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***Research Article** (Open Access)*

HUNTSMAN SPIDER AS A NATURAL CONTROL FOR CRICKETS WITH ADDED REPORT OF PREDATION ON MOLE CRICKET FROM NORTHEAST, INDIA

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ABSTRACT
The present study was focused on the review of predation of crickets by huntsman spiders with a report from Namsai, Arunachal Pradesh. A total of 15 reports across 5 continents have been found during the course of review. The genus Heteropoda was involved in 46% of the total reports and possibly has the highest potential as natural control. Huntsman spiders' diet consists of a variety of invertebrates and small vertebrates making them an important natural control for a wide range of pests. Previous records on predation of crickets are poorly documented and inadequate for analysis. The present study is an effort towards understanding cricket predation by huntsman spider. Crickets are a nuisance to agriculture and pose significant threat to economy. The existing control methods involving chemical pesticides are mostly ineffective or expensive; therefore, a need to consider natural control arises. The present report also highlights the adaptations of the huntsman spider in human settlements and weighs their potential as natural control for controlling cricket pests.

Keywords: *Huntsman spider, Heteropoda, Invertebrates, Predation, Adaptation, Arunachal Pradesh*

INTRODUCTION
Huntsman spiders (Araneae: Sparassidae) consists of 1,467 species belonging to 97 genera (World Spider Catalog, 2023). They are the eleventh most diverse family in the order Araneae. These spiders are known for their generalist predatory behaviour. According to a study solely focused on the diet of huntsman spider, these spiders may be generalist predators but the diet composition is far from similar; even between same species from different regions. Many factors such as availability of prey and vulnerability played a role in their diets. The study on the diet of huntsman spider showed that about 2% of the total prey belonged to orthoptera (Henschel, 1994).The diet of these predators may include cockroaches, ants, flies, moths as well as mealybugs and aphid colonies (Ntonifor *et al.,* 2012).
Spiders in general are reputed killers of pests (invertebrates and vertebrates) with an estimated 400-800 million prey kills per year (Nyffeler, 2017). Their significance as an agent for control of pests is well established. Their diet mainly but not exclusively includes small invertebrates. Occasionally they also feed on smaller vertebrates such as bats (Nyffeler & Knörnschild, 2013), stick insects (Soutinho *et al.,* 2018), geckos (Neogi & Islam, 2017; Vyas, 2012), frogs(Nyffeler & Altig, 2020) and birds (Valdez, 2020).
The huntsman group is of great interest to researchers for their wide range of diet. Although the interaction between crickets and spiders is not very common as the former tends to evade upon receiving chemical or visual cues (Bucher *et al.,* 2014). The interactions between huntsman spider and cricket are scarcely documented in published scientific literatures and the literatures found during review were quite old. This study sheds light on such interactions and highlights the potential of huntsman spider in minimising damage done by crickets to the agriculture sector.
Crickets are well documented pests of a variety of agricultural crops both in earlier (Bünzli and Büttike, 1955) and recent times (Moursey *et al.,* 2022; Tudu *et al.,* 2019). They are mostly harmful to agriculture

or simply nuisance to farmers as they feed on plant matter (shoot, root, fruits and leaves). Few studies suggest not all crickets are harmful.Predation of *Lolium multiflorum*by crickets has shown promising results in the prevention of the non-native weed species (Ichihara *et al.,* 2012). Their role in preventing the spread of other invasive weed species is yet not clear. They can also serve as an alternative source of human nutrition globally (Murugu *et al.,* 2021).Cricket predation is not only limited to the Sparassidae family; studies in a laboratory setup revealed theirconsumption by *Pisaura mirabilis*of Araneae family (Bucher *et al.,* 2014).Similar incidents were also observed in Lycosidae and Thomicidae families. However, the sources of these observations were videos and pictures on the internet and their locations could not be verified.

