ScienceWatch Home
Inside This Month...
Interviews

Featured Interviews
Author Commentaries
Institutional Interviews
Journal Interviews
Podcasts

Analyses

Featured Analyses
What's Hot In...
Special Topics

Data & Rankings

Sci-Bytes
Fast Breaking Papers
New Hot Papers
Emerging Research Fronts
Fast Moving Fronts
Corporate Research Fronts
Research Front Maps
Current Classics
Top Topics
Rising Stars
New Entrants
Country Profiles

About Science Watch

Methodology
Archives
Contact Us
RSS Feeds

scienceWATCH.com
TRACKING TRENDS & PERFORMANCE IN BASIC RESEARCH

AUTHOR COMMENTARIES - 2010

March 2010

PDF

[+] enlarge

Camille Parmesan

Science Watch® Newsletter Interview

It’s one thing to have evidence that the world is experiencing an unprecedented period of warming, but quite another to say for certain that this warming, subtle as it is, will have a significant effect on the natural world—on any species, let alone humans. Demonstrating that the planet’s flora and fauna are indeed feeling the effects of the warming trend has always been a critical challenge in the research.

The first compelling evidence that this is indeed the case began to appear in the mid-1990s. Leading the way was a single-author paper in Nature by Camille Parmesan, who completed much of the work as a graduate student, on the northward range shift of a species of butterfly known as Euphydryas editha or, more commonly, Edith’s Checkerspot.

Since then, the evidence has grown from a trickle of papers to a river, while Parmesan herself has become one of the leading figures in climate-change research and has co-authored some of the most influential and highly cited papers in the field. She is now ranked in the top 20 among most-cited authors in the Thomson Reuter's *Essential Science Indicators*SM listing in the field of Environment/Ecology for the last decade. Parmesan also ranked at #2 among highly cited authors in this publication’s recent survey based on papers devoted expressly to global warming and climate change (November/December 2009).

These feats are amazing considering that Parmesan has only published a couple dozen papers . One of those, however, is a 2003 *Nature* report—"A globally coherent fingerprint of climate change impacts across natural systems," co-authored with Wesleyan University economist Gary Yohe—that has already racked up over 1,100

"What we need to do now is not just recreate the ecosystems that existed 200 or 300 years ago, but create systems that we believe will be most suited to a given area for the next 100 to 200 years of

citations. That report was originally selected as a New Hot Paper at *ScienceWatch.com*, as was a 2006 paper in the *Annual Review of Ecology, Evolution, and Systematics* (C. Parmesan, 37:637-69, 2006). Another *Nature* paper, from 2002 —"Ecological responses to recent climate change"—written with eight other authors, has collected more than 1,200 citations (see table below).

climate change"

Parmesan, now 48, received her B.S. degree, summa cum laude, from the University of Texas at Austin in 1984. She went back to UT Austin for her Ph.D. in biological sciences in 1989 and received it in 1995. For the next three years, she worked as a postdoctoral fellow at the National Center for Ecological Analysis and Synthesis at the University of California at Santa Barbara, and in 2000 returned to Texas to join the faculty at Austin, where she's now an associate professor in the Section of Integrative Biology. In 2007, as a lead author, she shared in the Nobel Peace Prize awarded to the Intergovernmental Panel on Climate Change.

Parmesan spoke to Science Watch *from her office in Austin.*

SW: The paper that launched you into climate-change research was your original single-author paper in *Nature* in 1996 on the Edith's Checkerspot butterfly. [Table, paper #6.] How did that come about, considering how little research was being pursued on climate change at the time when you were first studying the butterfly?

When I started my graduate school, the bulk of my Ph.D. was very basic research on Edith's Checkerspot. I was not into climate change at all. Then I got a NASA fellowship from the Planet Earth Program to study possible biological impacts of climate change. I had been working with Edith's Checkerspot for several years by that time, and I knew that if anything was responding to climate change it would be this butterfly. People had been documenting for 40 years that it was very, very sensitive to climate variability. We knew populations had gone extinct with severe droughts or severe climate years in the past. At that time, 1991, climate scientists were still not even sure there was a significant warming signal. Everything was up in the air, so to speak. But this butterfly could be a bio-indicator of climate change. It could be more sensitive than a thermometer in some ways. So I got this fellowship funded for three years and set out to gather all the historical records for the butterfly, to visit as many sites as I could to determine whether the habitat was still suitable and whether the butterfly still had a population there or whether it had gone extinct.

SW: How long did the research ultimately take?

It ended up taking me about four and a half years. It was very laborious. I could have come up with absolutely nothing, but it didn't matter because I already had my Ph.D. in hand and I thought I would have a blast camping out for all that time, which I did. I was tracking butterfly populations, starting in March in Southern California and ending in August when they emerge in Canada. I could track them across the seasons from site to site.

SW: What did you find?

