

# Interview with Robert Kates, Pathfinder in Sustainability Science



*In this interview, Robert Kates discusses the challenges of sustainability science in moving from what scientists know to actions that can provide solutions to pressing environmental and development problems. Kates notes that sustainability science has the dual mission of addressing core scientific and intellectual questions, while at the same time addressing development in particular places. He suggests that one of the key questions is how to address long-term trends and transition to a “better synthesis between environment and society.”* 🐟

*What do you see as the key sustainability challenges in Maine and how did you come to recognize these challenges here?*

**Robert Kates:** Sustainability challenges in Maine are part of universal sustainability challenges: the linkage between environment and development. Sustainable development plays out in different ways. It involves not only the conflict between environment and development, but also the ways in which environment and development support each other. The Sustainability Solutions Initiative (SSI) has decided to focus on three long-term trends and how these relate to environment and development: changes in urban development in the southern part of Maine; forest management in the rest of the state; and climate change over time. Other long-term trends could also be considered and should be on the sustainability agenda, for example, the key role and long-term cost of energy. The Sustainability Solutions Initiative has begun to address energy as well.

Some sustainability challenges can be picked up just by reading the newspaper, for example, Should we build natural gas pipelines? Should we run a big electricity line to the rest of the New England states? What's happening to the cod in the Gulf of Maine? But there are also longer and larger trends. For example, what is the changing demography and how does that affect environment and development?

Currently, we have many specific research problems, but no overall effort addressing each of the major trends. I would hope that eventually we would try to bring them together and synthesize what we are seeing about the environment, development, and the interaction in each of these areas. More important, sooner or later, there needs to be an even larger question: How do those trends interact and what have we learned, if anything, about the ways that they interact?

I think one of the challenges of the work in SSI thus far is the need for a mix between what policymakers, stakeholders, towns, and institutions feel they're getting from a project and what the people involved in the project think. One of my thoughts on how to achieve that balance is to come up with solutions that challenge existing theories and provide real answers to place-based issues in the short run that also contribute to our knowledge about the long-run situation.

*Do you feel as if the solutions piece is unique to SSI? If you were to brand SSI, are solutions at the heart of it?*

**Robert Kates:** I do. To my knowledge, SSI is unique. It is the only endeavor in the U.S. where all of the statewide institutions of higher education have come together not merely to address sustainability science research, but to see that research move into action. It involves finding solutions to problems that have been jointly identified by people who can use the solutions and people who can help find solutions in which science and technology can be applied.

*Do you see other ways that SSI is helping to advance sustainability science as a field, beyond the solutions lens?*

**Robert Kates:** I think one of the grand challenges for sustainability science is to move knowledge into action to provide solutions. SSI is a major experiment because of its breadth, its range of participation, its funding, and its involvement with stakeholders throughout the state. So it's a pathfinder in how to do it. This puts an enormous sense of responsibility, collectively, on SSI. To date, SSI has suffered from one of the major problems of sustainability science generally, in that it does much better on the environment side than it does on the development side. Partly this grows out of the fact that most sustainability scientists come from the environmental disciplines. But now we have, for the first time, a major study on how sustainability science has developed since the 1970s (Bettencourt and Kaur 2011). The study finds that there is a significant literature, often in developing countries, that deals with the development side of sustainable development and the development side of environmental development. And that's encouraging. The study looks at some 20,000 articles that contain the word "sustainability" in their title or abstract, and the bulk are not produced on the East Coast (Harvard complexes) or the West Coast (Stanford and others).



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*Why do they think that is?*

**Robert Kates:** The authors think it is because of some of the distinctive roles of interdisciplinarity, which is often easier to do in places away from the deeply entrenched disciplines. They think it's because of the concern with practical problems. They think it's also because a lot of the sustainability work is often done by government agencies.

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*I've heard you say that no one size fits all. When Eleanor Ostrom came and spoke at the University of Maine last year, she talked about this idea that there's no panacea. In your paper in Science on sustainability science you articulate some core questions that are central to this field. I wondered if you could talk about those core questions relative to a policy audience.*

**Robert Kates:** Sustainability science, as distinct from SSI, has always had this kind of dual mission. One is to address what seem to be the seven core questions. (See sidebar.) The other is to have science and technology support sustainable development in particular places. It has these dual missions: first of trying to describe an entire interdisciplinary field using a series of scientific and intellectual questions and second of being useful in the world and applicable to this environment-development interaction. Now, it turns out that a number of the core questions can be quite useful. For example, to advance our understanding of this useful work, especially when you say, "How does it work out here in Maine?"—one of the key core questions, the one on which I work in my own research—is long-term trends and transitions. This is partly the essence of SSI, to address these long-term trends and to transition locally in places and in the state as a whole, to a better synthesis of interactions between environment and

society. Another core question that's powerful and useful would be: How can we measure sustainable development? What would sustainable development mean here in Maine? There is, of course, a big contradiction there. If you take a short-term horizon of, say, one generation, practically everything is sustainable. If you take forever, which critics often cite, nothing is sustainable. How far in the future should Maine towns plan for?

