viding habitat for endangered species—a cost that they often cannot escape, because the presence of the regulation makes the land worthless to buyers. By contrast, a purchase by CARL lets developers, in Kuester's words, "escape alive" from properties with wetlands or endangered-species problems. "With regulation, they're stuck. They can't do anything but fight. But if you offer to buy property on the CARL priority list, most of the time they'll talk with you."

The purchasing strategy does, of course, give landowners the option to say no. And that carries a risk of shutting the state out of vitally important land, Garland concedes. But so far it has not happened often. More important, in his view, buying rather than regulating prevents most complaints about the heavy hand of government intervention. "We've had several property-rights groups spring up in the state, with the two major ones in the panhandle and down by Naples," he says. "They feel that government should not be taking land off tax rolls, even if the sellers are willing. But mostly the opposition is muted."

How much is enough? Yet even CARL's most enthusiastic advocates admit that it will never have the estimated $5.7 billion needed to buy all the land recommended by the Cox-Kautz analysis. And some scientists think the program will have to do significantly more. Even the huge area CARL is currently going after may be an underestimate, according to PVA pioneer Shaffer, because the Florida team was "overly optimistic" about the likelihood of survival for small populations. And Reed Noss, editor of the journal *Conservation Biology*, argues that the project did not give enough weight to connecting individual conservation areas. "Even though they are talking about a huge increase in the amount of land protected," he says, "there's still a large amount of it that would be highly fragmented. If those areas ended up being surrounded by development, the conservation wouldn't work."

While conceding that "the connectivity issue" is a "very valid criticism," Kautz believes that guidelines from a study under way at the state Department of Environmental Protection should address that issue. And although specific plans for raising more money to purchase this land are not yet in evidence, Harris envisions a day not too far in the future when the Florida landscape contains an unbroken open strip that runs down the entire state. "What's happening here is exciting," he says. "I just came back from 6 weeks looking at preservation programs in Africa. And everywhere I went, people were asking me what we were doing in Florida."

–Charles C. Mann

Charles C. Mann is the co-author, with Mark L. Plummer, of Noah's Choice: The Future of Endangered Species.

CONSERVATION II

Slow Start for Europe's New Habitat Protection Plan

Spain's conservationists and politicians are grappling with a vexing riddle about a bird and a road. Like the old puzzler about the chicken, this one deals with an existential question, but the bird at issue is the great bustard, a threatened species. And the question is not why the bird crossed a road, but whether a road will cross paths with the bird.

The bustard, once a common sight in the fields of Europe, has been in decline for the past 100 years as agriculture stripped away its habitat and food. In Spain, the birds' last remaining stronghold is the steppelike grassland in the central plains. This area has been identified by ecologists as a possible candidate for protection under the European Union's Habitats Directive, a bold conservation law containing a master list of threatened European habitat types. It calls on member nations to identify and protect those habitats.

But the urge to conserve is not the only signal from Brussels these days. The European Union (EU) is also pushing—and funding, with $10 billion last year—ambitious regional development programs, including a massive new transportation infrastructure plan. And one of the proposed new roads crosses the great bustard's steppe stronghold—a development, biologists warn, that will send this bird population racing down the highway to extinction. "We're fighting this road proposal," says Juan Criado of SEO/Birdlife in Madrid, a key Spanish nature conservation organization.

They're fighting, however, without the help of the Habitats Directive. The law required Spain to list its proposed habitat sites this June, but like many of its European partners, the government hasn't complied—hardly an auspicious start for Europe's most prominent conservation effort.

The law has foundered because a lack of scientific data about local habitats and species distributions has prevented Spain and some southern European countries from figuring out which habitats to protect. Governments are also leery of programs that restrict use of large land areas, due to ever-present conflicts with development. Northern nations, with conservation programs already in place, are leery in a different way—reluctant to layer EU policy on their own. "Many politicians probably did not realize what they were signing up for," says John Lawton, director of the Centre for Population Biology at Imperial College, London. And in the face of this confusion and conflict, Lawton and some other observers are wondering how effective the new unionwide conservation policy will be.

