*	Terrestrial	Agricultural; open-field; bushy-forest	March-September	Adult	Fried, smoked
5	*Altractomorpa crenulata*	Terrestrial	Agricultural, open-field, bushy-forest	March-September	Adult	Fried, smoked
6	*Heiroglyphus banian*	Terrestrial	Agricultural, open-field, bushy-forest	March-September	Adult	Fried, smoked
7	*Mecopoda elongate*	Terrestrial	Agricultural, open-field, bushy-forest	March-September	Adult	Fried, smoked
8	*Gryllus bimaculatus*	Terrestrial	Agricultural, open-field	May-September	Adult	Fried, smoked
9	*Acheta domesticus*	Terrestrial	Agricultural, open-field	May-September	Adult	Fried, smoked
10	*Gryllotalpa affricana*	Terrestrial	Bushy-forest	Whole year	Adult	Fried, smoked
11	*Hydrophilus olivaceus*	Aquatic	Swamp-pond	Whole year	Larva and adult	Fried, smoked
12	*Oryctes rhinoceros*	Terrestrial	Bushy-forest	September-February	Larva	Fried
13	*Plectoderma scalator*	Terrestrial	Bushy-forest	May-August	Larva	Fried
14	*Microtermis obesi*	Terrestrial	Bushy-forest	March-July	Larva, adult	Fried
15	*Oecophylla*	Terrestrial	Bushy-forest	March-	Eggs	Fried

	smaragdina			August		
16	*Ictinogomphus rapax*	Terrestrial	Bushy-forest	Mar-August	Nymph	Fried
17	*Vespa affinis*	Terrestrial	Bushy-forest	April-October	Egg and larva	Raw, roasted, fried
18	*Polistis olivaceus*	Terrestrial	Bushy-forest	April-October	Egg and larva	Raw, roasted, smoked
19	*Apis indica*	Terrestrial	Bushy-forest	May-September	Egg and larva	Raw, fried
20	*Apis dorsata*	Terrestrial	Bushy-forest	May-September	Egg and larva	Raw, fried



a. b.

Figure 3: Distribution of habitats and collection sites among twenty recorded edible insect species (a & b).

4. Discussion

In this study the record and identification of twenty different species of edible insects provided valuable insights into the diversity of entomophagy found in several tribal

populations residing within different sampled villages of Raimona National Park. To fully comprehend the practice of entomophagy and its significance, it is worthwhile to investigate the relationship between traditional knowledge and the consumption of naturally obtained insects by tribal communities. In addition to meeting dietary needs, entomophagy offers a means of generating revenue for members of marginalized societies (Mozhui *et al*., 2020). Tribal communities and natural resources constantly coexist in a unique way that encourages consumers to embrace conservation measures for these resources and allows for the successful use of natural resources. It does, in fact, strongly promote environmental sustainability. Conventional wisdom consistently advocates for the prudent and secure use of natural resources, their preservation, and the enhancement of human-resource interactions. When it comes to the utilization of natural resources, the ease of access to nutrient-rich food sources, natural harvesting, income production, and commercialization, entomophagy also benefits various ethnic populations. Customers are prompted by this to embrace management techniques for the protection and preservation of these tasty insects. Many researchers around the world have already evaluated and documented the nutritional composition of numerous edible insects in relation to their potential health benefits. These studies highlight various edible insects as excellent providers of micronutrients like Fe, Mg, Zn, P, and Ca as well as vitamins, proteins, carbs, lipids, antioxidants and fibre. (Finke, 2002; Bukkens, 2005; Ganguly *et al.*, 2013; Huis, 2013; Ghosh *et al.*, 2016; Sarmah *et al.*, 2022; Kalita *et al.*, 2022; Kashyap *et al*., 2023; Das *et al*., 2023). Beyond serving as substitutes for traditional food sources, entomophagic insects also hold significant commercial value. Individuals from underprivileged communities may find financial support through this avenue, thereby strengthening their economic foundations. This contributes to the development of food tourism plans by policymakers and entrepreneurs. Throughout the data collection process, the majority of the documented species were found to be sold in marketplaces, both in fresh and dry forms, at varying prices. Remarkably, these markets attract large numbers of visitors eager to learn about and explore the entomophagic customs of various ethnic groups. During the study, numerous visitors to Raimona National Park were observed browsing these markets and sampling foods made with these insects. The study revealed that the majority of species found in the markets were sold for prices ranging between 60 and 80 INR/KG for grasshopper and cricket species, and between 100 and 150 INR/KG for *Lethocerus indicus, Laccotrephes ruber, Diplonychus rusticus, Hydrophilus olivaceus, Oxya multidentate, Altractomorpa crenulate, Heiroglyphus banian, Mecopoda elongate, Gryllus bimaculatus, Acheta domesticus,* and *Gryllotalpa affricana*. Products including pickles, honey made from bee hives, and compost made from insects were also offered in the marketplaces that were

sampled. All of them point to the potential for edible insects as a commodity, their nutritional value, and the development of an eco-sustainability paradigm.