Another core question is whether there are known limits or boundaries. What is the commercially cut forest size that is needed to support Maine industries in the long term, given that the generation of trees is so long? Where does biomass fit into our long term energy needs? How much biomass will we really need? In many ways, the core question about whether there are terminal limits at all is really a discussion about values and how values differ.

So does science have anything concrete to say about drawing lines—"guard rails," some people call them—fencing in boundaries of all kinds? How do we model nature-society or human-environment interactions? When you read through the discussions of some of the SSI projects, a number seem to be putting a lot of emphasis on building models. While these may be important to the core questions of sustainability science, they are abstract to policymakers and many have yet to demonstrate how useful they will be. One of the frequent problems is that model building is difficult and you often run out of time and energy before you get to the place where you can actually use them. On the other hand, there is a good deal of evidence that there are many useful models that already can be used at the town level. For example, there is simple software that enables a user to change the forecast about how a town is developing and look at its built-up area. You can take a map of any town and show how it would look given its current rate of growth, a much faster rate of growth, a slower rate of growth, or growth that has more commercially available land. You can put in, on a very simple model, questions that any town can find useful as it tries to develop a comprehensive plan. So, there are lots of relatively simple models that we already have that can be useful. There are other models that are useful, but that are one further step removed from what people in policy need, except for those in specialized areas of policy that

require models for things such as forest management, fisheries, and so on.

*In SSI there is a real emphasis on stakeholder engagement as fundamental to linking knowledge and action. Could you speak to stakeholder engagement? Is that something you see happening in other sustainability science programs? What do you see as the value of bringing in stakeholders?*

**Robert Kates:** Well, I don't like the term stakeholder engagement (chuckles). But it's very widespread. For many institutions in our society, it becomes a formulaic method of supposedly participatory involvement. What I am deeply interested in and what I think many of the projects in SSI are trying (or ought to be trying) to accomplish is the co-production of knowledge. In the next town from me, Surry, there's a big debate about raising oysters and clams in Morgan Bay. And in my own town, Goose Bay, they've just gotten permission to move ahead. The Department of Marine Resources makes sure there's a public hearing, makes sure there's a scoping session, makes sure there's a commentary session, makes sure the Morgan Bay Improvement Association gets involved, and so on and so forth. But none of those kinds of groups necessarily had a role in setting up the criteria that say, "Yes. No. You can. You do meet our particular criteria." Partly, that's based on an overall decision by the legislature and the state agency, which says "Aquaculture is important for Maine and our only concern is that it not interfere with the rest of the working waterfront." So there is stakeholder engagement. There is stakeholder involvement, but it's not the co-production of the knowledge that creates reasonable criteria for aquaculture.

Stakeholders will have something to teach us and will bring something important to the statement of the problem. That is probably the most important issue. Over and over again, those involved in science and technology think they have identified the problem. They have identified a useful research problem, or even a solution, and they then go looking for people who might be able to use it. So what about the co-production of identifying the research problem to work on? What might the possible solutions to that problem be? Joint agreement is the important critical first step.

### Core Questions of Sustainability Science

1. How can the dynamic interactions between nature and society—including lags and inertia—be better incorporated into emerging models and conceptualizations that integrate the Earth system, human development, and sustainability?
2. How are long-term trends in environment and development, including consumption and population, reshaping nature-society interactions in ways relevant to sustainability?
3. What determines the vulnerability or resilience of the nature-society system in particular kinds of places and for particular types of ecosystems and human livelihoods?
4. Can scientifically meaningful "limits" or "boundaries" be defined that would provide effective warning of conditions beyond which the nature-society systems incur a significantly increased risk of serious degradation?
5. What systems of incentive structures—including markets, rules, norms, and scientific information—can most effectively improve social capacity to guide interactions between nature and society toward more sustainable trajectories?
6. How can today's operational systems for monitoring and reporting on environmental and social conditions be integrated or extended to provide more useful guidance for efforts to navigate a transition toward sustainability?
7. How can today's relatively independent activities of research planning, monitoring, assessment, and decision support be better integrated into systems for adaptive management and societal learning?