When I put it all together, I found I had a much stronger signal than I ever could have imagined. It wasn't a matter of something complex, with certain ecotypes showing subtle changes that might be tied to climate change—it was a bloody obvious change. These butterflies were shifting their entire range over the past century northward and upward, which is the simplest possible link you could have with warming.

I was expecting some incredibly subtle, sophisticated response to warming, if at all. What I got was 80% of the populations in Mexico and the Southern California populations were extinct, even though there habitats still looked perfectly fine.

SW: After publishing this work in *Nature* in 1996, what response did you get?

You have to realize that there were two other studies published right about that time, one a year earlier, on biological responses to climate change, but that was it. One was on marine invertebrates, the other on Swiss mountain plants, and then there was mine on this butterfly. So the response was huge. The biological community was thrilled because of the amount of data I had and the scale I was looking at—the entire geographical range of a species, from Mexico to Canada. Typically in biology, people get lots of data from a single field site. Biologists working on climate change felt this was really the first convincing evidence that we were getting responses in natural organisms to climate change. And they found it convincing because the scale was so large. And the climate scientists were thrilled because they were finally detecting a significant global warming trend, but they were still kind of queasy about how real this was. My data convinced them that their data was real, not just a statistically significant fluctuation but a real signal that was already having an impact on a completely different system.

SW: Did you realize immediately that you were going to be in climate change for life?

Oh yes, it was pretty obvious that this was going to be what I'd be doing. I'd just gotten my Ph.D. when that paper came out, and the first response was not only a bunch of media, but an invitation to give a talk at the White House. And while I was on my DC trip I was asked if I'd like my name to be submitted as a nomination to the Intergovernmental Panel on Climate Change. As a post-doc, here I am suddenly on the international science circuit with silverbacks. It was great. And while I was working at the IPCC, it was very clear why I was catapulted so quickly. There were just very few biologists working on this subject at all. Policymakers wanted to know what was happening with the natural world, and there was an incredibly few people they could call upon to help inform them.

Highly Cited Papers by Camille Parmesan and Colleagues, Published Since 1996
(Ranked by total citations)

Rank	Papers	Cites
1	G.R. Walther, *et al.*, **"Ecological responses to recent climate change,"** *Nature*, 416 (6879): 389-95, 2002.	1,228
2	C. Parmesan, G. Yohe, **"A globally coherent fingerprint of climate change impacts across natural systems,"** *Nature*, 421(6918): 37-42, 2003.	1,123
3	D.R. Easterling, *et al.*, **"Climate extremes: Observations, modeling, and impacts,"** *Science*, 289(5487): 2068-74, 2000.	474
4	C. Parmesan, *et al.*, **"Poleward shifts in geographical ranges of butterfly species associated with regional warming,"** *Nature*, 399(6736): 579-83, 1999.	434
5	C. Parmesan, **"Ecological and evolutionary responses to recent climate change,"** *Ann. Rev. Ecol. Evol. & System.*, 37: 637-69, 2006.	367

SOURCE: Thomson Reuters *Web of Science*®

SW: Were you able to replicate the butterfly study with other populations?

Actually, with many more species. To do that I had to start working in Europe. It took me four and a half years to get sufficient data in the U.S. on one butterfly, about which we knew quite a lot. I knew I couldn't ramp up the numbers, the sample size, very much by staying in the U.S. I already had connections with lepidopterists in Europe, where they had distributions starting from 1760 in Great Britain, Sweden, and Finland. In northern countries, the first signs of spring are when the first butterflies are out. So a lot of people were recording butterfly flight seasons. We were then able to get down to the southern edge of these species in Spain, France and North Africa. The data wasn't as good on the southern edge, so we had to do some fieldwork, but we ended up getting data for 57 species, and it only took two years.

What was cool, in this case, was that the result was even stronger: 65% of the species were colonizing northward at the northern range of the boundary. They had jumped their historic ranges and were colonizing northward by a lot—200 to 400 kilometers. It was very dramatic. On the southern ranges, they had a tendency to be more stable, but still something like 22% were contracting northward, going extinct at the southern range boundary. We published that in *Nature* in 1999.

SW: Did the IPCC find this data convincing, or were there doubts that it was meaningful?

Well, the biologists at the IPCCC—about four of us total—wanted to come out with a statement that we had high confidence that wild plants and animals have responded to 20th-century climate change. But then the economists at the meeting—four or five of them—thought we were making too strong a claim. They wanted something much more watered down—much more wimpy, in effect. I argued quite a bit about this outside work hours with Gary Yohe, who's an economist at Wesleyan University in Connecticut. I felt like I was having to teach him Biology 101, and he was having to teach me how the rest of the world thinks. We just kept arguing and arguing. Finally the IPCC came up with a statement in its third assessment report (2001) that was halfway between what the biologists and the economists wanted. And Gary and I realized that we needed a new analysis, something that would get directly at the key issues that the economists had with the way the biologists were interpreting the data.

