



The evolution and structure of complex societies: lessons from snapping shrimp

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Many species of animals in a variety of taxonomic groups are known to form complex societies. But what is a complex society, how does one evolve, and are the societies that animals form in one taxonomic group really similar to those in another? Using empirical and comparative data from vertebrates, insects, and crustaceans, I will outline a framework for how researchers can begin to think about characterizing different types of animal societies based on their reproductive structures. First, I will use phylogenetically informed comparative analyses to show that not all reproductive arrangements within social groups are viable in nature. Instead, I will argue that societies with one reproductive female versus those with more than one reproductive female represent a major evolutionary divide. In other words, the selective routes to animal sociality differ depending on whether monopolization of reproduction by one individual is possible or not. I will then use empirical data from *Synalpheus* sponge-dwelling snapping shrimps to demonstrate how societies with one reproductive female and those with more than one reproductive female have different evolutionary origins. That is, both eusocial societies where reproduction is monopolized by one female and communal breeding societies where all females reproduce evolved independently from non-social, pair-forming ancestors. Finally, I will show that independent ecological factors related to the shrimps' sponge hosts explain the alternative evolutionary social transitions in *Synalpheus*. Specifically, sponge host breadth influences evolutionary transitions to eusociality, whereas sponge host size influences transitions to communal breeding. Ultimately, this approach may allow us to not only better understand the similarities and differences in social species in disparate animal groups, but also to develop a more unifying framework for studying animal social evolution.