Source: Kates et al. (2001)

But it also turns out that policymaker stakeholders do appreciate, at least in the beginning of the relationship, what we know already about a situation and the range of things we might be able to do. So there's this kind of mutual learning. Often it takes a lot of time, and it may take so much time that you haven't really launched the research and you've run out of time for it. So there's always a balance. It turns out that there's a real advantage, for example in SSI, between the research groups

that have long-standing relationships with some of the potential users and some of the stakeholders.

The vernal pools project [see sidebar] is an example that demonstrates this, as researchers were able to move more quickly to address what the useful research would be for policymakers. When legislation that was enacted to protect vernal pools was viewed as restricting development legislation, the researchers did not step forward with what often is the classic response of saying, “Here is what we scientists know about the importance of vernal pools for the protection of these particular species, but also for the maintenance of the healthy forests and the like. Here are all the good reasons you should be supporting the legislation.” Legislation is often broad brush: one size fits all. The vernal pool team was able to present options that had not been explored in the legislation that would allow towns a greater degree of flexibility. The group stepped forward, working with specific towns, specific places, looking at their vernal pools, looking at their maps. With enough of a cross section of those towns, they were able to draw larger questions. They came up with one initial set of possible solutions, and then were able to explore other solutions. One gets a sense that these researchers are both helpful and are being recognized.

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of changing, looking anew.

*Do you think this approach enters into the ongoing negotiations around the vernal pool legislation?*

**Robert Kates:** Yes. I attended a legislative hearing in which I listened to a presentation given by these researchers. The legislators all started with a common base of misinformation about how and why the legislation was developed. It actually was developed to prevent a larger federal role, to maintain the state role, to localize the issue. None of the legislators had realized that. And when they did realize that, they began looking at it freshly and anew. It was a powerful presentation. You could see it change

people’s perceptions. You could see the heads shaking both in the audience and in the panel of legislators.

*I think the vernal pool example speaks to this next question. How do you think SSI’s findings have contributed or will contribute to tangible solutions and a more sustainable future for the people of Maine?*

**Robert Kates:** I think SSI has created a group of people and institutions that, many of whom for the first time, are focusing on sustainability problems. They’re doing it in an interdisciplinary way and they’re training a large number of students. There’s been a whole, wonderful input of new faculty and students. All of them bring good ideas.

In many ways what the project has done is to find the 21st century version of the challenge to the land grant university. When the University of Maine was formed, the state was a different place. In many ways both the hopes and the conflicts of environment and development reflect the major changes and the challenge of the land grant university today.

I think it’s a good time for everyone with SSI research projects to pause a moment and ask themselves a question: What is the state of the problem we’re working on? In many cases there should be a restatement of the problem. They will have changed from where they originally began. Acquiring more stakeholder input can lead to a restatement of the problem. But they should stop and pause now because it’s easy to get started with original assumptions and not have effectively absorbed both how the world has changed and what the research says. Science is always a process of changing, looking anew.

I think that projects that have not identified the nature of solutions by now are candidates for not succeeding. For every problem there are multiple solutions. Some problems are intractable and there are no solutions that are obvious. But if you don’t keep your eye on solutions, you can drown in your own research and are unlikely to come up with solutions.

*In your experience, what are the most effective ways to leverage solutions from local to broader scales? How do we move these solutions across scales?*

**Robert Kates:** We have tens of thousands of case studies of particular places, some of which come up with solutions to problems, some of which are just good at stating a problem or identifying a troubling trend or concern. In my experience you can't take case studies and elevate the understanding deriving from them unless you have some elements of common data, common concern, common questions, within the distinctive situation of the case studies. The case studies are inevitably lacking because they are done at different times and places and with different people. Sometimes they use existing methods, sometimes existing questionnaires, but in general they are each unique. So my short answer is that the few successful cases we have of leveraging across scales have common elements from the beginning. It is possible to go back and try to think across scales or have a long-term study area. There are a significant number of good examples of that. To some extent SSI has elements that aim to move across scales. There's been some limited sharing of common methodology. There are a number of projects that have participants who are involved in long-term and in-depth study.

Let me go back to the common data set. There also is commonality of places, which can tell you a lot. So it isn't just that they're using the same methods. I've always been intrigued with so-called natural experiments. These occur where there's been some change that has taken place that extends over a large area and we can look at before and after that change. Then our challenge is to what extent can we draw upon our understanding of the local to the larger regional? I've always found that it helps, as part of that, to try to define clearly what you think are the common elements and then systematically look through our 400 towns in Maine and ask which meet those criteria? So when we're talking about leveraging up, we can talk about commonalities, say for example, in the 142 towns that share the same quality, or towns under 4,000 in population, or ones that have a single source of water, or whatever the issue is. You can then clearly define who you're trying to reach and then scale up.

