

# Looking More Deeply Into the Past to Gauge the Planet's Future

*Researchers are using new sources of historical data to better understand long-term environmental changes.*

*Top: A hawksbill sea turtle, a critically endangered species. Visual: Free-Photos / Pixabay (<https://pixabay.com/users/Free-Photos-242387/>)*

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05.18.2020

**I**N 1995, biologist Daniel Pauly (<https://oceans.ubc.ca/daniel-pauly/>) made a shrewd observation: Scientists in his field had forgotten about the past. Pauly, who studied commercial fishing at the University of British Columbia, observed that fisheries scientists tended to measure change in the abundance and species composition of the fish stocks they studied relative to what they were like at the beginning of their careers. As fish stocks declined, each new generation of scientists generally accepted the new normal as the natural state of things.

“The result obviously is a gradual shift of the baseline,” Pauly wrote, “a gradual accommodation of the creeping disappearance of resource species.” He called the phenomenon “shifting baseline syndrome.”

The idea provoked widespread discussion among fisheries scientists and the broader conservation community, for whom it had disturbing implications. If the baselines were shifting, then basic statistics on population decline and targets for recovery were likely to be underestimates. Things might be worse than they looked, and with severe environmental degradation and declines in biodiversity underway (<https://www.un.org/press/en/1995/19951114.he916.html>), conservationists knew things already looked bad.

Research on shifting baseline syndrome since Pauly’s observation suggests it could be pervasive for scientists and regular citizens alike, according to a 2018 review (<https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/fe> published in *Frontiers in Ecology and the Environment*). Despite historical declines in biodiversity and ecosystem health, people tended to assume that the natural environment of their childhood was how things had always been. The reviewers reported this “generational amnesia” increased tolerance for environmental degradation and pollution, while changing people’s feelings

about what in the natural world was worth protecting. The reviewers blamed the shift, in part, on a lack of historical ecological data.

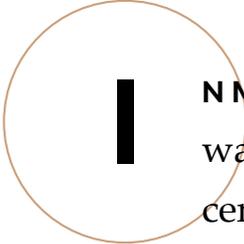
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Pauly suggested something similar back in 1995. The antidote to shifting baseline syndrome, he argued, is historical knowledge, especially anecdotal information like the stories of old fishers. “The big changes happened way back,” he wrote, “but all that we have to recall them are anecdotes.”

Scientists who study ecosystems of the past, however, know there’s a lot more data than that. In the decades since Pauly’s complaint, researchers have regularly pointed out (<https://royalsocietypublishing.org/doi/10.1098/rstb.2019.0297>) that long-term data, from the fossil record to the journals of early explorers, can help shift back the baselines. Concerns about the limitations of old data have been a roadblock to its widespread use, but scientists are now pushing for new conservation

efforts to apply the data as they search for insights on conserving species in the shifting world of the human-dominated epoch, the Anthropocene.

The realities of shifting baselines are “far bigger than I ever thought,” said Pauly, now the principal investigator with Sea Around Us (<http://www.seaaroundus.org/>), a fisheries science and data initiative at the University of British Columbia. “It is in fact terrifying.”



**I**N MUCH OF the world, ecological monitoring data was not regularly collected until late in the 20th century. Still, the long-term ecological past is not entirely obscure. Ecologists who reconstruct and study past ecosystems have diverse sources of data and methods to go way back in time, before the global industrial revolution, before European expansion, before some of the big changes.

These data have included (<https://royalsocietypublishing.org/doi/10.1098/rstb.2019.0220>) fossils, pollen, cave paintings, bone fragments, place names, records from industry and government, old letters and journals, indigenous knowledge, and genetic information; all the resources of paleontologists, archaeologists, and historians brought to bear on ecosystems. “It requires imagination, which scientists sometimes don’t

have,” Pauly said. “Because lots of us are really accountants, or stamp collectors, and not as imaginative as we should be.”

In Hawaii, marine ecologists have used restaurant menus

(<https://esajournals.onlinelibrary.wiley.com/doi/full/10.1890/1.>

from the early 20th century onwards to understand

fish abundance in coral reefs. In Egypt, one

biogeographer turned to Pharaonic monuments

([http://agris.fao.org/agris-search/search.do?](http://agris.fao.org/agris-search/search.do?recordID=BE2000001327)

[recordID=BE2000001327](http://agris.fao.org/agris-search/search.do?recordID=BE2000001327)) and hieroglyphs to

determine the range of the hippopotamus, which is

now extinct in the country. Researchers have used

centuries of records

(<https://royalsocietypublishing.org/doi/10.1098/rspb.2015.1299>

gathered by local officials in China to determine

where several species of small apes lived long ago.

In addition to giving a more complete picture of

past ecosystems, conservationists have proposed

(<https://royalsocietypublishing.org/doi/10.1098/rstb.2006.1977>)

other uses for this data. For instance, models of how

ancient ecosystems responded to shifts in the

climate could improve predictions of how climate

change will affect current ecosystems.