In the Bodoland Territorial Region (BTR), entomophagy is a prevalent practice among the local populations. The findings of present study offer a preliminary insight into the variety of edible insects consumed by ethnic communities residing in the sampled villages of Raimona National Park. A total of twenty species, representing eight orders and fifteen families, were documented in the study. Our findings are supported by the earlier report of Narzary and Sarmah (2015) who investigated the entomophagic behaviours of the Bodo population in Assam and identified 25 different species of edible insects across 8 orders and 14 families. These findings have shaded light on the cultural heritage of the Bodo community and their tradition of insect consumption practices. Similarly, Das *et al*. (2020) conducted a study on the entomophagic attributes and diversity of edible insects within ethnic groups in Manas National Park, BTR, Assam revealing 22 species from various families including Coleoptera, Odonata, Mantodea, Hymenoptera, Hemiptera, Lepidoptera, Blattodea, and Orthoptera. Another study by Das *et al*. (2021) reported 31 species of aquatic edible insects from the Baksa district of the BTR region, Assam. Similarly, Kalita *et al*. (2022) documented 25 edible species of insects belonging to 9 orders and 18 families from the BTR region of Assam. Their results also align with the present findings on dominance of the Orthoptera order, followed by the Hymenoptera and Hemiptera orders. These reports collectively indicate the active involvement of ethnic communities of BTR regions in entomophagy practices, underscoring their economic and sustainability implications. The similarities between the findings of the current study and those of previous research confirm the abundance and diversity of edible insects within Raimona National Park's range, emphasizing the need for comprehensive scientific investigations into their distribution, abundance, and nutritional significance.

5. Conclusion

National parks and sanctuaries are rich repositories of biodiversity, housing a diverse array of flora and fauna, each species intricately woven into the fabric of ecosystem dynamics. With many of these species serving as crucial food sources for human populations, the role of insects in the food chain is particularly noteworthy, given their significant contribution. Across civilizations, insects have been revered for their nutritional and energetic benefits, emerging as valuable food resources. This present study meticulously documented various species of edible insects consumed by a sizable population of different tribal community

within Raimona National Park, elucidating their habitats, seasonal availability, and consumption patterns. Furthermore, it highlighted the commercial importance and accessibility of these species through traditional harvesting methods, thereby enhancing sustainability and making them more accessible to other populations. However, constraints in chemical and analytical evaluation pose challenges in assessing their nutritional composition and potential health impacts on local consumers. While this study offers foundational insights into the edible insect variety within Raimona National Park, further research is imperative to guide commercial, conservation, and management strategies by comprehensively understanding the distribution, abundance, and biochemical makeup of edible insects.

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References

Banjo, A. D., Lawal, O. A., Songonuga, E. A. (2006). The nutritional value of fourteen species of edible insects in southwestern Nigeria. *African Journal of Biotechnology*, 5(3): 298-301.

Bodenheimer, F. S. (1951). Insects as human food; a chapter of the ecology of man. Dr. W. *Junk Publishers. The Hague, the Netherlands*, 352.

Borgohain, M., Borkotoki, A., Mahanta, R. (2014). Total lipid, triglyceride and cholesterol contents in *Oecophylla smaragdina* (Fabricius) consumed in upper Assam of North East India. *International Journal of Scientific and Research Publications*, 4(7): 455.

Bukkens, S. G. F. (2005). Insects in the human diet: nutritional aspects. In: Paoletti, M. G. (ed.) Ecological implications of mini livestock: role of rodents, frogs, snails and insects for sustainabkle development. *CRC Press, Boca Raton, FL, USA*: 545-577.

Chakraborty, J., Ghosh, S., meyer-Rochow, V. B. (2011). Practices of entomophagy and entomotherapy by members of the Nyishi and Galo tribes, two ethnic groups of the state of Arunachal Pradesh (North-East India). *Journal of Ethnobiology and Ethnomedicine*, 7(1): 5.

Chakravorty, J., Ghosh, S., Meyer-Rochow, V. B. (2014). Nutritional composition of *Chondacris rosea* (De Geer, 1773) and *Brachytrupes orientalis* (Burmeister, 1883): two common insects used as food by tribes of Arunchal Pradesh, India. *Journal of Asia-Paciific Entomology*, 17(3): 407-415.

Das, K. J. (2021). Entomophagy, a way of food sustainability amongst the tribal people in Baksa district, Assam, India. *International Journal of Creative research Thoughts (IJCRT)*, 9(11): 251-263.

