

EDITOR'S JOURNAL

Mud, Muddling, and Science Policy

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Most days, I think about science policy writ large. Where does the \$200 billion US taxpayers put toward science go, and how can science help craft better policy and better lives? But at home, I approach the subject at the level of the clam. The Maine island where I live has 477 human residents, and my role in town governance is to chair the shellfish conservation committee. As a clam decisionmaker, I do science policy at its smallest and muddiest.

It's not easy figuring out how best to manage mollusks. My committee is charged with ensuring "the protection and optimum utilization of shellfish resources." People in the communities around us depend on digging clams to make a living, continuing family traditions that go back many generations.

But since 2013, our surveys have dug up fewer and fewer clams in the town's three flats. We don't know of any single cause for the decline, which has been observed all along the Maine coast. Perhaps it's due to the rapidly warming waters of the Gulf of Maine or the sea's changing chemistry. Green crabs, voracious predators that arrived from Nova Scotia, Canada, appear a major culprit. But others lurk in the tides. The flat, putty-colored milky ribbon worm slips its proboscis into a clam's siphon, injects a toxin that dissolves the mollusk's tissues, and then slurps it out of its shell like a clam milkshake. And without any

idea of what will show up next, it's hard to predict how the behavior of the ecosystem as a whole may change. At our last meeting, a marine biologist from the nonprofit Manomet explained that newly arrived blue crabs may be eating the green ones. She asked us to document them for a citizen science project.

Amid so many unknowns and so little knowledge, we are left to muddle through the process of figuring out what to do. Should we license more clambers? Plant a clam farm? Close the flats for conservation? Kill crabs? Which ones, and how many? Meanwhile, the town has also created a climate action plan to figure out how to handle road flooding, possible sea water contamination of local aquifers, and the effect of rising waters on local salt marshes. It's a lot for 477 people.

Until recently, climate policy was primarily vexing for national and international policymakers who struggled to agree on limits for greenhouse gas emissions. Today it is increasingly a local matter, as every hamlet's clam committee begins to craft a response. Some argue that finding workable solutions among people who share land, highways, and values may be easier and more effective than global and national efforts. But for the scientific enterprise, the devolution of big policy to small places poses new challenges around establishing spaces for democratic decisionmaking, building knowledge to inform those decisions, and effectively linking the two.



Looking across the clam flat and the remains of a fishing weir toward the tidal marsh at Squirrel Point, Arrowsic, Maine. Photo by Lisa Margonelli.

Climate is not the only subject where policy has shifted to focus on the small. After all, the combined spending of state and local governments approaches that of the federal government, giving them a prominent role in decisionmaking, particularly on infrastructure, education, and environmental issues.

Political scientist Jacob Grumbach observes that “over the past generation, the state level has really become the main policymaker and the central battleground in American public policymaking, in contrast to the national level.” This dynamic, he argues, arose out of federal gridlock, but is now altering the way local and national political systems work—while favoring some interests at the expense of others. As on the clam flats, when new players arrive, the behavior of the whole system changes.

Since the end of World War II, the scientific enterprise has looked to the federal government for funding, orienting itself around national priorities. As decisionmaking moves toward states and localities, science

leaders will need to understand how the landscape of opportunity is shifting and build the capacity to answer questions posed by specific geographic communities.

Education is one area where science is already witnessing this shift in opportunity. After Sputnik launched the beginning of the space race, Congress passed the National Defense Education Act in 1958, which spurred the National Science Foundation to develop national curriculums, textbooks, and even films. By 1983, that program had ended, and there was new fear that US science education was falling further behind. A *Nation at Risk*, a report from the National Commission on Excellence in Education, diagnosed the problem in the dire terms of the times: “We have, in effect, been committing an act of unthinking, unilateral educational disarmament.”

But a 2021 report from the National Academies of Sciences, Engineering, and Medicine, *Call to Action for Science Education*, argues that highly local collaborations are the way to improve science education. In this issue, Susan Singer, Heidi Schweingruber, and Kerry Brenner, who worked on the report, relate that “across the nation, we have seen a path to achieve both an informed citizenry and capable workforce by recruiting local industry, community, and philanthropy into supporting science education and allowing learners’ experiences to be tailored to their local context.” These local efforts can identify their own priorities, secure resources, and draw on community connections. In southeastern Tennessee, for example, a STEM alliance between school systems, universities, employers (including Volkswagen), and philanthropy worked together to build teachers’ skills, supply resources, and reinforce regional connections. The alliance is credited with helping raise student scores on the *Ready Graduate* indicator to 76%—in contrast to an average of 40% for other Tennessee schools.

One strength of these regional STEM alliances is that they may sidestep some of the pitfalls of national partisanship. “Importantly, they provide a venue for people to find common ground,” Singer and coauthors write, “so that progress does not get lost to political polarization.”