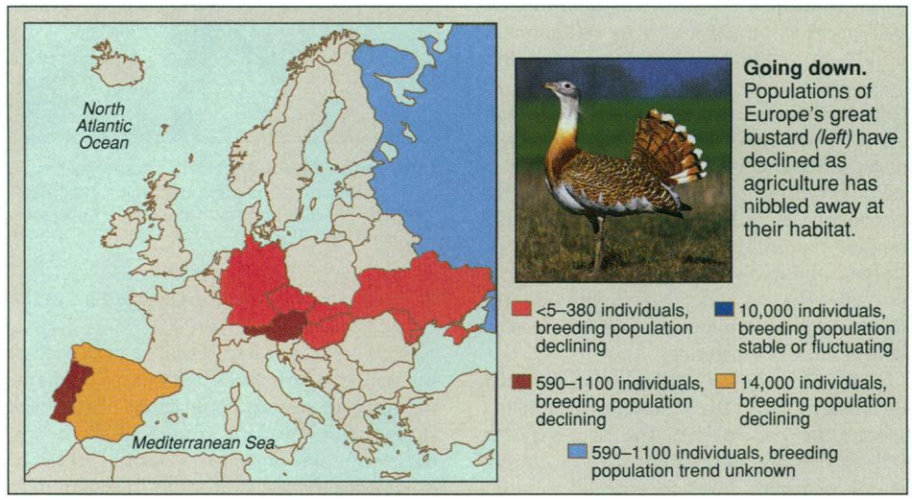
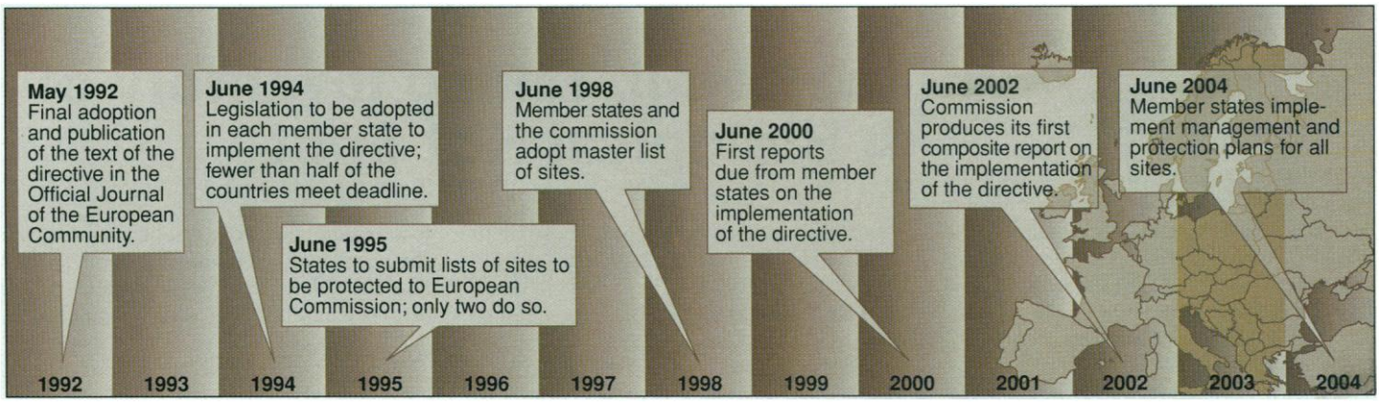


PHOTO: CARLOS SANCHEZ

SOURCE: *BIRDS IN EUROPE: THEIR CONSERVATION STATUS* (BIRDLIFE INTERNATIONAL, 1994).

Developing conservation. Although development has been the driving force behind the EU since its formation—last year, the EU spent more than half its budget on agriculture—the rising popularity of green issues, particularly in northern Europe, has forced conservation onto the pan-European agenda. Three years ago, concurrent with the worldwide environmental summit in Rio de Janeiro, the EU launched an ambitious plan to develop common conservation yardsticks along with an EU-wide network of protected conservation areas under the label Natura 2000. The tool for establishing that network is the Habitats Directive, focusing not just on individual threatened species—as does con-



Time for protection. The European Union's Habitats Directive, enacted in 1992, aims to manage and protect valuable areas by 2004.

servation legislation in the United States such as the Endangered Species Act—but on ecological communities.

For scientists, habitat protection was clearly the way to go, following the dismal lessons of the EU's first conservation legislation, a 1979 species-oriented measure designed to protect birds; it didn't check the decline of many species. "The move toward habitats came from the realization that in densely populated Europe, it was not enough to protect species. The experience with birds showed that protection doesn't work if their habitats are constantly degraded," says Olivier Diana, a senior official at the European Commission in Brussels who works on the Habitats Directive.

Ecologists and conservationists had higher hopes for the new law. "The Habitats Directive is a potentially extremely important way of enhancing European biodiversity," says Lawton. The legislation was pushed heavily by the Dutch during their presidency of the union in 1991 and passed by the European Parliament in 1992. Under the directive, member states agreed to establish a series of protected sites for habitats that contained plant and animal species of "community interest."

