

Monthly Issue APR-2025 Issue-IV, Volume-XIII

https://doi.org/10.69758/GIMRJ/2504I5VXIIIP0043

The Evolution of Parental Care Strategies in Spiders: Ecological and **Physiological Adaptations for Ensuring Offspring Survival**

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Abstract:

Parental care in spiders (Araneae) is a fascinating and diverse aspect of arachnid behavior, encompassing a range of strategies aimed at enhancing offspring survival. Unlike many invertebrates that produce numerous offspring with little to no post-oviposition involvement, several spider species have evolved intricate behaviors to protect and nurture their young ones. This care begins with the construction of protective egg sacs, which shield eggs from predation, desiccation, and environmental fluctuations. In some species, mothers go further by guarding these sacs vigilantly, fending off predators and ensuring favorable microclimatic conditions. Post-hatching care is equally remarkable. Certain species, such as those in the Lycosidae (wolf spiders) and Pisauridae (nursery web spiders) families, exhibit brood carrying, where spiderlings ride on the mother's abdomen or cephalothorax, gaining mobility and protection. In other cases, such as in Stegodyphus (social spiders), females engage in regurgitation feeding, offering partially digested food to their offspring. Even more extreme is the phenomenon of matriphagy, observed in some species, wherein the mother sacrifices herself as a food source, ensuring the survival and nourishment of her young. Furthermore, spiders may provide indirect care by constructing nursery webs or creating secluded habitats where spiderlings can develop safely before dispersal. The extent and form of parental investment vary widely, influenced by ecological pressures, predation risks, and environmental factors. Such behaviors highlight the evolutionary significance of parental care in juvenile survival and population stability under variable environmental conditions. Overall, parental care in spiders represents a remarkable convergence of survival strategies, reflecting both ancestral traits and adaptive innovations in response to environmental pressures. This diverse spectrum of behaviors not only enhances offspring fitness but also provides critical insights into the evolution of sociality and reproductive investment in arachnids.

Key Words: Parental Care, Spiders, Araneae, Matriphagy **Introduction:**

Parental care in animals is defined as any behavioral, physiological, or morphological adaptation exhibited by a parent that enhances the survival, growth, and development of their offspring. This care can manifest through provisioning food, protecting from predators, maintaining favorable environmental conditions, and offering guidance or teaching behaviors crucial for survival. The evolution of parental care is driven by selective pressures that favor increased offspring fitness, often at a cost to the parent's future reproductive success or survival. This paper examines the various parental care strategies observed in spiders, their ecological significance, and

Gurukul International Multidisciplinary Research Journal (GIMRJ)*with* International Impact Factor 8.357 Peer Reviewed Journal



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evolutionary implications. Parental care in spiders (Araneae) is a fascinating and diverse aspect of arachnid behavior, encompassing a range of evolutionary adaptation strategies aimed at enhancing offspring survival. Unlike many invertebrates that produce numerous offspring with little to no post-oviposition involvement, several spider species have evolved intricate behaviors to protect and nurture their young. This care begins with the construction of protective egg sacs, which shield eggs from predation, desiccation, and environmental fluctuations. In some species, mothers go further by guarding these sacs vigilantly, fending off predators and ensuring favorable microclimatic conditions. Post-hatching care is equally remarkable. Certain species, such as those in the Lycosidae (wolf spiders) and Pisauridae (nursery web spiders) families, exhibit brood carrying, where spiderlings ride on the mother's abdomen or cephalothorax, gaining mobility and protection. In other cases, such as in Stegodyphus (social spiders), females engage in regurgitation feeding, offering partially digested food to their offspring. Even more extreme is the phenomenon of matriphagy, observed in some species, wherein the mother sacrifices herself as a food source, ensuring the survival and nourishment of her young. Furthermore, spiders may provide indirect care by constructing nursery webs or creating secluded habitats where spiderlings can develop safely before dispersal. The extent and form of parental investment vary widely, influenced by ecological pressures, predation risks, and environmental factors. These complex behaviors underscore the evolutionary advantages of parental care in enhancing juvenile survival and maintaining population stability in harsh or unpredictable environments. Overall, parental care in spiders represents a remarkable convergence of survival strategies, reflecting both ancestral traits and adaptive innovations in response to environmental pressures. This diverse spectrum of behaviors not only enhances offspring fitness but also provides critical insights into the evolution of sociality and reproductive investment in arachnids. This paper explores the various forms of parental care observed in different spider species, including egg sac protection, guarding behavior, food provisioning, and cooperative breeding. Understanding these behaviors provides insights into the ecological pressures and evolutionary advantages that have shaped such nurturing strategies in these enigmatic arthropods.

