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Half of life on Earth has vanished since we arrived on the scene

There's a lot less life than there once was
Cris Bouroncle / AFP / Getty Images

By **Michael Le Page**

The amount of living matter on Earth has fallen by half since the beginning of human civilisation. This is one of the staggering facts from the most comprehensive global census of the mass of living organisms yet done.

"Many things did surprise us," says Ron Milo of the Weizmann Institute of Science in Israel, whose team carried out the analysis.

The team define biomass as the mass of carbon in living organisms. This reflects the mass of the molecules of life, such as proteins and DNA, and excludes water – which varies.

No one has attempted to do such a comprehensive census of all biomass before. "It's what you could call a meta-meta-analysis," says Milo. "It's based on hundreds and hundreds of papers. We also consulted with many, many experts."

The team concludes that the total biomass on Earth is 550 gigatonnes of carbon (Gt C). For comparison, the water in a relatively small lake like Lake Erie has about the same mass.

The weight of humanity

That overall figure hides many surprises. For starters, biologists tend to think that most of the biomass on the planet is bacteria. "We find it is by far plants," says Milo. Land plants alone account for 80 per cent of the total.

This has a disturbing implication. A 2017 study led by Karl-Heinz Erb of the University of Natural Resources and Life Sciences in Austria found that the total biomass of land plants has halved since human civilisation began. So it follows that total biomass has also roughly halved.

The decline in land plant biomass is partly due to deforestation and other changes in land use, and partly to grazing and forest management keeping vegetation levels low, says Erb. "Humans, by using land, have halved global biomass stocks."

This decline is not the only incredible impact humans have had on the planet. The biomass of domestic birds – mostly chickens – is now 30 times greater than the biomass of all wild birds combined. What's more, the total biomass of humans is 0.06 Gt C: far greater than the 0.007 Gt C of all the world's wild mammals.

This is because there have been big declines in wild mammals as the human population has grown to 7.3 billion. The biomass of wild land mammals has fallen from 0.02 to 0.003 Gt C, while that of marine mammals like whales fallen from 0.02 to 0.004 Gt C.

Where's the mass?

After land plants, bacteria are the second biggest group in terms of biomass, accounting for 70 Gt C: 13 per cent of the total. However, 90 per cent of these bacteria live deep under the surface and are barely alive.

In third place are fungi, which include mushrooms and toadstools. They are followed by archaea – simple cells similar to bacteria – and protists: more complex single-celled organisms like amoeba. All the world's animals account for just 2 Gt C, well under 1 per cent.

Another big surprise, says Milo, is there is 50 times more biomass on land than in the oceans. Land-living biomass weighs in at around 470 Gt C, compared to 70 Gt C of biomass in the deep subsurface and a piddling 6 Gt C in all the oceans.

The reason for this enormous disparity is that, on land, plants have to accumulate biomass to grow high and reach the light, Milo says. In the sea, photosynthetic organisms like plants tend to sink if they accumulate mass.

Uncertain numbers

However, there are huge uncertainties about these numbers. The team has estimated the uncertainties for each kind of life, which range from 1.2-fold for plants to 20-fold for viruses. For the total biomass, the uncertainty is 1.7-fold.

"This is far too low," says Vaclav Smil, who came up with biomass estimates for his 2013 book *Harvesting the Biosphere*. "I am all for integrative biosphere-scale studies, but we have to be always honest about the limits of our knowledge."

Smil points out that we don't even know the total biomass of elephants. "One of the three species has been recently well counted, but the slaughter has been so rapid that even that total is now invalid, and converting numbers to body masses involves a sequence of heroic assumptions."

The biomass of forests and crops, and of humans and livestock, can be calculated with reasonable

certainty, Smil says. “For all other terrestrial and marine fauna, the figures get much more shaky. For insects, bacteria and viruses, they remain essentially the best guesses.”

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