Natural and Applied Sciences International Journal (NASIJ)
eISSN: 2788-4619 (online)
https://doi.org/10.47264/idea.nasij/3.1.6
Vol. 3, No. 1, (January-June 2022), 71-80
https://www.ideapublishers.org/index.php/nasij
Research Article

Behavioural responses and feeding preference of *Aellurilus Logunovi* Azarkina, 2004 (Araneae: Salticidae) to prey in a controlled environment

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Received: April 14, 2022 Accepted: June 20, 2022 Published: July 4, 2022

Abstract

Forty adults of Aellurilus logunovi Azarkina, 2004 were randomly collected from scrub hills edges of district Swabi, Khyber Pakhtunkhwa, Pakistan and observed in a controlled environment at Zoology Lab, Women University Swabi. The study aimed to describe predatory behaviour, i.e., foraging modes, how they establish predatory responses to prey and the abiotic factors that influence their hunting in a controlled environment. It is firstly reported that Aellurilus logunovi Azarkina, 2004 is a generalist predator and has a mix of feeding modes of insectivores and araneophagic or cannibalism with, utilizing their prey by either squeezing or partially engulfing. As the handling time increases with an increased body mass of prey and decreases with an increased mass of predators and reduces the mass of prey. It is also first reported that the activity of Aellurilus logunovi is highly affected by ambient temperature and light, i.e., their activity increased with an increase in temperature and light and mainly was more active below 40°C.

Keywords: *Aellurilus Logunovi*, foraging modes, abiotic factors, feeding modes, insectivores, araneophagic, cannibalism.

How to Cite: Hidayat, Z., Ali, P. A., Tanzeela., Begum, M., Wahab, A., & Irfan, M. (2022). Behavioural responses and feeding preference of *Aellurilus Logunovi* Azarkina, 2004 (Araneae: Salticidae) to prey in a controlled environment. *Natural and Applied Sciences International Journal (NASIJ), 3*(1), 71-80. https://doi.org/10.47264/idea.nasij/3.1.6

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1. Introduction

In many agroecosystems, spiders are the most abundant generalist predators (Birkhofer *et al.*, 2013). The ability to move and scatter is one of the main characteristics of animals. Arachnids are one of the earliest terrestrial animal lineages, with octapodal locomotion mechanisms and hydraulic limb extensions. In arachnids, distinct locomotory patterns are involved which include climbing, jumping, leaping, crawling, rolling, diving and gliding (Wolff, 2021). Most Salticids are likely polyphagous predators who prefer to prey on soft-bodied and convenient to handle arthropods (Bartos, 2004; Guseinov, 2005; Huseynov, 2006). The jumping spiders of Pakistan have the least studies family than adjacent countries Iran, China and India (Ali *et al.*, 2018; Ali, 2021; Azarkina, 2004; Azarkina, 2019; Bauer & Freudenschuss, 2015; Caleb *et al.*, 2019; Caleb *et al.*, 2022; Dyal, 1935; Kadam *et al.*, 2021; Li, 2020; Logunov 2021a; b; c; Prószyński & Żochowska, 1981; Tripathi *et al.*, 2021]. *Aelurillus logunovi* Azarkina, 2004 was first described from a type of material from district Swabi, collected by A. H. Wild in 1958 from Hazara and Haripur-Tarbela Road and deposited in the Natural History Museum of United Kingdom (BMNH) (Azarkina, 2004).

In ecological research studies the differences between predator food intake, prey capture behaviour and preferences are mostly vague (Lockwood III, 1998; Morgan & Brown, 1996). In recent research on jumping spiders, it has been of particular interest (Cross & Jackson, 2006; Huseynov *et al.*, 2005). Predatory techniques exhibit a wide range based on the predator hunting method and target prey (Curio, 1976). The functional response of a predator feeding on single prey can be described by two parameters i.e., the predator search rate and handling time, which is the time spent in eating, processing and digestion of prey (Hollings, 1965; Hassell *et al.*, 1976). Within a species these characteristics may differ as a consequence of predator or prey size, presence of alternative prey or interference between predator-prey (Tripet & Perrin, 1994; Elliott, 2003). Over different predator-prey interactions, the body masses or sizes of predator and prey have a strong efficient effect on the functional response parameters i.e., search rate and handling time (Skalski & Gilliam, 2001; Jeschke *et al.*, 2002; Kratina *et al.*, 2009).

