

Tritrophic Interactions: Annotated Bibliography

- Agrawal, A. A., Janssen, A., Bruin, J., Posthumus, M.A., Sabelis, W. M. 2002. An ecological cost of plant defense: attractiveness of bitter cucumber plants to natural enemies of herbivores. *Ecology Letters* 5: 377-385.
The authors examine this tritrophic system from the bottom-up perspective by comparing the direct plant defense of producing the bitter compound, cucurbitacin, which repels the herbivorous spider mites, to the indirect plant defense of producing volatile compounds to attract predator mites using a greenhouse release-recapture experiment.
- De Feo, O., Rinaldi, S. 1997. Yield and dynamic of tritrophic food chains. *The American Naturalist* 150: 328-345.
An analysis of the Rosenzweig-MacArthur model by the authors leads to the conclusions that tritrophic systems with low frequency cycles or at equilibrium are undersupplied and tritrophic systems with high frequency cycles are oversupplied. They therefore determine that a system at the edge of chaos is required for maximum food yield.
- De Moraes, C. M., Lewis, W. J., Tumlinson, J. H. 2000. Examining plant-parasitoid interactions in tritrophic systems. *Anais Da Sociedade Entomologica Do Brasil* 29: 189-203
This paper is a review of recent studies that look at interactions between plants and parasitoids, particularly interactions involving the release of volatile compounds by plants in response to herbivory and how they affect the foraging behavior of parasitoids.
- Dutton, A., Mattiacci, L., Amado, R., Dorn, S. 2002. A novel function of the triterpene squalene in a tritrophic system. *Journal of Chemical Ecology* 28: 103-116.
Triterpene squalene is released by apple leaves in response to herbivory by leafminers and is found to aid a generalist parasitoid species in host location. Lab experiments show that female parasitoids engage in ovipositional probing only on leaves damaged by leafminers. Since this is a paper from the Journal of Chemical Ecology, it does go into quite a bit of detail on the composition and production of the different chemical compounds found in the apple leaves.
- Francis, F., Haubruge, E., Hastir, P., Gasper, C. 2001. Effect of aphid host plant on development and reproduction of the third trophic level, the predator *Adalia bipunctata* (Coleoptera: Coccinellidae). *Biological Control* 30: 947-952.
Based on lab experiments, this paper shows that glucosinolates (GLS) produced by three plant species in different levels improves herbivorous peach-potato aphid reproduction but both helps and hurts predatory lady-bird beetles. However, some of the results are confusing and they seem to get the high and low levels of GLS mixed up with the different plant species.
- Gingras, D., Dutilleul, P., Boivin, G. 2002. Modeling the impact of plant structure on host finding behavior of parasitoids. *Oecologia* 130: 396-402.
This was one of two papers I came across that looks at the effects of plant structure rather than volatile plant chemicals on parasitoids. An experiment is conducted using artificial plants with structure divided into size, heterogeneity, and connectivity. The authors formulate a model for predicting the host-finding success of a parasitoid and then apply that model to several experiments involving different tritrophic systems.