SW: What did you do?

I said, why not do a meta-analysis, but let's be really careful to deal with all the potential problems, specifically positive publishing bias. If you're working on a single species and you can link it to climate change, that gets published. If you're working on one species and there's no link, you don't publish. So there's a lot of positive bias with people working on single species. You get around that by only looking at multiple species. My European paper, for instance, had 57 butterfly species, so that went into the analysis. My Edith's Checkerspot paper, with one species, didn't go in. By doing it this way we found that about 50% of the species were being affected. I did that analysis with Gary and we tried to think of some pattern of response that could be uniquely attributed to change of climate, as opposed to all the other things humans are always doing—habitat loss, nitrogen loading, etc. We came up with something we called "sign shifting," in which the species habitat or springtime appearance responds to the various changes in temperature over the 20th century. You need long-term data for this, which cuts out a lot of species, but if you don't do it, you don't know if the changes you're seeing are really due to climate change.

SW: What do you think is the most important issue now, regarding the effect of climate change on different species?

It's one of the things I'm doing now that's considered very radical by most ecologists. We know a lot about ecological restoration at this point; we've been doing it in a scientific fashion for 30 years. For certain habitat types, we can recreate functioning ecosystems from fairly trashed-out land. We know we can do this. What I'm suggesting we need to do now is not just recreate the ecosystem that existed 200 or 300 years ago, which is what's being done now, but to create systems that we believe will be most suited to an area for the next 100 to 200 years of climate change. I think we have to pre-adapt habitats to the climate that's coming. I think that's where ecology needs to be going, where the science needs to be going.

SW: How do you do this?

We have to use our existing knowledge of restoration and of species' climate tolerances to create systems and communities that may not have present analogs. This could mean putting species together that don't reasonably exist together right now, but will exist in the climates we can expect to come. So, yes, the climate projections have to get better and better on the scale that ecologists work on—a few kilometers. That's what's needed in practical terms if we want to save endangered species in the face of climate change. Right now 50 kilometers is the resolution that gives high-confidence results. Technically we can take it down to one kilometer, but we can't have high confidence in the results.

SW: So your fellow ecologists are skeptical?

"We knew populations had gone extinct with severe droughts or severe climate years in the past. At that time, 1991, climate scientists were still not even sure there was a significant warming signal."

Yes. They think we don't understand species interactions well enough to be moving things out of their range, because we could cause invasions. They're also legitimately skeptical that climate projections are not yet consistent enough for many areas. If we're going to be creating policy based on those predictions, we need climate models in high agreement with each other. My response is, let's focus on the areas where they are in agreement—because there are those. And maybe we can continue policy-as-usual in areas where the climate models are all over the board.

SW: What do you think scientists have to do to get the public and the policymakers to take the evidence for climate change more seriously?

I think one of the problems is that climate-change science is moving so rapidly that a lot is known that isn't even out in the literature yet. Results are presented at conferences and they take a couple of years to be published. This is why it's incredibly important for scientists with knowledge of the latest science, scientists right on top of it, to be talking directly with policymakers. As it is, there's too many intermediaries, too many people who either aren't scientists at all or aren't up to date, and they're getting the policymakers to base decisions on ten-year old science. This is a very important role for scientists and something we all should be doing, although there's not much positive feedback for doing it. The reward system in academia is just not geared toward rewarding that kind of policy interaction and outreach. Universities have to start recognizing that it's part of the job of professors in this field, rather than an add-on.

SW: You're one of the most highly cited researchers in environment and ecology research, and yet you've only published 24 papers. This may be unprecedented. Is there a connection?

As you mentioned, it's unusual to have so many citations for so few publications. And I've just been talking about the reward system in universities. It was actually an active decision in my career to spend my research energy on a few really key papers where there was a major need for this kind of information or this kind of analysis. I also use my time to do outreach and speak to policymakers. I consciously chose to do these two things instead of getting a lot of smaller papers out and just padding my resume.

So yes, it was a conscious trade-off that paid off in my case. I'm not one of these people who can get by sleeping three hours a night. Given that, I had to consider how best I can spend my waking hours. I made the conscious decisions to participate in things like the IPCC, which my department told me to drop when I was first hired. I told them that I think the IPCC is more important than five more minor publications in five minor journals.

SW: You talked about how much you loved camping when you first did the Edith's Checkerspot paper. How much camping have you managed to do since that came out?

Don't ask me that. Since I became a professor nine years ago, I've spent maybe a total of three weeks camping, mostly in visiting my husband while he did his field work. I do a huge amount of traveling, but it's all conferences, meetings, giving outreach lectures to policymakers, spending almost all the time in windowless rooms.

KEYWORDS: Camille Parmesan, global warming, climate change, IPCC, ecological restoration, Edith's Checkerspot.