The reactive distance between the predator and prey and the capture success is the specific component of the search rate. With the increasing body mass of a predator, the reactive distance increases i.e., as compared to small predators' large predators have a high visual range and above an ideal body mass of the predator the capture success decreases (Aljetlawi *et al.*, 2004; Brose *et al.*, 2008). Predators' prey interaction is greatly influenced by environmental factors, especially temperature and light. The predation rate of spiders *Clubiona phragmittes* and *Pardosa prativaga* increases with an increase in temperature and the spiders were most active at the highest temperature (Kruse *et al.*, 2008). Moreover, as temperature increases, it decreases the handling time and provides time for the predator to search for more prey (Gilbert & Raworth, 1996).

The aims and objectives of the current study are: (1) To identify the foraging modes (predators are frequently divided into two types of forager: active foragers, who move around in their territory for searching and ambush foragers, who wait for prey to approach within striking range; (2) Predatory behaviour of *Aellurilus logunovi* Azarkina 2004 to prey in a controlled environment; and (3) To identify their web building behaviour, rest posture and effect of prey body size on *A. logunovi* predatory behaviour.

2. Materials and methods

The specimen selected for this study was 40 adults of *Aelurillus logunovi* Azarkina, 2004, a rarely common species that lives on banks of stony riverbanks and scrub mountains (Ali *et al.*, 2016). A rectangular glass box as a raring and observation cage is provided with a base of stony and sandy soil and some green branches of leaves to provide a habitat for *A. logunovi.* Variety of Diptera (flies) and spiders are used as food. The study has been carried out at the Zoology Lab, Women University Swabi.

The live specimens were placed in glass rearing cages to observe their foraging modes and predatory responses towards prey. Data has been collected by observing *A. logunovi* behaviour towards supplied prey that were provided at 6:00 am, 9:00 am, 12:00 pm, 3:00 pm, 6:00 pm and at night 9:00 pm. The body movement was observed for food response i.e., during hungry, full and avoidance. The movement of the different legs and their role were observed in capturing and handling their prey.

During feeding the function of the pedipalps in capturing and handling the food, the eyes of the spider at which angles the spiders focus on their prey and how the spider utilized their prey were observed. The effect of light and temperature on the predatory behaviour of the spider was also observed. The web creation process in *A. logunovi* and the rest posture of the species on the web is listed. The main parameters i.e., attack rate or rate of encounter per prey, the probability of attack following an encounter and the probability that an attack is successful, vary with prey size was also determined in this experiment.