MATERIALS AND METHODS

An extensive literature review was conducted in order to find relevant information available on natural control of crickets by huntsman spiders as well as their predation on cricket. The search was based largely on the Thomson-Reuters database (Web of Science), Google Scholar, Sodhganga: a reservoir of Indian thesis,ProQuest Dissertations & Theses, Open Access Theses and Dissertations, Flickr image-hosting website (hosting more than ten billion images) and similar image hosting websites. Additionally, an internet search for articles and blogs on this topic was conducted. Bloggers who had posted photographs and reports on huntsman spider eating cricket on the internet were contacted to get additional information on their observations.

RESULTS

During the course of review, a total of 14 incidents were found with an addition of one personal observation. The reports are spread across 5 continents (except Europe and Antarctica), indicating the worldwide distribution of the huntsman spiders and ranges from year 1986 to 2022. It was observed that spiders belonging to 4 genera fed upon crickets which belonged to 6 different families (Table 1). Also, the genus Heteropoda was observed in 7 out of the 15 studied reports.

Figure 1: Adult *H. venatoria* with a freshly caught mole cricket.

The present observation was recorded in Namsai district of Arunachal Pradesh, India (latitude: 27.645716, longitude: 95.871094). At around 19:00 hours, the adult *Heteropoda venatoria* was waiting motionlessly on a wall, carefully concealing itself from the eyes of its prey, the mole cricket, which was attracted by the light inside the room. The mole cricket landed about 1 meter away from the spider on the same wall. The spider waited for the prey to come within 10 cm of its proximity before swiftly jumping and digging its fangs on the prey just below the head. The prey was immobilised most likely due to the injected venom and was devouring began immediately.

Table 1: Reports of cricket predation by huntsman spider across the world.

Predator (Spider taxon)	**Pest (Cricket taxon)**		**Type of pest**	**Country and Year**	**Source**	**Report no.**
	Species	**Family**				
Heteropoda sp.	*Acheta sp.*	Gryllidae	Crop and storage pest	Australia, 2017	National Geography blog	#1
Heteropoda sp.	*Diestrammena sp.*	Rhaphidophoridae	Members of the family are pests of green house plants	Malaysia, 2016	Chien Lee, Flickr website	#2
Heteropoda sp.	*Burgilis sp.*	Tettigoniidae	Members of this family known to be important pest of agricultural crops	Argentina, 2011	Joaquin Lopez Pereyra, Flickr website, Pers. Comm.**	#3
Heteropodaboiei	Unidentified[#]	Gryllidae	Members of the family are crop and storage pest	Malaysia, 2012	Kurt G, Flickr website, Pers. Comm.**	#4
Heteropodaboiei	*Typophyllummortuifolium*	Tettigoniidae	Members of the family known to infest sorghum	Brazil, 2018	Francesco Tomasinelli,ScienceSource website	#5
Heteropodadavid	*Nisitrus sp.*	Tettigoniidae	N/A*	Malaysia,	Orionmystery,	#6

bowie				2012	Blog	
Heteropodavenatoria	*Gryllotalpa sp.*	Gryllotalpidae	Important pest of potato, sugar beet and vegetables	India, 2021	Personal Observation	#7
Isopedella sp.	*Acheta sp.*	Gryllidae	Crop and storage pest	Australia, 2022	Winton Night, Youtube, Pers. Comm.**	#8
Leucorchestris sp.	*Brachytrupesmembranaceus*	Gryllidae	Emerging pest for tobacco	Namibia, 1986	Henschel, 1994	#9
Leucorchestris sp.	*Comicus sp.*	Schizodactylidae	N/A*	Namibia, 1986	Henschel, 1994	#10
Leucorchestris sp.	*Acanthoproctus sp.*	Tettigoniidae	Important pest of agricultural crops	Namibia, 1986	Henschel, 1994	#11
Sparassidae	*Gryllodes sp.*	Gryllidae	Common house pest	USA, 2013	Tammy Yee, Flickr website	#12
Thelcticopis sp.	*Gryllacris sp.*	Gryllacrididae	N/A*	Malaysia, 2012	Orionmystery, Blog	#13
Thelcticopis sp.	*Macroxiphussumatranus*	Tettigoniidae	N/A*	Malaysia, 2012	Orionmystery, Blog	#14
Thelcticopisorichalcea	*Borneogryllacrisborneoensis*	Gryllacrididae	N/A*	Malaysia, 2014	Antonsrkn, Flickr website	#15

