

EVOLUTION OF SOCIALITY IN SPIDERS (THERIDIIDAE)

Scott Trageser

What is a Social Spider?

- Generally accepted as living in colonies while having generational overlap and exhibiting cooperative brood care and nest maintenance
- Can also have reproductive division of labor and exhibit swarming behavior (*Achaearanea wau*)
- Social hierarchies arise
- Species and population dependant
- Arguable if certain species qualify as eusocial

“Sub”-Social Spiders

- Sociality also classified by territoriality and permanence
- Can be social on a seasonal basis and have an obligate solitary phase
- Individuals can have established territories within the nest or can move freely
- Can have discrete webs connected to other webs in the colony (cooperative?)

Eusociality

- There is cooperative brood-care so it is not each one caring for their own offspring
- There is an overlapping of generations so that the colony will sustain for a while, allowing offspring to assist parents during their life
- That there is a reproductive division of labor, i.e. not every individual reproduces equally in the group

Social Definitions

- Solitary: Showing none of the three features mentioned in the previous slide (most insects)
- Sub-social: The adults care for their own young for some period of time (cockroaches)
- Communal: Insects use the same composite nest without cooperation in brood care (digger bees)
- Quasi-social: Use the same nest and also show cooperative brood care (*Euglossine* bees and social spiders)
- Semi-social: in addition to the features in quasisocial, they also have a worker caste (*Halictid* bees)
- Eusocial: In addition to the features of semisocial, there is overlap in generations (*Honey* bees).

Natural History

- 23 of over 39,000 spider species are “social”
- Many other species are classified as “sub”-social
- Tropical origin. Latitudinal and elevational distribution constrictions due to prey type/abundance
- Emigrate (swarm) after courtship and copulation but prior to oviposition

Natural History cont.

- Males and juveniles rarely emigrate, only adults and sometimes late sub-adult females emigrate.
- Males and young remain in colony
- Extremely inbred
- High female sex-ratio bias (up to 10:1)
- Some females never reproduce
- Generations are discrete in most species lasting approx 7 months with an overlap of 3 months between female adults and progeny (*Achaearanea wau*)

Natural History cont.

- Cooperative prey capture
- Communal web consists of a horizontal sheet of tightly woven silk with a loose tangle of vertical threads above it
- Flying insects which strike the vertical barrier threads drop onto the sheet, where they are attacked by the spiders
- Web construction and prey capture are group activities occurring primarily at night, during the day the spiders sit in groups inside curled-leaf retreats suspended in the barrier web by strong guy threads

Reproductive Division of Labor

- Dominant-subordinate dichotomy
- Hypothesized in some species to be a result of resource availability
- Early head start caused by either genetic robustness or opportunity creates dominance
- Able to monopolize food resources, grow larger, and reproduce leaving subordinates as non-reproductives

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Benefits to Group Living

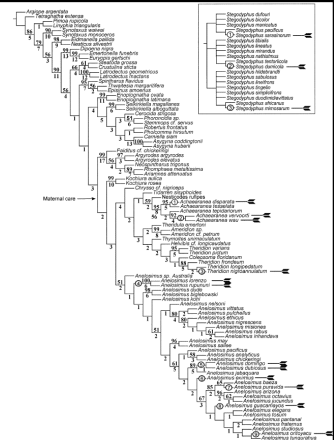
- Saving on per capita investment in silk structures
- Access to larger prey
- Predator defense
- Ready access to mates
- Anything else?

Is Inbred Sociality a Dead End?

Origin(s) of Sociality in Spiders

- Between 10 and 20 independent origins of sociality
- Extended maternal care is thought to be a pre-adaptation for sociality
- All social spider clades are nested around “sub”-social spiders exhibiting extended maternal care

FIG. 1. Interrelationships of social and nonsocial Theridiidae (one of 19 most parsimonious trees shown) and *Stegodyphus*. Numbered circles show counts of independent social origins; arrows indicate social species; numbers above branches are bootstrap support values; below branches, Bremer support values. The optimization of maternal care within Theridiidae is based on Agnarsson (2004, 2006a). All the species within the maternal care clade have either documented maternal care, or their behavior is unknown (see online Appendix). *Stegodyphus* relationships are shown as a tree for clarity (box) based on a nonquantitative hypothesis of Kraus and Kraus (1988). The theridiid phylogeny is based on a quantitative analysis including all social theridiids.



Discussion Points

- How would you characterize the sociality of Theridiid spiders?
- Could reproductive division of labor as exhibited by social spiders, be an important step in evolving a caste system?
- Why would non-reproductive females stay in colony?
- Would social spider clades speciate less frequently?