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### PROJECT

## Towards Conceptual Synthesis in Our Understanding of Interactions between Species

Humans are passionately interested in interactions with other individuals and other species. To cooperate with others is essential for our survival, and has been a hallmark of our species since we first evolved. As a consequence, we have a surprisingly large store of knowledge about the many ways in which organisms interact with each other. Problems arise, however, when we start extrapolating from one type of interaction to another. Humans do not interact with each other and with other species in exactly the same way that other organisms do; to speak as if they do impedes our understanding of the behavior of humans and of other species, as well. Certainly, a fundamental goal of human thought is to seek synthesis across diverse phenomena. However, at present, there are too many false parallels and inappropriate metaphors in circulation to form a solid foundation of understanding. Some popular ideas really must be dismantled before progress can be made. At the same time, there are compelling patterns to be elucidated at the intersection of different fields. As a Fellow of the Wissenschaftskolleg, I will be constructing new conceptual frameworks that synthesize our understanding of organismal interactions. I have been studying one form of interaction, mutualism (cooperative interactions between species), since its inception as a field of study. I will now: (i) work with colleagues to integrate scholarship on within-species cooperation and mutualism; (ii) analyze the use and misuse of the “mutualism” metaphor across fields; (iii) use our understanding of how cheating is controlled within and between non-human species to explore novel ways in which cooperation among humans might be fostered; (iv) analyze the relationship between mutualism and domestication; and (v) synthesize my career-long research program to argue for the dissolution of a typological view of organismal interactions. All of these projects cross disciplinary boundaries, and three reach beyond biology.

### Recommended Reading

Bronstein, Judith L., ed. (2015). *Mutualism*. New York: Oxford University Press.

Díaz-Muñoz, Samuel L., Amy M. Boddy, Gautam Dantas, Christopher M. Waters, and Judith L. Bronstein (2016). “Contextual Organismality: Beyond Pattern to Process in the Emergence of Organisms.” *Evolution* 70: 2669–2677. <https://doi.org/10.1111/evo.13078>.

Barker, Jessica L., Judith L. Bronstein, Maren L. Friesen, Emily I. Jones, H. Kern Reeve, Andrew G. Zink, and Megan E. Frederickson (2017). “Synthesizing Perspectives on the Evolution of Cooperation within and between Species.” *Evolution* 71: 814–825. <https://doi.org/10.1111/evo.13174>.

# Mutualism: The Past, Present and Future of a Young Field of Science

The classic view of nature is one of a deathly struggle for existence. Yet, throughout nature, organisms cooperate with each other. Mutualisms – mutually beneficial interactions between species – are more than simply fascinating stories from natural history: They are central to the diversity and diversification of life on Earth. Charles Darwin, well aware of mutualisms, mused that if species could be shown to act exclusively for the good of others, “it would annihilate my theory”. The very young field of mutualism research attempts in part to address Darwin’s challenge. In my presentation I will first briefly discuss the relationship between within-species cooperation and mutualism. Then I will introduce two underlying concepts that are helping to guide our growing understanding: Mutualism not only confers benefits but also exacts costs on the participants; and the immediate interests of mutualists commonly conflict. I will then review some of my group’s recent findings, which help address two of the most vexing puzzles mutualism poses: If mutualisms are beneficial, why isn’t the world replete with them; and if mutualisms are costly, then why doesn’t everyone cheat their partners? Our understanding of mutualism has greatly expanded in recent years, but this new focus has come at the price of exploring connections between mutualism and other forms of interaction – a situation I am working to mend during my Wiko fellowship. I will conclude my talk by highlighting the interfaces that excite me the most.

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## PUBLICATIONS FROM THE FELLOWS' LIBRARY

Bronstein, Judith (Lausanne,2022)

Flight-Fecundity trade-offs : a possible mechanistic link in plant–herbivore–pollinator systems

<https://kxp.k1oplus.de/DB=9.663/PPNSET?PPN=1827020091>

Bronstein, Judith (Thousand Oaks, Calif. [u.a.],2018)

The promise of the organizational ecosystem metaphor : an argument for biological rigor

<https://kxp.k1oplus.de/DB=9.663/PPNSET?PPN=1812804067>

Bronstein, Judith (Oxford,2017)

Synthesizing perspectives on the evolution of cooperation within and between species

<https://kxp.k1oplus.de/DB=9.663/PPNSET?PPN=1017835756>

Bronstein, Judith (2016)

Contextual organismality : beyond pattern to process in the emergence of organisms

<https://kxp.k1oplus.de/DB=9.663/PPNSET?PPN=1017835357>

Bronstein, Judith (Oxford,2015)

Mutualism

<https://kxp.k1oplus.de/DB=9.663/PPNSET?PPN=1616446137>

Bronstein, Judith (Oxford,2015)

Cheaters must prosper : reconciling theoretical and empirical perspectives on cheating in mutualism

<https://kxp.k1oplus.de/DB=9.663/PPNSET?PPN=1042049777>

Bronstein, Judith (New York, NY,2012)

The value of a metaphor : organizations and ecosystems

<https://kxp.k1oplus.de/DB=9.663/PPNSET?PPN=1666716367>