- Gomez, J. M., Zamora, R. 1994. Top-down effects in a tritrophic system: parasitoids enhance plant fitness. *Ecology* 75: 1023-1030.
The effects of three parasitoid species on a seed-eating weevil species and a crucifer plant are studied and discussed in this paper. Through observational and experimental studies, the authors find that parasitoids directly control the weevil population and indirectly increase host plant fitness.
- Havill, N. P., Raffa, K. F. 2000. Compound effects of induced plant responses on insect herbivores and parasitoids: implications for tritrophic interactions. *Ecological Entomology* 25: 171-179.
This is the paper I chose for the class to read. The authors conduct a greenhouse experiment to study the induced plant responses of a poplar species on gypsy moth larvae and a parasitoid species. The study uses appropriate bioassays and of the papers I read, I think this study has the best sampling design, which allows them to draw reasonable conclusions about this tritrophic system based on their results. They find that chemical responses by the poplar species hinders gypsy moth larvae growth and development and attracts the parasitoid but also has negative effects on the parasitoid's development and survival.
- Huxel, G. R., McCann, K. 1998. Food web stability: the influence of trophic flows across habitats. *The American Naturalist* 152: 460-469.
This is a theoretical paper that looks at how allochthonous inputs of nutrients and energy affect the stability of tritrophic food webs. Several previously published tritrophic models are discussed and modified to account for these inputs. The authors apply these models mainly to marine tritrophic systems.
- Letourneau, D. K. 1987. The enemies hypothesis: tritrophic interactions and vegetational diversity in tropical agroecosystems. *Ecology* 68: 1616-1622.
The author evaluates the "Enemies" hypothesis by studying the abundance of a parasitoid species in stands of mixed crops and monocultures. Some of the results show support for the "Enemies" hypothesis while other results suggest that the presence or absence of a particular plant species has more effect on parasitoid abundance than general species richness.
- Lill, J. T., Marquis, R. J. 2001. The effects of leaf quality on herbivore performance and attack from natural enemies. *Oecologia* 126: 418-428.
Field experiments are done to investigate the effects of defense compounds in oak leaves on an herbivorous bivoltine leaf-tying caterpillar. Results give some support for Clancy and Price's slow-growth-high-mortality hypothesis.
- Marvier, M. A. 1996. Parasitic plant-host interactions: plant performance and indirect effects on parasite-feeding herbivores. *Ecology* 77: 1398-1409.
This is the only paper I came across that actually looks at a host plant-parasitic plant-herbivore tritrophic system. It examines parasitic plant performance on three host plants and the effects on a parasite-feeding aphid. It is an interesting paper and the experimental design and statistical analyses are well done.
- Rinaldi, S., De Feo, O. 1999. Top-predator abundance and chaos in tritrophic food chains.

Ecology Letters 2: 6-10.

This is a follow up theoretical paper to the De Feo and Rinaldi paper from 1997. They discuss three food chain models, one again being the Rosenzweig-MacArthur model. Like the 1997 paper, they conclude that maximum predator abundance and food yield exist at the edge of chaos.

Schmalhofer, V. R. 2001. Tritrophic interactions in a pollination system: impacts of species composition and size of flower patches on the hunting success of a flower-dwelling spider. *Oecologia* 129: 292-303.

This was the only paper I came across that looks at a plant-pollinator-predator tritrophic system. The author uses field experiments to compare the hunting success of a flower-dwelling spider on two different plant species and flower patch size. Results show that spider success depends on the plant preferences of larger pollinators rather than visitation rates of the pollinators.

Shiojiri, K., Takabayashi, J., Yano, S., Takafuji, A. 2002. Oviposition preferences of herbivores are affected by tritrophic interaction webs. *Ecology Letters* 5: 186-192.

Two tritrophic systems are studied simultaneously in this paper. Comparisons are made between the rates of parasitization of the two parasitoid species on their respective host species when the host species are found on separate plants and then on the same plant.

Sipura, M. 1999. Tritrophic interactions: willows, herbivorous insects and insectivorous birds. *Oecologia* 121: 537-545.

The authors of this paper find that birds prefer foraging for insects on a willow species that produces weaker defense compounds to the willow species that produces stronger defense compounds because of the higher abundance of insects found on the more weakly defended willow species. However, the field experiments used seem insufficient in controlling for several extraneous variables.

Sundararaju, D., Sundara Babu, P.C. 1999. Survey and tritrophic interactions between host plants, *Helopeltis antonii* Signoret (Heteroptera: Miridae) and its egg parasitoids. *Journal of Biological Control* 13: 19-23.

The focus of this paper is comparing what parasitoid species are associated with a particular insect herbivore found on crop plants in different geographical areas. It does not really discuss any dynamics that exist between the trophic levels. The dominant parasitoid species found with the herbivore is suggested as a possible biological control agent.

Walker, M., Hefin Jones, T. 2001. Relative roles of top-down and bottom-up forces in terrestrial tritrophic plant-insect herbivore-natural enemy systems. *Oikos* 93: 177-187.

This is a review of papers written on tritrophic interactions. The authors conduct a survey of the literature in order to determine whether sufficient literature exists to make generalized statements on the roles of top-down and bottom-up forces. They conclude that the literature is not sufficient and that most papers claiming to discuss tritrophic interactions do not properly address all three trophic levels.