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Thursday, February 26, 2015

INSIDE SCIENCE NEWS SERVICE

Hippo Droppings Drive River Food Webs

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Hippopotamus amphibius opens wide while enjoying the cool mara river in the Maasai Mara National Park, Kenya

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Hungry hippos heft grass from African savannahs to rivers.

Originally published: Feb 26 2015 - 1:15pm

By: Leigh Cooper, Contributor

(Inside Science) – The Mara River winds its way through steep Kenyan agricultural fields, logged forests and growing towns before entering the Maasai Mara National Reserve, on the border of Tanzania. Oddly, the grasses growing in the savannahs surrounding the Mara appear to be manicured.

"When you go along these rivers you see these massive 'hippo lawns' where they have grazed the grass down – it looks like a golf course," said Robert Naiman, a professor of aquatic ecology at the University of Washington, Seattle.

And not all that grass gets digested by the hippos. Amanda Subalusky, an aquatic ecology graduate student at Yale University in New Haven, Connecticut, and her colleagues found that the Mara hippopotami (*Hippopotamus amphibius*) act as nutrient "conveyor belts," moving nutrients from the grasslands to rivers during daily feeding migrations.

Subalusky originally moved to Kenya as part of a water resource management team, studying the sustainability of water use in the Mara River basin. Subalusky and her husband, also a scientist, sampled the water from the inhabited upper basin of the Mara downstream through the reserve.

"We expected to see the biggest effects on water quality where there were all the people and the river kind of

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improving as it goes through the reserve," said Subalusky. "What we saw was the opposite."

On further inspection the rocks were lined with feces. Even in fast moving rapids, waste rotted on the bottom of the river.

"If you set a net in the river for a minute, the whole net will be lined with hippo feces," said Subalusky.

That feces contains numerous components that influence the river's ecology. Microbes feast on carbon, the primary building block of sugars. And algae and bacteria use nitrogen and phosphorus to grow. The researchers wanted to learn how much carbon, phosphorus and nitrogen entered the Mara because of the hippos' daily feeding treks.

The team travelled to Wisconsin's Milwaukee County Zoo to measure the amount of each nutrient eaten and excreted by three captive hippos. Figuring out what they ate was easy. To learn how much came out the back end, the team tested the water in the hippos' pool for dissolved nutrients. After they drained the pool, they shoveled the remaining feces into wheelbarrows and carted them away to be weighed and measured for nutrients.

"It was a lot of fun and a little bit dirty," said Subalusky.

After adjusting for differences in wild and captive hippo diets, the team calculated the amount of carbon, nitrogen and phosphorus excreted by a wild hippo every day. Cameras at the reserve in Africa showed that local hippos usually wandered toward their grazing grounds at dusk and returned to water at dawn, which probably means half their feces landed in the river.

The hippos' contributions flood the river with small pieces of grass and other particles. In the reserve the river contains almost seven times the amount of small particles than when it leaves the human-inhabited areas upstream. The researchers also found that the hippos increased the amount of phosphorus and nitrogen in the river by 25 percent. The study will be published in the March edition of the journal [Freshwater Biology](#).

"There has been a great deal of speculation over the years about the role the hippos might play in bringing nutrients into [sub-Saharan] rivers," said Naiman, who was not associated with the study. "[Subalusky and her team] went out and made quantitative measures of how much hippos bring into the rivers. And it's substantial."

Naiman points out that not all wild hippos act the same. Some populations will feed on land during the day, eat different grasses or even change their feeding patterns with the seasons.

The researchers also divided nutrient excretion into urine and feces. Bacteria and algae quickly gobble up urine, which is full of nitrogen, phosphorus and simple, easy-to-digest sugars. Hippo feces, on the other hand, are made of hard-to-digest grasses. Microbes can – and will – break them down, but it will take them weeks or even months.

The urine washes downstream immediately, while the feces pile up and putrefy on the river's bottom.

"We see massive, massive amounts of hippo feces move through the system," Subalusky said of the floods that happen a few times each year. "It's tens of thousands of kilograms moving downstream per hour at the peak of some of these flood pulses."

Hippopotamus populations in the Mara Maasai Reserve have grown by a factor of 16 since the 1950s, probably due to a crackdown on hunting. But they are declining in many other areas and have been listed as vulnerable by the International Union for Conservation of Nature.

"When you lose hippos, you lose a very vital connection between the river and the savanna," said Subalusky. The river's food webs have evolved to depend on this high input of nutrients, she said.

Subalusky says we shouldn't think of river systems like the Mara, or the Pacific coast rivers that are fertilized annually with salmon carcasses, as extreme ecosystems. Subalusky says her studies in sub-Saharan Africa "inform us about processes that used to happen all across the world including in North America when we had our megafauna, which was only 10,000 years ago."

Leigh Cooper is a science writer based in Santa Cruz, California. She tweets at [@gdaycoop](#).

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