Yet despite what many researchers see as the

potential of historical data, it is still usually left out

of the assessments that drive conservation policy

and funding. According to one 2010 study

(<https://conbio.onlinelibrary.wiley.com/doi/full/10.1111/j.1755-263X.2010.00139.x>) in the journal *Conservation Letters*, only 15 percent of assessments of long-term population decline used data older than 100 years. For many species, such as the hawksbill turtle, (<https://pubag.nal.usda.gov/catalog/585978>) populations of which were decimated as early as A.D. 1800, even 100 years is not far enough back to avoid a shifted baseline.

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“I think we’re generally very focused on the present — What’s happening now? What are the problems we need to address now?” said Molly Grace (<https://www.zoo.ox.ac.uk/people/dr-molly-grace>), a conservation biologist at Oxford University. “So there’s this whole other field of paleoecology and historical ecology that has tons of data that hasn’t really been tapped into in conservation.”

In 2019, Samuel Turvey (<https://www.zsl.org/science/users/samuel-turvey>), a conservation biologist at the Zoological Society of London, and Erin Saupe

(<https://www.earth.ox.ac.uk/people/erin-saupe/>), a paleobiologist at Oxford, organized a meeting at the Royal Society of London (<https://royalsociety.org/science-events-and-lectures/2019/01/the-past-is-a-foreign-country/>) to gather scientists from disciplines that study past ecosystems to discuss how their work might help current conservation efforts.

“The potential for this source of data to contribute to conservation — both in terms of conservation science and practical conservation planning — has really taken off in recent years,” Turvey told Undark in an email. “We are also still gaining a more coherent understanding of what the past can tell us, versus what it can’t. What are its limitations as well as its strengths?”

So far, Turvey and Saupe concluded (<https://royalsocietypublishing.org/doi/10.1098/rstb.2019.0208>) after the meeting, the potential hasn’t been realized: “Although the importance and value of integrating past and present is now widely discussed as a novel paradigm in conservation, the reality lags far behind the theory.”

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**NE REASON LONG-TERM** data is not regularly included in conservation assessments is because conservation scientists are taught to think of their field as a “crisis discipline,” Grace said. Occupied with preventing imminent extinctions, conservation scientists don’t always know enough about older information to use it.

When conservation scientists do know about the long-term data, it is often perceived to be too unreliable or too incomplete to be applied to the pressing, practical concerns of protecting species today. “Ever since Darwin people have banged on about how awful, incomplete, and biased the fossil record is,” said Turvey at the Royal Society meeting (<http://downloads.royalsociety.org/events/2019/01/the-past-is-a-foreign-country/Final-discussion.MP3>). “But in reality all sources of scientific data have got incompleteness and bias.”

Historical data can be especially difficult to deal with. “These are very challenging records,” said Sophie Monsarrat, an historical ecologist at the Biochange center at Aarhus University in Denmark.

When the records exist, they are often hidden away in old books in obscure archives. Researchers must find those records and scour them for references to the natural world: What species? Where? When? How reliable are the records?

The data pulled from the records then must go through a series of statistical gymnastics to make up for biases and incompleteness. “If you want to know the past you cannot sample it the same way,” explained Pauly. “You have to sample people who have sampled.” In other words, it’s a mess. It might also require visiting distant libraries and working in multiple languages. And it’s slower than collecting new data, which researchers have cited as a serious concern under the publish-or-perish system in academia.

**M**ONSARRAT IS FAMILIAR with the joys and frustrations of historical ecological data. Now working on wilderness restoration projects — also called rewilding (<https://projects.au.dk/mega/>) — she has squinted at 19th-century whaling records from the New Bedford Museum in Massachusetts and combed through archaic references to the large mammals of South Africa. Her career straddles the divide between historical ecology and conservation.

In South Africa in 2017 and 2018, while a postdoctoral researcher at Nelson Mandela University, she worked with ecological data collated from letters, journals, diaries, and books from the past 500 years of colonial history, starting with Vasco da Gama's observation of elephants in Mossel Bay in 1497. That 500-year dataset had been painstakingly collated by her supervisors André Boshoff and Graham Kerley (<https://www.tandfonline.com/doi/full/10.1080/0035919X.2015>) who were themselves building on decades of work by an eccentric ornithologist named Cuthbert John Skead. "I was lucky to arrive in South Africa when the data collection was pretty much done," Monsarrat said.

Still, she acquainted herself with the records to gain a sense of historical context. She needed to know, for example, that when British colonists wrote "tiger" they really meant "leopard." Places change. Sensibilities change. Who was writing and why were they writing? "You start by looking for very specific things — records, locations, species names," said Monsarrat. "And you start getting lost in the description of the daily life. It's very fascinating. They were these European travelers just discovering a new world and describing the world in very colonialist ways, very often."

