

Weighing the planet's biological matter

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WEIGHING THE PLANET'S BIOLOGICAL MATTER

THE PLANT KINGDOM DOMINATES

Our biosphere is composed roughly of

80%
plant matter



15%
bacteria

5%
all other organisms

LAND AND SEA

80x

MORE biomass on land than in the oceans.

"It was surprising to discover that the food pyramid in the ocean is inverted, meaning that there are more consumers than producers," says Phillips.



DOMESTIC VS WILD

Humans and livestock have

≈20x

the mass of all wild animals combined.





The total weight of chickens on farms

≈3x

the total weight of wild birds.



HUMANITY'S OUTSIZED IMPACT

The present-day global biomass is about **half** what it was before humans.

Wild mammal biomass is **1/6th** what it was before humans evolved.



*The biomass distribution on Earth
Journal: Science, Risk, Policy, and Ethics
Proceedings of the National Academy of Sciences
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Caltech

Credit: Caltech and Pete Fecteau/Noun Project

Our planet is teeming with life: Even in the most extreme places, like the scorching deserts and the pitch-black ocean depths, living organisms can be found. But just how much living matter is on this planet? A new study now makes the first global estimates of the total weight, or biomass, of life on Earth. The research is a collaboration between Yinon Bar-On and Ron Milo of the Weizmann Institute of Science in Israel and Rob Phillips of Caltech.

A paper describing the research appears in the May 21 issue of the journal *Proceedings of the National Academy of Sciences*.

"This quantification is part of the history of life on Earth," says Phillips, who is Caltech's Fred and Nancy Morris Professor of Biophysics, Biology, and Physics. "Understanding these numbers is crucial for understanding what I like to call the 'human experiment': How exactly are we shaping the planet?"

The plant kingdom dominates

Our biosphere is composed roughly of 80 percent plant matter, 15 percent bacteria, and 5 percent for all other organisms.

Land and sea

There is almost 80 times more biomass on land than in the oceans.

"It was surprising to discover that the food pyramid in the ocean is inverted, meaning that there are more consumers than producers," says Phillips. "Most of us are used to thinking about such food pyramids the other way around, but one has to think about the generation times of the different organisms as well."

Domestic vs. wild

Humans and their livestock combined outweigh wild mammals at a ratio of about 20 to 1. In particular, the total weight of chickens on farms is approximately three times that of the total weight of all wild birds.

"I was struck when I realized how much of the living world we have already depleted and lost," says the study's corresponding author Ron Milo, professor at the department of plant and environmental sciences at the Weizmann Institute in Israel. "In the puzzles of big animals that I do with my daughters, there is usually an elephant next to a giraffe and a rhino. But in real life, there is now a cow next to a cow next to another cow and then a chicken. I think we should reconsider how much we consume and what we want to protect before it will be too late."

Humanity's outsized impact

The present-day global biomass is about half what it was before humans. Wild mammal biomass is now one sixth of what it was before humans.

"Most of the impact on global biomass comes from cutting down trees," says Yinon Bar-On, graduate student at the Weizmann Institute and the study's first author. "The main drivers of this decrease are probably forest management and conversion of wild habitats to grazing lands for livestock."

Provided by California Institute of Technology

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