This insight applies beyond education: superlocal green energy projects could create new political alliances if they’re carefully tailored to local needs and culture. Ariel Kagan and Mike Reese describe an “elegant” pilot project that harnesses wind power to produce ammonia at the University of Minnesota West Central Research and Outreach Center. The project aims to help farmers save money on expensive imported fertilizer while lowering the carbon footprint of their crops. It also builds on a long local history of farmer cooperatives that organized to fight the power of railroads and grain monopolies—and are now partners in the pilot. Its achievements offer a glimpse of how uniquely local energy

solutions could create new economic and political alliances around climate-friendly technologies.

This bespoke wind-to-hydrogen-to-ammonia plant required significant local knowledge production. Scientists and engineers at the University of Minnesota worked to optimize processes to electrolyze water, separate nitrogen from the air, and then combine hydrogen and nitrogen to make ammonia using the region's stranded wind energy. Another unit at the university developed a tractor and a grain dryer fueled by ammonia. That meant small-scale, locally produced ammonia could be used to fertilize, grow, and dry corn. The project estimates that by combining these technologies, the grain's carbon emissions can be reduced by nearly 80%.

Going local opens up interesting new possibilities for policy, but it also challenges the science enterprise to produce evidence for decisionmakers. Some initiatives that are already underway could help this transition. *Issues* has published articles on state- and county-level programs to bring evidence to policymakers in North Carolina, California, Missouri, Maine, and upstate New York. Movements for engaged research and citizen science could be expanded to produce knowledge fit to community needs. And, as Rayvon Fouché argues in this issue, involving more social scientists and non-scientists in forming the questions that science tries to answer could be a powerful tool for transformation.

Another possible tool for creating relevant knowledge is developing theory that can be applied to diverse circumstances. Samantha Montano reflects on the pace of disasters in the Gulf of Mexico and calls for building the capacity of local emergency management agencies in the region. But to boost the effectiveness of the response system as a whole, she recommends investing in more research on disaster theory to inform best practices so that local efforts can learn from and build upon the experiences of other management agencies and communities.

Dipping into *Issues*' 40-year archive, the shift toward the local is readily apparent. In the magazine's early days, proposals for arms control, agriculture, ozone, health, and climate policy were regularly aimed at national or international policymakers and institutions. By contrast, in this issue, an article on monitoring biosecurity in the melting Arctic argues that researcher-to-researcher science diplomacy can be a powerful tool at a time when global bodies are constrained by geopolitical tensions. Nataliya Shok and Katherine Ginsbach write that "keeping scientific connections like these alive among Arctic researchers should be a diplomatic imperative, both to deepen the global understanding of shared health and

climate risks as well as to preserve peace, stability, and constructive cooperation in the region and beyond."

When I'm wearing my clam hat, the switch to local focus feels inescapable. But in my *Issues* hat I sometimes mourn the eclipse of Big Policy, and the way society has traded the possibility of doing big things for a raft of small ones—the "art of the possible."

In his 1959 essay "The Science of 'Muddling Through,'" social scientist Charles Lindblom provided an antidote to a similar nostalgia for a past age of big ideas. Lindblom wrote to clarify that incremental policies reflected real-world decisionmaking practices, even though the policy community at the time derogatorily called this "muddling through" and attached more credibility to so-called rational policies.

Revisiting Lindblom's essay offers a window into a moment when ideals of centralized planning, which had been integral to the New Deal, were being superseded by incremental approaches that reflected shifting social values and goals. Lindblom mentioned in passing that congressional interest in creating Medicare, now regarded as a success of Big Policy, was powered by divergent ideals: Democrats wanted to strengthen federal welfare programs, while Republicans wanted to counter unions' demands for pensions. Lindblom argued that "muddling through," in its ability to handle complexity, opposing values, and hazards, constituted a legitimate and in many ways superior system—"not a failure of method for which administrators ought to apologize."

Lindblom's article turns 65 years old this spring—old enough to apply for Medicare—and its citation rates have accelerated, from 5,382 on Google Scholar in 2011 to nearly 19,000 as this went to press. If it seems difficult to imagine that anyone would have had to strongly defend what is now an established method of policymaking, consider that we may be in a similar place with local policymaking today. And, following on Lindblom's insight, having identified new dynamics between local, national, and international policy, it will take time and research to understand what new opportunities and hazards this murky, shifting ecosystem will hold.

As for the clam committee, last year we realized that obsessing over lost clams was not making those that remain any happier. At the urging of two teens who attended meetings of the committee, we scavenged piles of marine debris out of the salt marshes surrounding the flats and turned them into a sculpture in front of the town hall. By encouraging residents and summer tourists to talk about the enormous quantity of plastic in our estuary, the teens hope to influence policy at higher levels.

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