Global Extinction Rates: Why Do Estimates Vary So Wildly?

Is it 150 species a day or 24 a day or far less than that? Prominent scientists cite dramatically different numbers when estimating the rate at which species are going extinct. Why is that?

BY FRED PEARCE • AUGUST 17, 2015

Most ecologists believe that we are in the midst of the sixth mass extinction. Humanity's impact on nature, they say, is now comparable to the five previous catastrophic events over the past 600 million years, during which up to 95 percent of the planet's species disappeared. We may very well be. But recent studies have cited extinction rates that are extremely fuzzy and vary wildly.

The Millennium Ecosystem Assessment, which involved more than a thousand experts, estimated an extinction rate that was later calculated at up to 8,700 species a year, or 24 a day. More recently, scientists at the U.N. Convention on Biological Diversity concluded that: "Every day, up to 150 species are lost." That could be as much as 10 percent a decade.

The golden toad, once abundant in parts of Costa Rica, was declared extinct in 2007. WIKIMEDIA COMMONS

But nobody knows whether such estimates are anywhere close to reality. They are based on computer modeling, and documented losses are tiny by comparison. Only about 800 extinctions have been documented in the past 400 years, according to data held by the International Union for the Conservation of Nature (IUCN). Out of some 1.9 million recorded current or recent species on the planet, that represents less than a tenth of one percent.

Nor is there much documented evidence of accelerating loss. In its latest update, released in June, the IUCN reported "no new extinctions," although last year it reported the loss of an earwig on the island of St. Helena and a Malaysian snail. And some species once thought extinct have turned out to be still around, like the Guadalupe fur seal, which "died out" a century ago, but now numbers over 20,000.

Moreover, the majority of documented extinctions have been on small islands, where species with small gene pools have usually succumbed to human hunters. That may be an ecological tragedy for the islands concerned, but most species live in continental areas and, ecologists agree, are unlikely to prove so vulnerable.

But the documented losses may be only the tip of the iceberg. That's because the criteria adopted by the IUCN and others for declaring species extinct are very stringent, requiring targeted research. It's also because we often simply don't know what is happening beyond the world of vertebrate animals that make up perhaps 1 percent of known species.

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One way to fill the gap is by extrapolating from the known to the unknown. In June, Gerardo Ceballos at the National Autonomous University of Mexico — in collaboration with luminaries such as Paul Ehrlich of Stanford and Anthony Barnosky of the University of California, Berkeley — got headlines around the world when he used this approach to estimate that current global extinctions were "up to 100 times higher than the background rate."

Ceballos looked at the recorded loss since 1900 of 477 species of vertebrates. That represented a loss since the start of the 20th century of around 1 percent of the 45,000 known vertebrate species. He compared this loss rate with the likely long-term natural "background" extinction rate of vertebrates in nature, which one of his co-authors, Anthony Barnosky of UC Berkeley recently put at two per 10,000 species per 100 years. This background rate would predict around nine extinctions of vertebrates in the past century, when the actual total was between one and two orders of magnitude higher.

Ceballos went on to assume that this accelerated loss of vertebrate species would apply across the whole of nature, leading him to conclude that extinction rates today are "up to a hundred times higher" than background.

A few days earlier, Claire Regnier, of the National Museum of Natural History in Paris, had put the spotlight on invertebrates, which make up the majority of known species but which, she said, currently "languish in the shadows."

Regnier looked at one group of invertebrates with comparatively good records — land snails. And to get around the problem of under-reporting, she threw away the IUCN's rigorous methodology and relied instead on expert assessments of the likelihood of extinction. Thus, she figured that *Amastra baldwiniana*, a land snail endemic to the Hawaiian island of Maui, was no more because its habitat has declined and it has not been seen for several decades. In this way, she estimated that probably 10 percent of the 200 or so known land snails were now extinct — a loss seven times greater than IUCN records indicate.

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Extrapolated to the wider world of invertebrates, and making allowances for the preponderance of endemic land snail species on small islands, she concluded that "we have probably already lost 7 percent of described living species." That could mean, she said, that perhaps 130,000 of recorded invertebrates have gone.

Several leading analysts applauded the estimation technique used by Regnier. But others have been more cautious about reading across taxa. They say it is dangerous to assume that other invertebrates are suffering extinctions at a similar rate to land snails. Mark Costello, a marine biologist of the University of Auckland in New Zealand, warned that land snails may be at greater risk than insects, which make up the majority of invertebrates. "Because most insects fly, they have wide dispersal, which mitigates against extinction," he told me.

The same should apply to marine species that can swim the oceans, says Alex Rogers of Oxford University. Only 24 marine extinctions are recorded by the IUCN, including just 15 animal species and none in the past five decades. Some think this reflects a lack of research. But Rogers says: "Marine populations tend to be better connected [so] the extinction threat is likely to be lower."

Whatever the drawbacks of such extrapolations, it is clear that a huge number of species are under threat from lost habitats, climate change, and other human intrusions. And while the low figures for recorded extinctions look like underestimates of the full tally, that does not make the high estimates right.

