ENVIRONMENTAL POLICY

War Over the Wetlands: Ecologists v. the White House

How wet must a wetland be? That may sound like a riddle, or a scholastic question of interest only to conservation biologists, but in fact it has political implications. At this moment, Vice President Dan Quayle's Council on Competitiveness, using what scientific critics call outdated ecological concepts, is developing regulations for wetlands that would protect only areas that are wet continuously. And that's a mistake, say ecologists, who are alarmed by a 1990 government inventory that found that the nation's total of 104 million acres of wetlands is declining—despite President Bush's promise that it would be protected.

Near the heart of the set-to between the White House and its ecologist-critics is a profound paradigm shift that has taken place in ecology in the past decade. Beginning in the late 1970s and 1980s ecology shifted away from the view that most ecosystems, when they mature, tend toward a steady state. In place of this "balance of nature" view, ecologists adopted a "flux of nature" view, in which an ecosystem is seen as a mosaic of variegated pieces that change character and function over time.

This "patch dynamics" paradigm has critical consequences for understanding wetlands, which are among the most changeable of ecosystems. "A functional wetland—and I emphasize functional—is one in which some patches are indeed wet all year long, but in which other connected patches are wet only part of the year and some patches aren't wet at all in some years," says Leigh W. Fredrickson, director of the School of Forestry, Fisheries, and Wildlife at the University of Missouri, Columbia. In other words, a wetland isn't always wet—and ecologists think the Administration is making a mistake in seeking to protect only the wettest areas. They argue that protecting the nation's wetland's requires setting aside a much larger area—including the sometimes dry patches needed for these ecosystems to function.

Perhaps it isn't surprising that the Administration is relying on the static view. After all, even though patch dynamics was formulated in the late 70s, it was applied initially to problems in forest ecology that traditional methods couldn't solve. And though the concept was rapidly embraced by the ecological community, it takes time for a conceptual shift to have consequences for policy. Not until 1989 did Michael Soulé of the University of California, Santa Cruz, and David Western of the New York Zoological Society call on conservation biologists to make the new paradigm central to species and ecosystem preservation.

Once patch dynamics began spreading through the ecology community, wetlands ecologists found it of great help in understanding their subjects of study, which are unstable because rain and snowfall are among the most variable of all climatic phenomena. That variability translates into large shifts in the degree of soil saturation in wetland patches. Thus, while a 1- or 2-year inventory might identify certain patches as wet, seasonally wet, or dry, an inventory several years later might find that the patches have changed categories entirely. And with those shifts, the type of species changes. In the wetlands south of San Diego, for example, several endangered plant species show up only in certain years, when the arrangement of patches is suitable—otherwise they remain dormant in the soil.


CRAIG KOPPIE/USFWS

Is wetter better? An eagle nesting area on Taylor's Island, Maryland, on the Chesapeake Bay. How to protect wetlands is at the center of a dispute between policy makers in the Bush Administration and ecologists.

Critics of the Bush Administration's efforts to rewrite wetlands regulations argue that this ecological dynamism is being ignored. In response to White House criticisms of the 1977 Clean Water Act, the Environmental Protection Agency, the Fish and Wildlife Service, the Army Corps of Engineers, and the Agriculture Department Soil Conservation Service drafted regulations limiting federal protection to wetlands that are permanently saturated. "Under the new regulations, a wetland would have to pass the so-called duck test: If a duck splashes when it lands, it must be a wetland," scoffs Peggy L. Fiedler, wetlands specialist and director of the conservation biology program at San Francisco State University. In some parts of the country, this could declassify as much as 75% of wetlands currently protected by the Clean Water Act.

The draft regulations also contain a mitigation provision: Developers can fill in low-priority wetlands for construction as long as they create an equal amount of similar wetland elsewhere. But creating new wetlands has yet to succeed on a large scale—indeed, a report issued by the National Research Council last November stated that, in fact, it may be impossible to recreate a functional wetland. Part of the problem in recreating the system is its dynamic, patchy nature. Says Joy B. Zedler, director of the Pacific Estuarine Research Laboratory at San Diego State University, "you may create something that looks like a natural wetland in one year, but it may not be functional in other years because it is not connected to the other patches that together make up a functional wetland."

The bottom line of patch dynamics for policy, says Zedler, is that preserving the nation's wetlands will require setting aside far more land than most policy makers want to acknowledge. Estimates of how much range from 10% to more than double the acreage of wetlands now protected. Worse, patch dynamics suggests that in states such as California, which has lost more than 90% of its wetlands, the few wetlands remaining may be in serious danger. "There's not much area surrounding these wetlands to allow the patches to be dynamic. As a result, we're left with trying to force these patches to be static, and that's just not going to work in the long run," Zedler says.

The 1991 regulations were denounced by a broad range of environmental groups, including the Sierra Club, the National Audubon Society, and the National Wildlife Federation. But Zedler and others worry that things could get even worse after the Council on Competitiveness gets through modifying the regulations. Jonathan B. Tolman, the MBA who heads the wetlands office at the Council on Competitiveness, says the coun-

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cil is constructing a ranking scheme that would place wet areas at the top of the list for protection and drier areas at the bottom. That system would "make no ecological sense whatsoever" in terms of the patch dynamics model, says Stan Gregory, associate professor of fisheries and wildlife at Oregon State University and principal author of the Willamette National Forest Riparian Management Guide.

