CHAPTER 1

INTRODUCTION

India is famed for its rich biodiversity and significant number of endemic species. It hosts four of the world's 36 biodiversity hotspots, namely Western Ghats, Eastern Himalayas, Indo-Burma region and Sundaland (Nicobar Islands) (Myers et al., 2000; CEPF Eastern Himalaya; CEPF Sundaland). The Northeasten region of India, which includes the Assam state of India, is rich in biodiversity due to its unique geographical and climatic conditions. Assam, being located in the Indo-Burma biodiversity hotspot boasts a wide range of ecosystems, including tropical rainforests, grassland and wetlands, and is home to numerous endemic species (Assam State Biodiversity Board). India is home to 1993 species of spiders belonging to 504 genera in 62 families of the total known 52,168 species all over the worlds (Caleb and Sankaran, 2024). However, specific data on the present biodiversity status of spiders in Northeast India including Assam is lacking. Numerous undiscovered species awaits identification in the region. Despite their numbers and ecological importance, they are not captivating to researchers as compared to other charistmatic or ecologically important species. The comparative lack of beauty, particularly the Araneae (spiders) and varied habits of spiders contributes to the limited interest, notably limited attention within Zoological Research community (Cambridge, 1869; Stoliczka, 1869).

The field of systematics involves three major elements: biodiversity exploration (inventory); taxonomic discovery and description (taxonomy); and the estimation of phylogenetic relationships among these species (phylogeny) (Agnarsson et al. 2013). Taxonomy is a subdivision of systematics which consists of three associated activities namely identification (referring a specimen to a previously classified and named group), classification (ordering organisms into groups based on perceived similarities or differences), and nomenclature (naming groups of organisms conferring to guidelines

established for the process) (Caleb, 2015). It is the most science of all biological disciplines which requires an integrative approach where scientist benefit by working collaboratively to synthesize the results of data derived from morphology, behaviour, bioacoustics, ecology, geography, molecules, chemistry, history and other diverse fields of inquiry (Engel et al., 2021).

Taxonomic impediment refers to the knowledge gaps in our taxonomic system, the shortage of trained taxonomists and curators, and the impact these deficiencies have on our ability to conserve, use and share the benefits of our biological diversity (Secretariat of the Convention on Biological Diversity). Biodiversity loss is a major threat to planetary health and halting the loss requires that the basic building blocks of biodiversity are known, so that changes can be recorded, drivers of change can be identified and appropriate policy actions can be implemented (Srivathsan et al., 2023). The key drivers affecting the loss of biodiversity worldwide are: habitat destruction and fragmentation, land use changes, overexploitation, invasive alien species (Schultheiss et al., 2022; Beheregaray and Caccone, 2007). Many species are disappearing before being discovered which poses a threat to global biodiversity. With the development of biodiversity crisis, it is now doubtless that a large part of these species will become extinct in the current and coming decades due to anthropogenic activities which puts taxonomic urgency at the top priority list for biological sciences in our century of extinctions (Engel et al., 2021). Taxonomic practice develops more slowly, however there is recent progress by adopting novel tools i.e., use of molecular data for species identification, improved methods of imaging and georeferencing images, computer databasing and geo referencing of specimens, cyber informatics, collection, digitization and linking of distribution data to public databases such as Global Biodiversity Informatics Facility (Agnarsson et al., 2013).

