The New York Times

TAKE A NUMBER

Counting All the DNA on Earth

By Rachel Nuwer

July 18, 2015

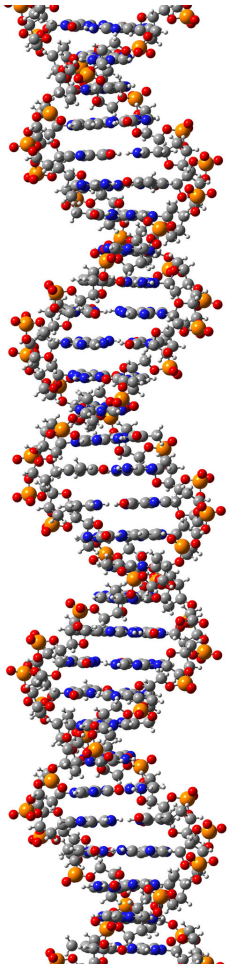
When scientists want to estimate global biodiversity, they typically tally the total species or organisms found around the world. In theory, there is another approach: to calculate how much DNA is contained on Earth.

This would be a more fundamental way of quantifying the diversity of life, but until recently no one had tried doing it.

“In the biosphere, it all comes back to DNA,” said Hanna Landenmark, a doctoral candidate in astrobiology at the University of Edinburgh in Scotland. “It’s the smallest unit of information we have, and all of that information has the potential of being connected to and interacting with everything else.”

By this logic, the planet is a sort of supercomputer in which total DNA represents the system’s storage capacity, and the rate of genetic transcription its computing power. But the first step in applying this approach to the study of biodiversity is to determine a composite figure for DNA.

By calculating the biomass of the world's microbes, plants, animals and fungi, researchers estimated all the DNA on the planet as a measure of global biodiversity.
Chromatos



With that goal in mind, Ms. Landenmark and her colleagues performed an exhaustive review of the number of microbes, plants, animals and fungi found on Earth. They also included viruses, because those agents play an important role in processing DNA and genes.

The researchers calculated each group's total biomass, based on the estimated number of living individuals and their size. Finally, they calculated the number of cells contained in each organism and multiplied that by the amount of DNA contained in each cell, giving them a value for the amount of DNA contained in a given person or tree, mushroom or bacterium.

As the researchers reported in the journal PLOS Biology, they found that Earth contains around 50 trillion trillion trillion DNA base pairs — the building blocks of DNA's double helix — plus or minus 3.6×10^{37} base pairs. If gathered together, that amount of DNA would weigh 50 billion tons and fill one billion shipping containers.

The team also calculated the planet's equivalent of computing power: the speed of DNA transcription. Given the average rate of genetic transcription for different organismal groups, they found that the biosphere processes more than 10^{24} subunits of DNA per

second.

The final figures should be considered preliminary approximations, Ms. Landenmark said. In searching for numbers to support their calculations, she and her colleagues discovered that much of the data they needed to make accurate estimates — such as the total number of animals in a given biome, or the size and number of copies of a particular species' genome — are not available.

Still, she said, "it was a very useful exercise, because it revealed gaps in knowledge about various aspects of the biosphere that we need to fill."

A version of this article appears in print on July 20, 2015, on Page D5 of the New York edition with the headline: 50