Such interest was determined on the basis of rarity, the danger of disappearance, or whether the sites were outstanding examples of the main biogeographic regions within Europe. Panels of scientists from member countries, divided into six groups covering broad biogeographic regions, came up with a total of 169 habitats of community interest for inclusion in the directive in 1992.

Some habitat types are so small as to be nearly nonexistent, such as continental salt meadows estimated to cover only 1 hectare in the United Kingdom and less than 100 hectares in the entire EU. Others, such as blanket bog, are huge, covering more than 1.5 million hectares in Ireland and western U.K. The directive also covers coastal and marine habitats, such as the rare posidonia beds in the Mediterranean Sea, which contain rich animal communities.

Developing reluctance. Member states were given 3 years to identify all sites of the relevant habitats within their borders. But the deadline came and went last month with most of the 15 member states still to submit a list to Brussels.

The reasons for the failure to meet this initial goal are many. Several countries say they intend to comply, but don't have the scientific knowledge about the locations of flora and fauna within their boundaries, nor the resources to pin down such locations in time to meet the deadline. "We have 40 years of data on species as a result of conservation efforts, but we know much less about the distribution and composition of habitats," says Ian Hepburn, an ecologist who worked on the directive for the World Wide Fund for Nature.

In Spain, which contains 60% of the habitat types listed in the directive—the most of any EU nation—the work has turned into a huge, time-consuming project. "We could have just asked local experts, but we chose to use the opportunity of the Habitats Directive to carry out a detailed national survey," says Cosme Morillo, head of the wildlife unit at Icona, the Spanish Ministry of Agriculture's center for nature conservation in Madrid.

Countries also had difficulties coming to grips with the directive's definitions of habitat types. "This is the first attempt to address these issues at a supranational level," says Michael O'Brian, another official working on the implementation of the Habitats Directive at the European Commission. And applying the pan-European habitat definitions at a local level has caused some confusion.

For example, one habitat type, called limestone pavements, is composed of flat expanses of fissured and weathered limestone and is home to a number of rare plant species including the rigid buckler fern, baneberry, and dark-red helleborine orchid. It is also found only in the United Kingdom and Ireland. But Spanish scientists thought tracts of rocky limestone habitats in some of Spain's mountain regions were also limestone pavements and should thus be listed and protected under this label, says John Hopkins, scientific coordinator for the directive at the U.K.'s Joint Nature Conservation Committee. After much confusion, the scientists had to reclassify the Spanish habitats under a different label.

For other habitats, such as dry heathlands, found at many sites across northern Europe, it was necessary to carry out extensive quality assessments to rank sites. "Dry heathlands can vary substantially in the number and type of species they carry," says Johan Thissen, an information scientist at the Dutch government's National Centre for Nature Management at Wageningen. "We wanted to identify which sites were the most important for conservation."

Dodging development. Then there are the inevitable conflicts with development—which cause more problems in the less economically developed southern nations. Spain, in particular, is under the spotlight, because threatened habitats there are thought to cover up to 20% of the total land area. "Many politicians are against the directive because it might affect a big part of the country," says Carlos Vallecillo of the World Wide Fund for Nature in Madrid.

This situation is echoed in Greece. The list of Greek habitat sites has been prepared by the Greek Biotope Wetland Centre, a private organization working for the Ministry of the Environment. Greece contains large tracts of land of potential conservation interest. Already 11% of the country's land area is designated as important bird areas, and these areas are likely candidates for the directive. But several projects, including four hydroelectric dams along the Nestos River in northeastern Greece, are also under consideration by the government, says Kostas Vasilakis of the Hellenic Ornithological Society in Athens, which may imperil several potential habitat sites, including the species-rich Nestos delta.

In contrast, conflicts with development are fewer in northern Europe, where conservation movements have historically been strong. The Royal Society for the Protec-

tion of Birds in the United Kingdom, for instance, has a membership of 890,000, making it the biggest wildlife conservation organization in Europe. The Greek equivalent, the Hellenic Ornithological Society, has 500 to 1000 members.

As a result of this history of activism, many sensitive areas in the north are already protected. In Denmark, for example, "the total area of protection is expected to increase by only 1%, from 7% to 8%," says Claus Goldberg, a biologist in the ecology division of the Danish Ministry of Environment and Energy.

There are, therefore, questions about the relevance of the Habitat Directive troubling the north. The Dutch, the original champions of the directive, were expected to release their proposed listin April, but the government is still reviewing it. Case Lancaster of the Netherlands Society for Nature and the Environment says the Dutch are already doing a great deal of work on the development of a national ecological strategy. And this strategy, unlike the Habitats Directive, is geared toward developing new habitats as well as protecting pre-existing ones: The Dutch have been trying to craft new habitats from agricultural land, because little undisturbed land is left. The Dutch goal of developing Europe-wide conservation measures has left it with a directive that adds little to its national effort. "The directive is likely to cover some new sites, but it won't do much to improve management of Dutch habitats," says Thissen.