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To account for biases in the data, Monsarrat spent a lot of time reading through records, trying to understand how people — primarily European colonists — perceived the wildlife they encountered. “I would say it was very utilitarian,” she said. “You often have these descriptions of this animal and they describe how beautiful it is and then they shoot it. They shoot everything. It’s very striking how much death and how much animal shooting happens. I remember this one passage describing a leopard: ‘Female, yellow, very beautiful — I shot her. But then she had cubs, so I shot them.’”

Scientists: The Latest Wildlife Trackers (<https://undark.org/2018/01/wildlife-tracking-citizens/>)

Monsarrat’s work culminated in a 2019 paper (<https://royalsocietypublishing.org/doi/10.1098/rstb.2019.0215>) quantifying how leaving out the long-term data led to shifted baselines for the historical distribution of 12 species of large mammals in South Africa. And while it was rooted in historical ecology, it was oriented towards conservation. It was what Pauly had called for in 1995: Anecdotes from the past shifting back the baseline.

Without considering the historical data, the study showed, conservation planners risked underestimating the long-term range of species they want to conserve. This could also lead to

underestimates of a species' preferred habitat, throwing off projections of how that species may respond to climate change and other pressures.

"Today's range is a fraction of what it was in the past for most species, especially for large mammals," said Monsarrat. "You can't project into future climate change if you don't have the right data to start with."



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**HILE STUDIES LIKE** Monsarrat's have long been informally incorporated into conservation management, there's currently no consistent way to bridge the gap. That may change with the Green Status, a new conservation framework (<https://www.iucn.org/species/about/species-survival-commission/ssc-leadership-and-steering-committee/iucn-red-list-committee/iucn-green-list-species>) being developed by scientists from the International Union for the Conservation of Nature (IUCN). Monsarrat said this will "try to take it to another level."

The Green Status, set to launch at the IUCN World Conservation Congress (<https://www.iucncongress2020.org/>) (postponed from June 2020 to January 2021 due to Covid-19), will be a companion to the IUCN Red List of Threatened Species, which is the most widely used source for the extinction risk assessments that drive

global conservation policy and funding. While the Red List focuses on preventing extinction, the Green Status will focus on recovery.

In order to define recovery in terms of the historical abundance and distribution of species, the Green Status will require historical baselines — and long-term data.

The new policy is part of a broader shift in conservation biology, said Grace, who is also the IUCN task force coordinator for the Green Status project. “We’ve started to think more long term.”

But even within the Green Status, researchers haven’t always agreed on how to set historical baselines. Initially, the task force (<https://royalsocietypublishing.org/doi/10.1098/rstb.2019.0297>) proposed a one-size-fits-all baseline for all species either at A.D. 1500 or A.D. 1750 — benchmarks for the beginning of European expansion and the global industrial revolution, respectively. A more recent date would mean more data would be available, but there would be a greater risk of shifted baselines due to human impact, explained H. Resit Akcakaya, a professor of ecology and evolution at Stony Brook University and a member of the Green Status task force. “There’s a tradeoff,” he said.

*The historical baselines used in the Green Status will not represent an ecosystem's so-called pristine state, or even necessarily a desirable one.*

Some researchers pushed back on the idea of a universal baseline entirely, pointing out that it would not be ecologically or historically relevant for many regions, since human impacts vary so much around the world. Now, where possible, Green Status assessments will tailor baselines to human impacts on particular species in particular regions. "That's a good principle, but practicality must be considered," said Akcakaya. Namely, he added, are there data?

Grace and Akcakaya are quick to clarify that the historical baselines used in the Green Status will not represent an ecosystem's so-called pristine state, or even necessarily a desirable one. ("You can't have lions in Greece and Turkey. It's just not practical," said Akcakaya, referring to the fact that the big cats lived

(<https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1365-2907.2010.00181.x>) in Greece as recently as 100 A.D. and Turkey as recently as the 19th century) But knowing the full extent of the changes can support more ambitious conservation goals, they said. It's about a change in perspective — a shift of the baseline.

“You cannot present reestablishment without proper baselines,” said Pauly. “I think it’s good that we will have a spot where we will find all the reestablishment stories and where we can find that, in principle, it all works.” However, he is concerned that success stories might distract from the dire situation for many other species. According to the United Nations, a million plant and animal species are threatened

(<https://www.un.org/sustainabledevelopment/blog/2019/05/nature-decline-unprecedented-report/>) with extinction.

Grace views the Green Status differently: “We see this as a way of documenting what’s been lost,” she said. “Our thinking is that it’s good to know the scope of human impact on a species and to not let people off the hook so easily.”

Not letting people off the hook, for tens of thousands of species, will require a lot of very old data, and a fresh descent into the archives where they keep the bones and dustiest books. It will be a victory for the researchers who have long wanted to see the long-term data suffuse the world of conservation.

“It’s waiting to be found,” said Grace.

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