Much of the large and charismatic animals have been described, however the majority of less charismatic species i.e., insects and spiders are yet to be discovered. Birds and mammals are well described globally, but much larger gaps for almost all invertebrate

groups (Corlett, 2020). Taxonomic neglect tends to increase with diversity and decrease with body size (Srivathsan et al., 2023). It is estimated that only 10% vertebrates remain to be described, but greater than 50% of terrestrial arthropods are undescribed (Secretariat of the Convention on Biological Diversity). More than 80% of described eukaryotic species on earth are invertebrates, affecting many ecosystem functions and services and provide extensive benefits to human societies (Schultheiss et al., 2022). Spiders are ranked seventh in total known species of all orders of animals. They are the most diverse predatory order in the arthropod world and despite being major diverse groups of organisms on earth, spiders have largely been ignored because of the human tendency to favor some organisms over the others of equal importance because they lack universal appeal (Sebastian et al., 2012). Systemic documentation is necessary to conserve these natural pest regulating factors for maintaining ecosystem sustainability and conservation of biodiversity (Smitha and Sudhikumar, 2020). With well over 51,000 accepted species (World Spider Catalog, 2024), all experts agree that we have not yet discovered even half of extant spider species (Agnarsson et al., 2013). According to Wilson (1987) when we scoop up a double handful of earth almost anywhere except the most barren deserts we will find thousands of invertebrate animals where biology of most of the species is unknown. Knowledge on the distribution and abundance of organisms is fundamental to understanding their roles within ecosystems and their ecological importance for other taxa (Schultheiss et al., 2022). Priorities for improving protection of biodiversity include: improving the inventory with surveys focussed on geographical areas and taxonomic groups which are under collected (Corlett, 2020). The need in time is to discover and describe species prior to their extinction due to loss of habitat and climate change. The discovery of spiders has been accelerating for the last 60 years (Agnarsson et al., 2013) and this acceleration is due both due to discovery of new forms in nature and increase in productivity of active systemic aranelogists (Agnarsson et al., 2013).

Spiders being a hyper diverse group of predator habits both in natural and agricultural communities preying on varieties of insects, thus playing an important role in

biological control. They are the most abundant predator group in terrestrial ecosystems all over the world (Arias, 2014). They inhabit grassy areas, forest floors, meadows, benetath rocks and branches, shrub bases, within deserted rodent tunnels, and within soil cracks and crevices (Weeks and Holtzer, 2000). Spiders are generalist predators that inhabit nearly all environments and are quite abundant and diverse in the natural system, developing a great variety of life histories, behaviour and morphologic, physiological and ecological adaptations (Jiménez-Valverde and Lobo, 2007). They occupy intermediate positions in food webs and are involved in intraguild interactions with other arthropod and vertebrate predators (Arias, 2014). A total of eight guild types i.e., (1) sensing web weavers, (2) Sheet web weavers, (3) space web weavers, (4) orb web weavers, (5) specialists, (6) ambush hunters, (7) ground hunters and (8) other hunters is differentiated in spiders based on foraging strategy (type of web and method of active hunting), prey range (either stenophagous or euryphagous), vertical stratification (ground or vegetation) and circadian activity (diurnal or nocturnal) (Cardoso et al., 2011). Studying ecological guilds can be useful to investigate assemblage response to climate change, habitat disturbance, management among many other areas (Cardoso et al., 2011).

Spiders have an important role in ecosystem functioning (Kralj-Fiser and Gregoric, 2019). Being a generalist predator, they play a role in the biological control of pests as part of a multi species assemblage as well as together with other predatory arthropods (Arias, 2014). They serve as buffers that limit the exponential growth of pest populations in various ecosystems by virtue of their predatory potency (Sankari and Thiyagesan, 2010). Spiders are also used as ecological indicator species for environmental monitoring (Tyagi et al., 2021). Because of spiders' sensitivity to environmental changes and human disturbances this predatory group can be a valuable bioindicator. Being highly diverse and abundant predators, spiders are important regulators of terrestrial arthropod populations and may prove to be useful indicators of the overall species richness and health of terrestrial communities (Aiken and Coyle 2000). Spiders are highly responsive to environmental changes, and their reliance on habitat structure plays a significant role in defining their

assemblage composition leading to a greater structural diversity involving ecological niche diversification facilitating the coexistence of different groups of spiders (Rosas-Ramos et al., 2020). The "habitat heterogeneity" hypothesis is an essential principle of ecology where it is presumed that structurally complex ecosystems could provide more niches and different ways of utilizing environmental resources, hence increasing diversity of species (Tews et al., 20004; Bazzaz, 1975). Habitat structure and vegetation complexity has been consistently recognised as one of the most important factors in determining the presence of spider species as well as their species richness and composition because of their relationship with vegetation structure (Jiménez-Valverde and Lobo, 2007).

