

Predators affect the carbon cycle, researchers show

June 17 2013

A new study shows that the predator-prey relationship can affect the flow of carbon through an ecosystem. This previously unmeasured influence on the environment may offer a new way of looking at biodiversity management and carbon storage for climate change.

The study, conducted by researchers at the Yale School of Forestry & Environmental Studies, comes out this week in the *Proceedings of the National Academy of Sciences*. It looks at the relationship between grasshoppers and spiders—herbivores and predators in the study's food chain—and how it affects the movement of carbon through a grassland ecosystem. Carbon, the basic building block of all organic tissue, moves through the food chain at varying speeds depending on whether it's being consumed or being stored in the bodies of [plants](#). However, this pathway is seldom looked at in terms of specific animal responses like fear from predation.

"We're discovering that predators are having important effects on shaping the make-up of [ecosystems](#)," says Dr. Oswald Schmitz, professor of ecology and one of the co-authors of the study. "But we've not really spent a lot of time measuring how that translates into other functions like nutrient cycling and recycling."

The researchers manipulated the food chains of grassland ecosystem to see how the levels of carbon would change over time. Dr. Schmitz and his team created several controlled ecosystems: some that contained only native grasses and herbs, others that had plants and an herbivore

grasshopper, and some others that had plants and herbivores along with a carnivore spider species—all three tiers of the food chain. In addition, a form of traceable carbon dioxide was injected into sample cages covered with Plexiglas, which allowed the team to track the carbon levels by periodically taking leaf, root, and dead animal samples.

The study found that the presence of spiders drove up the rate of carbon uptake by the plants by about 1.4 times more than when just grasshoppers were present and by 1.2 more times than when no animals were present. It was also revealed that the pattern of [carbon storage](#) in the plants changed when both herbivores and carnivores were present. The grasshoppers apparently were afraid of being eaten by the spiders and consumed less plant matter when the predators were around. The grasshoppers also shifted towards eating more herbs instead of grass under fearful scenarios.

At the same time, the grasses stored more carbon in their roots in a response to being disturbed at low levels when both herbivores and carnivores were present. In cases where only herbivores were present, the plants stored less carbon overall, likely due to the more intense eating habits of the herbivores that put pressure on plants to reduce their storage and breathe out carbon more. These stress impacts, then, caused both the plants and the herbivores to change their behaviors and change the composition of their local environment.

This has significance for biodiversity conservation and ecosystem management. Although the study was carried out on a small scale, it could inform practices done in much larger areas. Places such as the Alaskan wilderness, for example, are home to animals that have the same predator-and-prey dynamics that drive the carbon cycle, and so protecting lands and storing carbon could be linked at the same time. Appreciating the role of predators is also important currently, given that top predators are declining at rates faster than that of many other species

in global trends of biodiversity loss.

"It's going to force some thinking about the vital roles of animals in regulating [carbon](#)," concludes Dr. Schmitz, pointing to the fact that the UN's body of scientific experts who study [climate change](#) don't consider these multiplier effects in their models. "People are arguing for a paradigm change."

More information: Trophic cascade alters ecosystem carbon exchange , www.pnas.org/cgi/doi/10.1073/pnas.1305191110

Provided by Yale University

Citation: Predators affect the carbon cycle, researchers show (2013, June 17) retrieved 2 February 2023 from <https://phys.org/news/2013-06-predators-affect-carbon.html>

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