3. Results

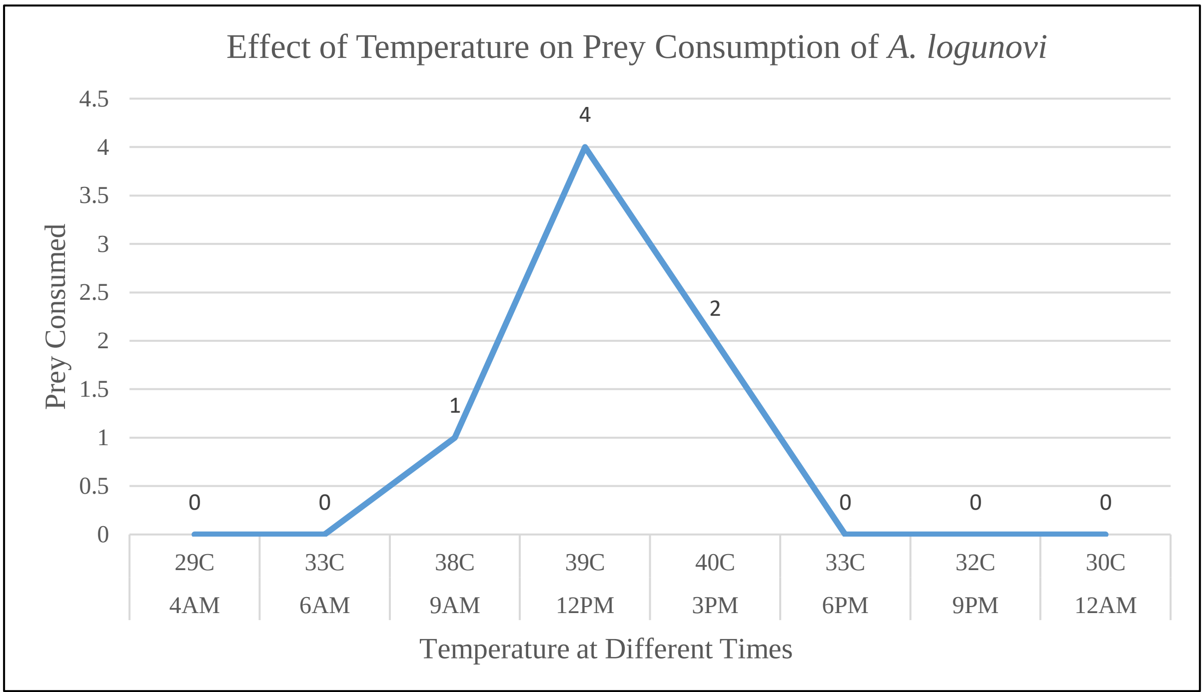
It is reported for the first time that *Aelurillus logunovi* Azarkina, 2004 are an active forager like other Salticids such as searching and attacking prey. They showed mixed strategies of insectivorous and araneophagic patterns and under the condition of suitable food supply like Diptera, fruit flies and moths the *A. logunovi* reduced feeding on other small spiders such as juvenile lynx and lycosids (Table-1). The consumption of food was processed by two methods, either by sucking fluid or by totally or partially grinding the prey. *A logunovi* is diurnal i.e., they are active at day-time and inactive at night-time.

Table-1: Prey consumption of *Aelurillus logunovi* Azarkina, 2004 during 12 week

No of weeks	Prey consumption
Week 1	1 Diptera, 1 moth
Week 2	4 Diptera, 2 moth
Week 3	1 Juvenile spider, 3 fruit flies, 1 Diptera
Week 4	1 Diptera, 1 drain flies, 1 moth
Week 5	2 Fruit flies, 2 moth, 1Dipteria
Week 6	1 Juvenile spider, 2 moth, 2 drain fly
Week 7	4 Moth, 3 fruit flies
Week 8	4 Drain flies, 2 Diptera, 1 juvenile spider
Week 9	2 Juvenile spider, 2 Diptera
Week 10	1 Diptera, 4 drain flies, 1juvenile spider
Week 11	1 Moth, 2 fruit flies, 4 Diptera
Week 12	8 Diptera

A. logunovi is greatly affected by temperature and light. Moreover, up to a certain limit, the activity of *A. logunovi* as well as the prey increased with an increase in temperature and is more active at 12 pm. At an elevated temperature not only does the *A. logunovi* predation rate increase but also the prey escapes rapidly with rising temperature (Figure 1). Also, with increased light, the predation rate of *A. logunovi* increases as it helps in finding the prey. When encountering prey *A. logunovi* focuses at 90 angles on the prey with their principle eyes and slightly moves their body towards the prey so as to keep the prey within the field of view of both principle eyes.