Spiders are the main arthropods predators in many biomes and habitat types as such they ought to be a good indicator taxon to reflect ecological change and in addition they have already been suggested to be an ideal group for predicting extinction debt in other taxa due to habitat destruction (Cardoso et al., 2011). "The little things that run the world" is how eminent biologist Edward O. Wilson encapsulated the ecological importance of insects and other vertebrates (Schultheiss et al., 2022).

Compared to other regions of India, the understanding of spider diversity and distribution in Northeast India is limited. The current study was conducted in the Jharbari Forest Range of Chirang Reserve Forest, Kokrajhar, Assam, India, prompted by the absence of prior studies conducted on spiders in this particular area. Chirang Reserve Forest is one of the oldest reserve forests located in the western part of Assam constituted on 20th November 1875 (Bhattacharjee et al., 2014). The area falls under Haltugaon Forest Division bounded on the north by an international boundary with Bhutan, on the south by the river Brahmaputra, on the east by the river Bhur and on the west by the river Saralbhanga (Das et al. 2013). The forest type of the reserve can be divided into Sal Forest, evergreen and semi-evergreen forest, deciduous forest, savannah/grassland, and riverine forest (Bhattacharjee et al. 2014). It is home to many threatened plant species of Assam (Bhattacharjee et al. 2014), and homes the rare and endangered Golden langur.

This study aims to explore the diversity and status of spiders within the Jharbari Forest Range. As the first comprehensive assessment of the spider fauna in Chirang Reserve Forest, it will provide valuable insights into the region's spider diversity and contribute to their conservation efforts. The fragile ecosystem of the Chirang Reserve Forest is undergoing rapid degradation and fragmentation of wildlife habitat with an increase in human encroachment, illegal feeling of trees, extensive livestock grazing, and poaching for bushmeat. In the past years due to socio-political situation and insurgency problems majority of the areas of Chirang Reserve Forest have been degraded (Bhattacharjee et al., 2014). Large scale slaughtering of trees and encroachment during the last 10 years has shaken the very existence of the reserve forest (Bhattacharjee et al., 2014).

Most of the information available for this reserve forest pertains to flora and mammals and insects (Basumatary and Sarma, 2004; Bhattacharjee et al., 2014; Bhattacharjeee et al. 2015; Das et al. 2008; Dutta and Sharma, 2013; Basumatary, 2023; Choudhury, 2002; Lahkar et al., 2006; Nath et al., 2008; Choudhury, 2014). The study on invertebrate fauna were confined to Lepidoptera, until recently new species discovery and new country record of spiders were reported from the reserve forest viz., Basumatary et al. 2018a, b; Basumatary et al. 2019; Basumatary and Brahma, 2019a, b; Basumatary et al. 2020a, b, c; Basumatary et al. 2021; Basumatary and Brahma, 2021.

Given the scarcity of data on spiders and their vulnerability, it is crucial to include them in conservation planning efforts. Exploring spider diversity is important for comprehensive development of a database which is essential in the formulation of conservation strategies. Therefore, the current study aims to access the diversity and abundance of spiders in the Jharbari Forest Range of Chirang Reserve Forest, contributing to conservation intiatives in the region.

The present work aims to:

1. To know the overall status of spiders in the Jharbari Forest Range.
2. To prepare a checklist of spiders from the Jharbari Forest Range.
3. To study the abundance of spiders along with seasonal variation.
4. To study the diversity and guild types of spiders in different microhabitats.
5. To study the perception of the local community towards spiders on fringe villages of Jharbari Forest Range.