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## The Preservation Predicament

By CORNELIA DEAN

Conservation organizations that work to preserve biologically rich landscapes are confronting a painful realization: In an era of climate change, many of their efforts may be insufficient or beside the point.

Some scientists say efforts to re-establish or maintain salmon runs in Pacific Northwest streams will be of limited long-term benefit to the fish if warming makes the streams inhospitable. Others worry about efforts to restore the fresh water flow of the Everglades, given that much of it will be under water as sea level rises. Some geologists say it may be advisable to abandon efforts to preserve some fragile coastal barrier islands and focus instead on allowing coastal marshes to migrate inland, as sea level rises.

And everywhere, ecologists and conservation biologists wonder how landscapes already under preservation will change with the climate.

“We have over a 100-year investment nationally in a large suite of protected areas that may no longer protect the target ecosystems for which they were formed,” said Healy Hamilton, director of the California Academy of Sciences, who attended a workshop on the subject in November in Berkeley, Calif. “New species will move in, and the target species will move out.”

As a result, more and more conservationists believe they must do more than identify biologically important landscapes and raise money to protect them. They must peer into an uncertain future, guess which sites will be important 50 or 100 years from now, and then try to balance these guesses against the pressing needs of the present.

“It’s turning conservation on its head,” said Bill Stanley, who directs the global climate change initiative at the Nature Conservancy. He said the organization has a goal to protect 10 percent of major habitat types — like grasslands, forests and freshwater systems — by 2015.

“We are not sure exactly how to treat this yet,” Mr. Stanley said. “Areas that we preserved as grasslands are going to become forests. Does this mean we are going to have to have more than enough forest and less grassland than we had before? Or does it mean we should fight it — try to keep the forest from coming into those grasslands? Or should we try to find new areas that are least likely to change, that seem to be the least susceptible to change, and prioritize those areas?”

As Dr. Hamilton put it, “Our whole strategy is going to have to shift.”

No one is suggesting that land conservation done so far has been a wasted effort. Many argue that preserved areas will contribute immensely to ecosystem resilience as the climate changes. For example,

environmentally intact salmon streams will undoubtedly be useful if new species move into them. And even if much of the Everglades is lost to a rise in sea level, preserving the rest will be crucial for maintaining fresh water supplies in South Florida, said Dan Kimball, superintendent of Everglades National Park.

Mr. Kimball said that if the Intergovernmental Panel on Climate Change was right, and sea levels rose as much as two feet by the end of the century, up to 50 percent of the Everglades's fresh water marsh "would be transformed into a salt water system." But, he said, restoring the fresh water flow might "create a fresh water barrier, hopefully, and keep the rising seas at bay."

The Everglades ecosystem is full of uncertainties, Mr. Kimball said, explaining that "we don't know the rates of change." If seas rise faster than the climate panel predicted in its report last year, which many scientists regard as likely, mangroves crucial to the health of the glades could be submerged. But "if it's slow," he said, "the mangroves could gather sediment and actually build landform" — something that he said happened after Hurricane Wilma washed over the vast wetland in 2005.

This kind of uncertainty is widespread. For example, Dr. Hamilton said that on the Northern California coast, fog has an influence on natural systems. But "none of our climate models can tell us what is going to happen with fog," she said. "So we are facing profound uncertainties about how our coastal ecosystems are going to look."

"It's a real dilemma," said David S. Wilcove, a conservation biologist at Princeton. "What you are trying to do is balance the urgent needs of the present — the ongoing destruction of habitats that species need now — with the urgent needs of the future — places where they may end up if they are able to move in response to changing climate."

Mr. Stanley said that to cope, the Nature Conservancy was adopting new strategies, which include identifying for preservation potential refuges against changing climate, landscapes that have had relatively stable vegetation over thousands of years, and removing or reducing other stresses on the landscape, particularly activities by people.

Other plans are to search for resilient species or subspecies that can cope with a warming trend. For example, conservancy scientists looked at which reefs did best when Caribbean waters warmed in an El Niño event in the late 1990s.

"We said, 'Why did they survive, and are they the ones most likely to survive in the future?'" Mr. Stanley said. Resilient strains could be used to restore damaged reefs. "The same approach could translate to the land," he said. A pair of apparently contradictory strategies are to find new ways to preserve particular landscapes by, say, burning out plant species trying to move in or, the opposite, to encourage habitat alteration by creating open space "corridors" that plants and animals can use to move between protected areas.

Still others are looking for ways to encourage people who own property near protected areas to manage them so that target species will be able to move into them. For example, Dr. Hamilton said, there are

vineyards with patches of forest adjacent to protected sites along the California coast near Mendocino. “We have to make sure those winegrowers are incentivized for keeping those patches of forest on their land,” she said.

Some scientists say it may be necessary one day to move plants and animals into new areas and are working to devise theoretical frameworks for deciding when, how or whether to act.

“This term ‘assisted migration’ is gaining some traction,” said Dr. Wilcove, who formerly worked with the Wilderness Society and Environmental Defense. But “it’s a tough call,” he added. “What you are basically doing is moving species to places where they do not occur but where you think they will be suitable. But we often get into trouble translocating species for all kinds of unexpected reasons that come up.”

Coastal ecosystems are likely to be the first to pose difficult conservation problems, as sea level rise inundates protected areas or makes them more vulnerable to damage in storms.

For example, Asbury H. Sallenger, an oceanographer at the United States Geological Survey and an expert on coastal hazards, said conservationists had been considering massive sand-pumping efforts in hopes of restoring a bird habitat on the Chandeleur Islands, barrier strands off the coast of Louisiana that were severely damaged in Hurricane Katrina and other storms. But with sea level rise accelerating, Dr. Sallenger said in an e-mail message, “there is reason to believe these islands may disappear much more quickly than we thought just a few years ago.”

As a result, Dr. Sallenger said, the agency was working to estimate the projected lifespan of the islands, should they be rebuilt to their configuration of the late 1990s. “In other words,” he said, “will the time gained be worth it.”

But while many realize that ocean beaches are threatened by climate-related sea level rise, they do not understand that coastal wetlands — crucial nurseries for fish and shellfish — are at least as vulnerable, much less likely to be preserved and, in many areas, penned in by development and unable to migrate inland, as they would naturally as seas rise.

“We need to be preserving upland areas to allow for the landward expansion of wetlands,” Robert S. Young, director of the Program for the Study of Developed Shorelines at Western Carolina University, said in an e-mail message. “Sadly, this isn’t happening in any serious way.” Dr. Young said his program was beginning an effort to get this point across to the public.

Some conservationists advocate triage, accepting that some ecosystems, like coral reefs, may not survive in a warmer world, and putting their efforts elsewhere. Others, like Mr. Stanley at the Nature Conservancy, are not ready to give ground. “I don’t think those analyses take into account the resilience,” he said. “We are less focused on triage and more focused on resilience.”

Roger Kennedy, former director of the National Park Service, said Americans had been making and remaking conservation strategies since colonial days.

In that era, Mr. Kennedy said, people conserved green space, like Boston Common, close to where people lived densely. Later, he said, conservationists preserved “very special places,” like Yosemite, Grand Canyon and what became Glacier National Park — efforts encouraged by railroads, which anticipated that Americans would travel by train to see them.

It was only in the late 19th century that people began thinking of preserving vast swaths of land for plants and animals that inhabit them. He said he believed this ethic of preservation would succeed, even in a warming world.

“Over time, all systems have altered,” Mr. Kennedy said. “They are just changing more rapidly. But our means of accommodation are greater too.”

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