Figure 1: Temperature effect on predatory behaviour of *Aelurillus logunovi* Azarkina, 2004

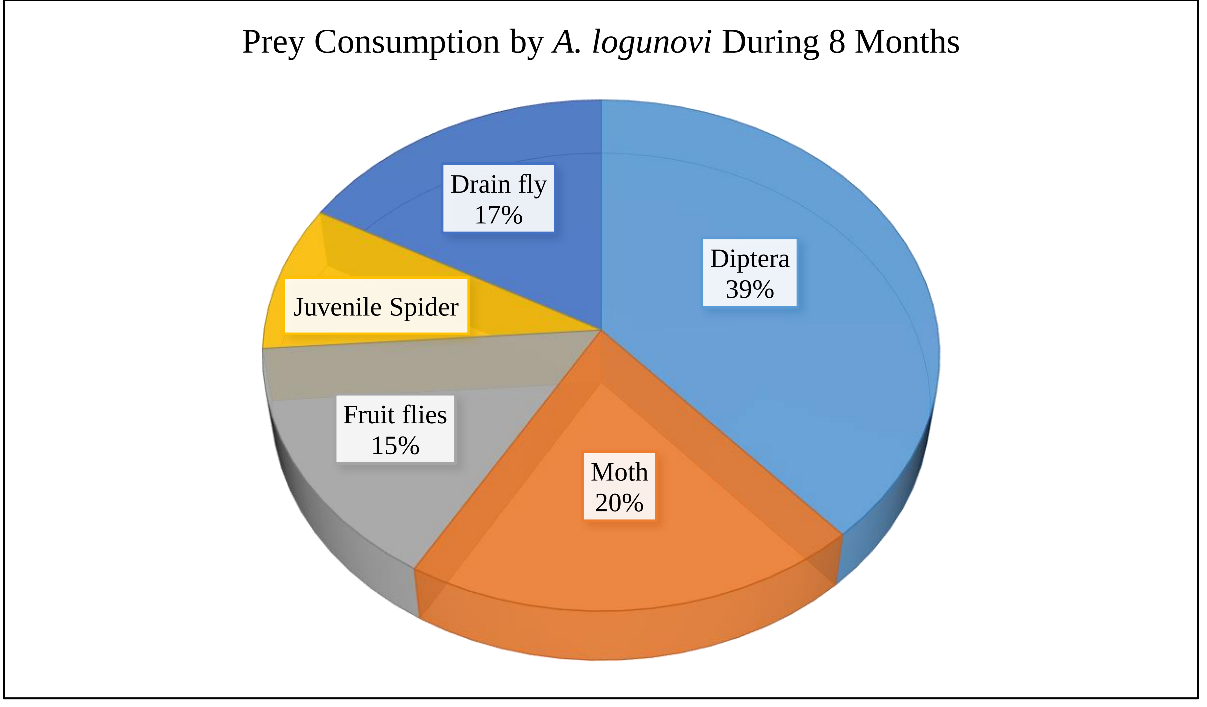


A. logunovi attack rate following an encounter with prey is successful when the prey is small in size and is not so active while the attack rate on prey is not so successful when the prey is large in size and more active. When the reactive distance between the spider and prey is high the spider suddenly speeds up their movement towards the prey however, when the reactive distance is low the spider jumps on the prey and strongly captures it. While capturing the prey the *A. logunovi* used its palp first and second pair of legs to strongly capture the prey and prevent the escape of the prey and the last two pair of legs has no role in capturing the prey. Furthermore, in handling the prey during feeding it uses the first pair of legs and pedipalp. It is also reported during this study that the handling time decreases with an increasing body mass of the spider (predator) and prey. As compared to juvenile the adult *A. logunovi* has a smaller handling time however, the handling time increase with large size prey.

Furthermore, A. *logunovi* exhibits a wide range of feeding modes including insectivores as well as araneophagic behaviour with the utilization of their prey by two methods comprising squeezing and partially engulfing prey. On encounter with flies squeezes the abdomen, while feeding on juvenile spiders they not only suck their body fluids but also grind some of their soft body parts. Moreover, the results show that in presence of flies, they avoid the araneophagic behaviour. *A. logunovi* with no hunger drive when provided with prey no response is recorded towards the prey while when the species is hungry, they show a fast response towards the prey and rapidly orient, pursuit and capture live prey and avoid prey they are decease.