Tolman, who told *Science* that he's never heard of patch dynamics, sees the situation differently. He and his colleagues are "aware that wetter is not always better," he says. Yet he argues that research on wetlands hasn't gone far enough to institute a more accurate ranking scheme. "The science isn't really in place to say which types of land are more valuable than others, and we need to have some scheme that will allow us to go forward with development in appropriate areas while protecting the nation's wetlands."

Tolman adds: "Until someone comes up with a better way of assessing the importance of different kinds of wetlands, we'll continue using this approach." One strategy his office is considering, he says, is a "mitigation bank" for each watershed area to which developers would pay a fee for filling in land according to its ranking. This money would then be used to acquire or construct wetlands somewhere else in the watershed. "The theory is that you would have a free market within that watershed ecosystem. Developers would obviously want to spend less money mitigating, so they would develop the less expensive land," explains Tolman.

Even if patch dynamics hasn't penetrated the White House, it has had an impact on the local level, as wildlife officials attempt to use the new ideas to better manage the lands under their purview. In Oregon's Willamette National Forest, to cite only one example, U.S. Forest Service managers are taking a patch dynamics approach to setting timber harvest procedures in such a way as to protect the area's rivers and surrounding riparian ecosystems. Oregon's Stan Gregory says the key to this plan is recognizing that a functional river depends as much on the forests that lie upland of the river—land that is rarely saturated at any time of the year—as it does on the lowlands more directly associated with the river. "The forest acts as a hydrological buffer, a seed bank, and a source of dead trees that reach the river and stabilize its banks. If you harvest the trees in the region, the river and adjoining land degrades significantly."

Whether approaches like Gregory's will ever be applied on a national scale depends, in part, on whether the divide between the White House and the ecology community can be bridged. Since at the moment they appear to be operating on the basis of two completely different paradigms, the prospects for accord would seem be remote.

–Joseph Alper

Physicists Rock the Standard Model in Dallas

The 1400 physicists who converged on Dallas 2 weeks ago for the International High Energy Physics meeting came from all over. Ask them about the state of their field, however, and you'll find a common dream–to go beyond the standard model of particles and forces. For physicists "searching for chinks in the model's armor," as several put it, the elusive, unobtrusive neutrino is a promising object of study. And while the meeting saw the possibility of a superheavy "17-keV" neutrino fade, cosmic ray-produced neutrinos gave new hints of physics in that over-the-rainbow region beyond the standard model.

Requiem for a Heavyweight

Early last year, after a long, dry decade without big discoveries, some particle physicists thought nature had finally offered up a surprise: a neutrino with 1000 times more mass than any existing theory predicted (*Science*, 22 March 1991, p. 1426). At the Dallas meeting, this inexplicable "17-keV neutrino" still topped the list of hot topics, but the biggest news was that the evidence is now stacking up against it.

The negative evidence, coming from three different research groups, was the fruit of an intensive effort to follow up on the early hints of the neutrino. Physicists admit that they got so excited about this elusive particle because they haven't had much else to be excited about. "Hundreds of millions of dollars are spent to find new physics," says Thomas Bowles of the Los Alamos National Laboratory, who is participating in several neutrino experiments. But "everything new and exciting has gone away."

> **"I think nature contrived to put artifacts in all these experiments to mimic a 17-keV neutrino."**
>
> **–Andrew Hime**

Before it looked like the heavy neutrino, too, was bound for oblivion, the physics community had been locked in a stalemate over whether it really exists. After all, the standard model of particle physics suggests that neutrinos have no mass at all. And though a few other theories did predict a trace of neutrino mass—perhaps a few electron volts—nobody expected anything like the 17,000 electron volt (17 keV) behemoth first sighted by John Simpson of the University of Guelph in 1985 in studies of radioactive nuclei.

Simpson was studying a process called beta decay, in which a decaying nucleus emits an electron and a neutrino. Ordinarily, the electron flies off with almost all of the energy of the reaction, but Simpson found that in some decays a chunk of energy—17 keV, to be exact—seemed to be missing from the electron. Simpson proposed that a heavyweight neutrino was carrying off the mass equivalent of the missing energy.

He gained allies in 1991, when a handful of experimenters found what looked like confirming evidence. But other physicists still saw grounds for doubt: All of the positive results, from Simpson on, came from solid-state detectors in which the electron energies were gauged by their ionizing effect on crystals of silicon or germanium. When other researchers tried to confirm these results by measuring the energy of emitted electrons in mass spectrometers rather than crystals, they saw nothing. And the physics community as a whole remained skeptical that either type of experiment had the sensitivity to settle the issue.

Until now. One result that especially impressed the physicists at the Dallas meeting came from Japanese researcher Takayoshi Oshima of the National Laboratory for High Energy Physics. He used a mass spectrometer, but one he says gives a more detailed picture of the energy region around 17 keV, where the effect should show up. The result: still no neutrino.

And even the solid-state detectors can't consistently find the beast, reported Eric Norman of the Lawrence Berkeley Laboratory, previously one of the biggest boosters of the 17-keV neutrino. He said he was getting a positive signal from the decay of carbon-14, but when he tried another experiment based on iron-55, he came up empty-handed. "If there were a 17-keV neutrino we would have seen it in the iron-55 [as well]," he said.

But the death blow, in the minds of many physicists, came from Stuart Freedman, also of Lawrence Berkeley. He also used a solid-state detector—and he boosted the credibility of his result by checking beforehand that his set-up was sensitive enough to detect the