Das, K. J., Hazarika, K. A., Kalita, U., Khanna, S., Kalita, T., Choudhury, S. (2020). Diversity of edible insects in a natural world heritage site of India: entomophagy attitudes and implications for food security in the region. *Peer J*: 1-20.

Das, K. J., Kashyap, R. R., Mwchahary, H. (2023). Exploring the nutritional potential of *Microtermes obesi* consumed by the ethnic communities of Baksa district, Assam, India. *Uttar Pradesh Journal of Zoology*, 44(16): 115-123.

Finke, M. D. (2002). Complete nutrient composition of commercially raised invertebrates used as food for insectivores. Zoo Biology, 21: 269-285.

Food and Agricultural Organization of the United Nations (FAO). (2013). Edible Insects: future prospects for food and feed security. *FAO forestry paper*, 171. FAO, Rome, Italy.

Ganguly, A., Chakravorty, R., Das, M., Guota, M., Mandal, D. K., Halder, P., Ramos-Elorduy, Moreno, J. M. P. (2013). A preliminary study on the estimation of nutrients and anti-nutrients in *Oedaleus abruptus* (Thunberg) (Orthoptera: Arcididae). *International Journal of Nutrition and Metabolsim*, 5(3): 50-56.

Ghosh, S., Halder, P., Mandal, D. K. (2016). Evaluation of nutrient quality of a short-horned grasshopper, *Oxya hyla hyla* Serville (Orthoptera: Acrididae), in search of new protein source. *Journal of Entomology and Zoology Studies*, 4(1): 193-197.

Huis Van, A. (2013). Potential of insects as food and feed in assuring food security. Annual Review of Entomology, 58: 563-583.

Illgner, P., Nel, E. (2000). The geography of edible insects in Sub-Saharan Africa: a study of the mopane caterpillar. *The Geographical Journal*, 166(4): 336-351.

Kashyap, R. R., Das, K. J., Mwchahary, H. (2023). Antioxidant properties of *Gryllus bimaculatus*: A promising alternative nutrient source for animal feed. *International Journal of Entomology Research*, 8(7): 58-61.

Krogmann, L., Holstein, J. (2010). Preserving and specimen handling: insects and other invertebrates. In: Eymann, J., Degreef, J., Hauser, C., Monje, J. C., Samyn, Y., Vanden Spiegel, D. (eds.) Manual on field recording techniques and protocols for all taxa biodiversity inventories. *Belgian Development Cooperation, Brussels, Belgium*: 463-481.

Kruse, M., Kwon, C. (2004). Edible insects, importance source of protein in Central Africa. *FAO Newsroom, FAO, Rome, Italy*.

Meyer-Rochow, V. B. (1975). Can insects help to ease the problem of world food shortage. *Search*, 6(7): 261-262.

Mitsuhashi, J. (2017). Edible insects of the world. CRC press, Boca Raton, FL, USA.

Mozhui, L., Kakati, L. N., Kiewhuo, P., Changkija, S. (2020). Traditional knowledge of the utilization of edible insects in Nagaland, North-East India. *Foods*, 9: 852.

Musundire, R., Zvidzai, C. J., Chidewe, C., Samende, B. K., Manditsera, F. A. (2014). Nutrient and anti-nutrient composition of *Henicus whellani* (Orthoptera:Stenopelmatidae), an edible gorund cricket, in south-eastern Zimbabwe. *International Journal of Tropical Insects Science*, 34(4): 223-231.

Narzary, S., Sarmah, J. (2015). A study on the prevalence of entomophagy among the Bodos of Assam. *Journal of Entomology and Zoological Studies*, 3(2): 315-320.

Paoletti, M. G., Buscardo, E., Vanderjagt, D. J., Pestuszyn, A., Pizzoferrato, L., Huang, Y. S., Chuang, L. T., Glew, R. H., Millson, M., Cerda, H. (2003). Nutrient contents of termites (*Syntermes soldiers*) consumed by Makiritare Amerindians of the Alto Orinoco of Venezuela. *Ecology of Food and Nutrition*, 42: 177-191.

Riggi, L. G., Veronesi, M., Verspoor, R., MacFArlane, C. (2013). Exploring entomophagy in Northern Benin-practices, perceptions and possibilities. *Bugs for life, London, UK*: 40.

Sarmah, M., Bhattacharyya, B., Bhagawati, S., Sarmah, K. (2022). Nutritional composition of some commonly available aquatic edible insects of Assam, India. *Insects*, 13: 1-10.

Yhoung-Aree, J. (2010). Edible insects in Thailand: nutritional values and health concerns. In: Durst, P. B., Johnson, D. V., Leslie, R. N., Shono, K. (eds.) Edible Forest insects: humans bite back! *FAO regional office for Asia and the Pacific, Bangkok, Thailand*: 201-216.