It is observed that a spider builds a small dense web with walls and stone. When the web is damaged the species repair the web and make a new web after several days. *A. logunovi* constructs a web by fastly moving its abdomen in a circular fashion covering an inch area. The rest posture of *A. logunovi* in the web is quite unlike its posture when active in such a form that the first and second pair of legs are arched forward close to the body while the third and fourth pair of legs are arched backwards close to the body and the ventral portion of their body is closed to the substratum. They build the web possible to avoid extreme temperatures and are also used for rest and to take shelter from prey and predator.

Figure 2: Prey consumption of *A. logunovi Azarkina 2004* during controlled condition



4. Discussion

This study showed how *A. Aelurillus logunovi* Azarkina, 2004 responds to different prey in control conditions. Salticidae are generally categorized as hunter spiders that do not rely on the web or other silk for prey capture similarly to other Salticidae. This study also reported that the *A. logunovi* are active forager spiders and they capture and handle the prey independently of the web or other silk these findings were also reported by Richman and Jackson (1992) that most jumping spiders do not construct a web for capturing prey. Araneophagic and insectivore behaviour is reported in the present study in *A. logunovi* that is also reported in five groups of hunter's spiders (small-size oxyopidae, large-oxyopidae, Thomisidae, Salticidae, Lycosidae) (Nyffeler, 1999). Insectivores' behaviour is reported in C. algerina, and genera of member of Brettus and Cybra (Jackson & Hallas, 1986) in member of genus Habronattus (Taylor, 2012). Furthermore, in the presence of flies the *A. logunovi* avoids feeding on juvenile spiders which is not reported in other studies.

The present study also recorded the prey consumption by either sucking body fluid or by grinding soft body parts. These findings are not yet reported in other Salticidae. Present study reveals that the functional response parameter such as handling time decreases with an increased body mass of *A. logunovi* and increases with an increased mass of the prey. It is also reported in wolf spider (Vucic-Pestic *et al.,* 2010). Present study also recorded that temperature and light have a great effect on the behaviour and activity of species i.e., their activity increases with increase temperature and light. Kruse *et al.* (2008) also reported that light and temperature have a great effect on the activity of the spiders (*Cluboinidae* and *lycosidae*) *(Clubiona phragmitis and Pardosa prativaga*). Chai and Wilgers (2015) also reported the effect of light and temperature on wolf spider i.e., Rabidosa punctulata that their burrowing behaviour is affected by temperature and was active in the dark and when it is warm. Neethling and Haddad (2019), also reported that the temperature and precipitation have the greatest effect on the activity of trapdoor spiders.

The response of *Aelurillus logunovi* towards the prey during the hunger time and when satiated were also reported and it shows no response to prey when the species is full i.e., it then avoids the prey and shows a fast response when they are hungry that is not reported in other studies. Formation of the web and repairing of the old web for rest, shelter and to avoid the extreme condition (excess cold and temperature) in *A. logunovi* is recorded during the present study that was also reported in jumping spiders that they use web for resting (Richman & Jackson, 1992). The present study also reported the posture of the species during rest which is totally different from the posture when they were active. Jackson and Hallas (1986) also reported the resting posture of *Brettus*, *Cyrba* and *Phaeacius*.

5. Conclusion

It is concluded from the current study that the functional response of *Aelurillus logunovi* Azarkina, 2004 to prey in a controlled environment that variations occur in the biological clock of the species by changing the habitat and environment but are soon recovered after a few days. The feeding pattern of the species is also established in that it feeds on a variety of flies and juvenile spiders and in the presence of flies it avoids juvenile spiders and utilizes the food by two methods squeezing and grinding. It is also concluded that the activity of spiders is greatly affected by light and temperature.

Acknowledgment

This study was supported by the Women University Swabi grant to Pir Asmat Ali, PhD for Pakistani spiders' worldwide catalogue and ICUN listing.

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