A directive for the future? Diana admits the directive faces a raft of problems. But it has full legal backing, and there is the possibility of financial penalties for member states failing to comply with its requirements through the European Court in Luxembourg, he says: "These penalties have not been used so far, but they could in the future." He doesn't anticipate having to make good on this threat, however, saying that countries will fall into line, given enough time to complete their biological surveys.

But other observers are not as sanguine, particularly on the issue of whether governments, when push comes to shove, will protect habitats over development needs. "Politicians are often willing to pay for more research, but they have so far ducked the issues of conservation in favor of development policies," says Lawton. "There's no evidence governments have undergone a fundamental shift in the way they assess these conflicts of interest." As the battle for the bustards looms and other species are threatened, "it will be impossible to present a complacent picture," says David Baldock, deputy director of the Institute for European Environmental Policy in London. "It will be increasingly clear we still haven't got things right."

–Nigel Williams

BIOLOGICAL SURVEYS

In Hawaii, Taking Inventory of A Biological Hot Spot

As far from any continent as it's possible to get, the Hawaiian islands have cradled a selective assortment of the world's biota. Early in their history, the islands held no mosquitoes, no cockroaches, no snakes, no frogs, no animals larger than a bird. The animals and plants that did manage to wash or blow ashore transformed the rugged volcanic terrain into habitat for a globally unique biota. They launched some of the planet's most explosive examples of adaptive radiation, as new species evolved from the founding stock. Hawaii boasts a quarter of the world's species of the fruit fly *Drosophila*, well over 600 species which are believed to have descended from one or two original wandering groups. Before human settlement, according to the fossil record, the islands supported at least 47 species of honeycreepers, birds with bills of widely disparate shapes, that all evolved from a single finch species. As a living lab to test theories of adaptation and evolution, Hawaii has no parallel.

JACK JEFFREY

Unexpected find. Hawaii's biological survey turned up the rare orange-black damselfly in a surprising place: a building construction site.

More recently, Hawaii has acquired a less distinguished reputation as a hotbed of extinction—only 20 of the honeycreeper species remain, for example, most of them at risk as their habitat falls before urban expansion or is invaded by harmful or competing exotic species, a particularly severe problem for Hawaii. Weeds not native to the islands, destructive feral goats and pigs (brought to Hawaii by James Cook and others), and exotic birds that compete for resources or carry avian diseases can invade even protected tropical forests and threaten the survival of remaining native species.

Now, because of its evolutionary value and concern for its conservation, Hawaii's biota is gaining yet another point of distinction: It is the subject of the most detailed biological survey ever attempted for a single biogeographic area. "[This] is the first time this has been done for any area approaching the diversity of Hawaii," says entomologist Scott E. Miller, head of natural sciences at the Bishop Museum in Honolulu. Authorized by the state legislature in 1992 and funded with a $260,000 start-up grant from the John D. and Catherine T. MacArthur Foundation, the museum staff and outside collaborators are producing a database of all Hawaii's known species and their habitats and biology. Already the effort, which is based on scientific literature, museum collections, and fieldwork, has begun to pay off: Investigators have found that some species thought to be rare or even extinct, such as certain damselflies, are still hanging on in odd pockets of land.

Biologists elsewhere are hailing the effort, saying that it should help Hawaii chart conservation strategies, yield new insights into the global species total, and test methods for larger scale biological surveys. Says tropical biologist Thomas E. Lovejoy of the Smithsonian Institution in Washington, D.C.: "This is a test of the value of collection-based data. I'm confident of the value it will have."

Researchers conducting the Hawaii survey began by scouring the literature for all citations for a particular group, such as ferns. Unpublished sources (from government biologists or conservation groups, for example) were consulted as well. From the results, the Bishop staff has gleaned a list of all the species ever spotted in Hawaii and is standardizing the names and descriptions. (Historical terminologies sometimes conflict with current ones.) The researchers are combining the lists of Hawaiian species to create a massive new database* that not only contains a bibliography of all the research articles on a particular species but also lists the specimens of that group housed in the museum's collections. The contents of other museums' Hawaii collections are to be linked to the database as well. Once all the existing information on a species is amassed and assessed, biologists can begin to identify gaps in the database, noting species that haven't

* The Bishop Museum's database can be reached on the World Wide Web at http://www.bishop.hawaii.org