I have one example that popped into my mind of my own research that can illustrate this from 15 years ago. I've always been interested in Africa and have always been interested in demography. In general,

Africa is under-populated, which surprised me, but it does have some places with very large populations. I was curious about the natural experiment of how people have dealt with hunger, food supply, and food security in places that were underdeveloped. Could we look at places that had high populations and see as their populations increase what did people do, how did they do it, did they have a world in which they suffered famine? Did they have to leave or were they able to absorb the change in resource availability? And if so, how? It turned out that using census data and a subunit of national data and districts or regions we could find 200 places that had enormous populations by any standard of more than 200 people per square kilometer. So we looked for people who had written over a long time about an area within those areas. We found 10 who had been doing long-term research in those areas and recruited them to just answer the questions: How, over time, did people cope with increased density? Did they suffer famine? Did they starve? Were they able to develop new crops? From that we got important insights on African agriculture. The first step was to define the common places for the natural experiment—places that had changed rapidly over time—and the second, who had studied within those places and were willing to help by answering a few well-defined questions.

*I have two more questions. What advice do you have for students who are entering the field of sustainability science?*

**Robert Kates:** When friends or family visit places I ask them to send me a postcard, picture postcard preferably, with three adjectives that either reflect how they feel in that milieu or that describe the milieu, or a combination of both. So I have this big box of cards, which I keep promising I'm going to sort through. Meanwhile, I keep urging people to send me a postcard when they go some place new. I've been writing "three adjectives" because I did a research project on forests in which I took out groups to the Harvard Forest and tried different methods to get them to characterize what they were seeing. I found that asking them for three adjectives in a forest often turned out to be just as effective as any complicated indicators.

# Top 10

## Ways SSI Is Not “Science as Usual”

- SSI is working with Maine citizens to address their needs, through all stages of the research process
- SSI is focused on solutions
- SSI researchers are working with stakeholders
- SSI is working across disciplines rather than having individual disciplines work in isolation
- SSI researchers are working together across higher education campuses
- SSI is working across and integrating problems
- SSI is focused on addressing economic, environmental, and social challenges at the same time
- SSI researchers are focused on adapting their research to make it more applicable to Maine communities, using a place-based approach
- SSI scientists are focused on finding new ways to get the word out about research
- SSI is training applied and solutions-oriented researchers

*“Top 10” lists provide a synthesis of common themes, methods, strategies and outcomes within SSI and reflect the collective input of more than 30 SSI faculty and students.*

So my three words of advice for students entering the field of sustainability science are “excited,” “comfortable,” and “integrated.” I think you should feel excited that you’re on the cusp of a new great development. You should be excited because of the remarkable opportunity here, getting support and so on; the good people you will learn from and work with; the sense of bridging the gap between learning and doing. You should feel comfortable and set aside all your worries. You have two kinds of worries: worries that you share with every other graduate student in anything, and then a few distinctive worries, although they become more widely shared, such as, Will I ever get a job? What will I do in the future? How can I possibly learn enough within and across my disciplines? And integrated because—and this is strictly my own—some time in this century, disciplines will disappear. I think we’re

on our way to reorganizing how science is done, how universities are organized. That will take a long time, may take a longer time to change. To give an example, we will no longer have departments of physics or cosmology or astronomy. Instead we will have the department that tries to answer—the cluster of people who try to answer—what is the origin of the Universe, you see? I’m reminded that one of the nicest invitations I had was one I could never turn down because once a year, the graduate students organize a conference just amongst themselves at Arizona State University. This was something that the IGERT (Integrative Graduate Education and Research Traineeship) students had organized and I was the keynote speaker. Somebody in the audience got up and asked the chairman, “You’ve been talking all about their presentations, all about integration and how you’re integrating this and integrating that. What about your professors?” And immediately the chair said, “Oh, we’re, we’re so far ahead of our professors it’s incredible.” That’s how you ought to feel.

*So my last question: Is there anything I didn’t ask that you’d want to add to this conversation?*

**Robert Kates:** One of the things I didn’t bring up is education. Sustainability scientists are divided about where they should go with education. There is an evolutionary group who want to slowly develop some interdisciplinary courses, but never challenge or take on the limits of disciplinary organization, knowledge, and so on. There are others who want to move ahead with either creating new disciplines, like sustainability science, or more often transcending that stage and creating schools of sustainability science. And then there’s a variant of that one, such as the Earth Institute at Columbia, which creates an institution. To some extent, the George Mitchell Center at the University of Maine is similar because it is an existing institution that can take this project under its wing. But often the challenge is: Is there a distinctive degree in sustainability science or is it a notion that it’s a degree in an established discipline with an emphasis maybe on sustainability science? I don’t know how much of that discussion is going on. I do believe that the having people work together on research is probably often the best way of initiating that discussion. 🐙

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