***No available data on pest status **Personal communication #Devoured beyond Identification*

DISCUSSION

The huntsman spider has proved to be successful for biological control of cockroaches and houseflies(Ahmed *et al.*, 2014) as well as brown planthoppers (Karthikeyani & Kannan, 2012). It is also important to discuss the different reasons that might prove as limiting factor while using huntsman spider as control. Prey sharing among the huntsman spider is about 27%, which is not significant (Auletta & Rayor, 2011); therefore, it may be safe to assume that a larger population will not be sustainable in a small field. More over crickets have previously shown recognition for different species of predatory spiders (Binz *et al.*, 2014) as well as sex based response to chemicals from predators (Tanis *et al.*, 2018) which shows their remarkable adaptability. Further long-term studies are required to assess these observations and establish a suitable population size of *H. venatoria* per unit square.

There are other natural control for crickets that have previously worked; Mole crickets have been controlled successfully using *Steinerne mascapterisci* (Nematode) and *Larra bicolor* (parasitic wasp) in Florida and Puerto Rico (Leppla *et al.*, 2007). A comparative study is lacking stating the efficiency of

these control agents. Furthermore, there are reports of spiders eating organisms like frogs and birds (Valdez, 2020), (Quah *et al.*, 2022) which also need to be considered because uncontrolled population of these predators might be troublesome for native species.

It was observed that 7 out of the 15 incidents involved Heteropoda, probably due to their abundance in human habitation (Ahmed *et al.,* 2014). Thus, Heteropoda can be effective for controlling cricket pests and the following six families of cricket taxawas observed to be devoured and are potential prey -

Family Gryllacrididae: Commonly called as leaf rolling and raspy crickets. They are reported to feed on nectar and plant fluids (Scholtz *et al.*, 2018) but there is scarcity of data on their potential as pest.

Family Gryllidae: Commonly called as true crickets. The *Brachytrupes membranaceus* is a member of this family and an emerging pest of tobacco plants (Bünzli and Büttike, 1955). Members of the family are reportedly found on *Lolium perenne,* a perennial grass species used to prepare cow feed and another member of this family *Acheta sp.* is reported to be a minor pest for rice and sugarcane (Sultana *et al.*, 2021).

Family Gryllotalpidae: Commonly called as mole crickets. *Gryllotalpa sp.,* member of this family has proven to be harmful to potato (Tudu *et al.,* 2019), sugar beet (Moursey *et al.,* 2022) and many more vegetables and seeds.

Family Rhaphidophoridae: Commonly called as camel crickets. Members of the family are reported to eat carrot/cereal based baits (Spurr and Berben, 2004). Many members of this family have been reported to prefer greenhouse plants in the United States (Texasinvasives.org).

Family Schizodactylidae: Commonly called as splay footed crickets. Although sufficient data isn't available for *Comicus sp*., a member of this family which is of similar genus Schizocomicus from Sindh, are reported to be a minor crop pest (Sultana, 2019).

Family Tettigoniidae: Commonly called as bush crickets. Member of this family, *Acanthoproctus sp.* is an important pest for agricultural crops such as maize and sorghum (Conti & Viglianisi, 2010).

CONCLUSION

The present study suggests that huntsman spider has potential to act as natural control for crickets; especially genus Heteropoda. Biological control being free of chemicals have much scope in organic farming. The cosmopolitan nature of the Heteropoda genus makes it easier to be used for control without risking invasion of an ecosystem. But due to the lack of sufficient literature, it may be a challenge to estimate extent of its success but further documentation and research into the subject can shed much required light on control potential of huntsman spider for cricket pests.

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