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Can we really be losing thousands of species for every loss that is documented? Some ecologists believe the high estimates are inflated by basic misapprehensions about what drives species to extinction. So where do these big estimates come from?

Mostly, they go back to the 1980s, when forest biologists proposed that extinctions were driven by the "species-area relationship." This relationship holds that the number of species in a given habitat is determined by the area of that habitat. The biologists argued, therefore, that the massive loss and fragmentation of pristine tropical rainforests — which are thought to be home to around half of all land species — will inevitably lead to a pro-rata loss of forest species, with dozens, if not hundreds, of species being silently lost every day. The presumed relationship also underpins assessments that as much as a third of all species are at risk of extinction in the coming decades as a result of habitat loss, including from climate change.

But, as rainforest ecologist Nigel Stork, then at the University of Melbourne, pointed out in a groundbreaking paper in 2009, if the formula worked as predicted, up to half the planet's species would have disappeared in the past 40 years. And they haven't. "There are almost no empirical data to support estimates of current extinctions of 100, or even one, species a day," he concluded.

He is not alone. In 2011, ecologist Stephen Hubbell of UC Los Angeles concluded, from a study of forest plots around the world run by the Smithsonian Institution, that as forests were lost, "more species always remained than were expected from the species-area relationship." Nature is proving more adaptable than previously supposed, he said. It seems that most species don't simply die out if their usual habitats disappear. Instead they hunker down in their diminished refuges, or move to new habitats.

Claude Martin, former director of the environment group WWF International — an organization that in his time often promoted many of the high scenarios of future extinctions — now agrees that the "pessimistic projections" are not playing out. In his new book, *On The Edge*, he points out that El Salvador has lost 90 percent of its forests but only three of its 508 forest bird species. Meanwhile, the island of Puerto Rico has lost 99 percent of its forests but just seven native bird species, or 12 percent.

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Some ecologists believe that this is a temporary stay of execution, and that thousands of species are living on borrowed time as their habitat disappears. But with more than half the world's former tropical forests removed, most of the species that once populated them live on. If nothing else, that gives time for ecological restoration to stave off the losses, Stork suggests.

But we are still swimming in a sea of unknowns. For one thing, there is no agreement on the number of species on the planet. Researchers have described an estimated 1.9 million species (estimated, because of the risk of double-counting). But, allowing for those so far unrecorded, researchers have put the real figure at anywhere from two million to 100 million.

Last year Julian Caley of the Australian Institute of Marine Sciences in Townsville, Queensland, complained that "after more than six decades, estimates of global species richness have failed to converge, remain highly uncertain, and in many cases are logically inconsistent."

That may be a little pessimistic. Some semblance of order is at least emerging in the area of recorded species. In March, the World Register of Marine Species, a global research network, pruned the number of known marine species from 418,000 to 228,000 by eliminating double-counting. Embarrassingly, they discovered that until recently one species of sea snail, the rough periwinkle, had been masquerading under no fewer than 113 different scientific names.

Costello says double-counting elsewhere could reduce the real number of known species from the current figure of 1.9 million overall to 1.5 million. That still leaves open the question of how many unknown species are out there waiting to be described. But here too some researchers are starting to draw down the numbers.

Back in the 1980s, after analyzing beetle biodiversity in a small patch of forest in Panama, Terry Erwin of the Smithsonian Institution calculated that the world might be home to 30 million insect species alone — a far higher figure than previously estimated. His numbers became the received wisdom. But new analyses of beetle taxonomy have raised questions about them.

In June, Stork used a collection of some 9,000 beetle species held at London's Natural History Museum to conduct a reassessment. He analyzed patterns in how collections from particular places grow, with larger specimens found first, and concluded that the likely total number of beetle species in the world might be 1.5 million. From this, he judged that a likely figure for the total number of species of arthropods, including insects, was between 2.6 and 7.8 million.

Some researchers now question the widely held view that most species remain to be described — and so could potentially become extinct even before we know about them. Costello thinks that perhaps only a third of species are yet to be described, and that "most will be named before they go extinct."

Does all this argument about numbers matter? Yes, it does, says Stork. "Success in planning for conservation … can only be achieved if we know what species there are, how many need protection and where. Otherwise, we have no baseline against which to measure our successes." Or indeed to measure our failures.

None of this means humans are off the hook, or that extinctions cease to be a serious concern. Extinction rates remain high. And, even if some threats such as hunting may be diminished, others such as climate change have barely begun. Moreover, if there are fewer species, that only makes each one more valuable.

But Stork raises another issue. He warns that, by concentrating on global biodiversity, we may be missing a bigger and more immediate threat — the loss of local biodiversity. That may have a more immediate and profound effect on the survival of nature and the services it provides, he says.

Ecosystems are profoundly local, based on individual interactions of individual organisms. It may be debatable how much it matters to nature how many species there are on the planet as a whole. But it is clear that local biodiversity matters a very great deal.

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