Forms of Parental Care in Spiders: Parental care in spider manifests in multiple forms, each tailored to the ecological pressures and environmental conditions faced by different species.

Egg Sac Protection: The most widespread form of parental care in spiders is the protection of egg sacs. Many female spiders create silk sacs to enclose their eggs, ensuring protection from predators, parasites, and environmental hazards. Wolf spiders (**Family: Lycosidae**) are known for carrying their egg sacs attached to their spinnerets, maintaining constant vigilance over their brood. In nursery web spiders (**Family: Pisauridae**), the female carries the sac in her chelicerae and eventually places it in a protective "nursery web," where she guards the spiderlings after they hatch. Huntsman Spiders (**Family: Sparassidae**), female typically carry their egg sacs under their bodies, attached to their spinnerets. Cellar Spiders or Daddy Longlegs (**Family: Pholcidae**), female carry the egg sac in their chelicerae, holding it delicately while continuing with daily activities like web maintenance and prey capture. Cobweb spiders or comb-footed spiders



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(Family: Therididae), female often carry their egg sacs using their spinnerets or hold them with their chelicerae (mouthparts). This behavior minimizes predation risks and ensures optimal environmental conditions for egg development.

Guarding Behavior: In some species females guard their egg sacs or nests, deterring potential threats. Nursery web spiders (Family: Pisauridae) construct protective silk retreats where they guard their offspring until they are ready to disperse. In Orb-weaving spiders (Family: Araneidae) Guarding is usually passive. The female creates egg sacs near her web, often attaching them to leaves or branches. In some species female remain nearby or even wrap the sac in silk to protect it from predators and environmental factors, while others die shortly after laying eggs, leaving the sac camouflaged in silk. In wolf spiders (Family: Lycosidae) after hatching, spiderlings ride on the mother's back, giving them extra security. The mother defends her young fiercely, using her body as a shield against predators. Jumping spiders mothers (Family: Salticidae) exhibit strong parental care. They place egg sacs in secure locations like rolled leaves, silken retreats or crevices. The female guards the sac, defending it against predators and even staying with the spiderlings post-hatching. In Crab spiders (Family: Thomisidae) female often create their egg sacs on leaves, flowers, or under bark, using silk to secure them. After laying eggs, the mother typically guards the sac closely, staying near or directly on top of it. In some species, the female guards the egg sac until she dies, providing constant protection throughout her life's final stage. Two-tailed spiders (Family: Hersilidae) female create flat, disk-shaped egg sacs, which they often attach to tree bark. The sac is camouflaged to blend in with the substrate, reducing visibility to predators. The female stays close to the egg sac, guarding it diligently. She often spins additional silk layers around the sac, creating a protective barrier.

Food Provisioning: Certain spider species engage in food provisioning, a behavior where the mother actively provides sustenance to her young. In Velvet Spiders (Family: Eresidae) mothers regurgitate food for their young, and in some species, they undergo **matriphagy**, where the mother sacrifices herself to be consumed by her spiderlings. This extreme form of parental investment ensures the offspring get a strong nutritional start. In cobweb spider (Family: Theridiidae) female also regurgitates food for her spiderlings, ensuring they receive adequate nutrition during the early stages of development. In Wolf Spiders (Family: Lycosidae) after hatching, the spiderlings climb onto the mother's back. While not directly providing food, the mother helps her young find prey- rich environments, indirectly aiding in food acquisition.

Cooperative Breeding Cooperative breeding is a rarer form of parental care observed in social spider species like *Stegodyphus* (Family: Eresidae). In these communal webs, multiple females contribute to brood care by guarding nests, providing food, and protecting spiderlings from predators. This cooperative approach enhances offspring survival and exemplifies the benefits of social living in challenging environments.

Conclusion:

Parental care in spiders exemplifies the diversity of reproductive strategies employed by these arthropods to ensure offspring survival. From guarding egg sacs to cooperative breeding,





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these behaviors reflect a complex interplay of ecological pressures and evolutionary adaptations. Further research into these nurturing strategies will continue to illuminate the intricacies of arachnid life and their ecological significance.

Pictorial Depiction of Parental Care Behaviors in Spiders:





Family: Lycosidae (wolf spiders)



Family: Pisauridae (nursery web spiders)



Family: Eresidae (Velvet Spider)



Family: Sparassidae (Huntsman Spiders)



Family:Pholcidae (Cellar Spiders or Daddy Longlegs)

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Family: Theridiidae (cobweb spider)



Family: Araneidae (Orb-weaving spiders)



Family: Hersilidae (Two-tailed spiders)





Family: Salticidae (Jumping spiders)



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