The Threat to One Million Species

While genetic diversity is being eroded at an accelerating rate, key programs are being cut

By the end of the century, up to a million species of plants and animals will disappear from the face of the earth. This impending mass extinction, which will occur mostly in the developing countries, will seriously deplete the genetic diversity of the world's biological resources. Included in the loss will be many species that have potentially useful or intriguing properties, but whose existence will forever go unrecorded.

These concerns, which have been voiced with mounting urgency in the past few years, formed the theme of a conference convened by the State Department and several other federal agencies on 16 to 18 November. Called the Strategy Conference on Biological Diversity, it pulled together some 150 scientists, environmentalists, and government bureaucrats to discuss what, if anything, can be done to slow down the rate of species extinction or to mitigate the impact. The most powerful statement of concern came from a top official of the Reagan Administration, James L. Buckley, Under Secretary of State for Security Assistance, Science, and Technology.

"The needless extinction of a single species can be an act of recklessness," said Buckley. "By permitting high rates of extinction to continue, we are limiting the potential growth of biological knowledge. In essence," he said, "the process is tantamount to book burning; but it is even worse in that it involves books yet to be deciphered and read."

In spite of these strong statements, however, many participants privately charged that some Administration policies are undermining the intent of the conference. In particular, the latest round of budget cuts has forced the National Science Foundation to reduce support for tropical biology, an area that the meeting singled out for increased attention. The Administration has also sought major budget cuts for international agencies that have been playing important roles in biological conservation. And environmental groups have warned that industry lobbyists are gearing up for an assault on the Endangered Species Act when it comes up for reauthorization next year; so far, the Administration has shown no inclination to support the act, and environmentalists fear the worst.

Species are being driven to extinction at an accelerating pace largely because tropical habitats are fast disappearing under the pressure of population growth and economic development. A committee of the National Academy of Sciences reported last year, for example, that "the tropical forests of the world are being altered so rapidly that most will not exist in their present form by the close of the century." It has been estimated that some 3 million different species of organisms exist in the tropics, but only about one-sixth of them have been identified and recorded. In addition, traditional, genetically varied crops are being replaced in many regions by relatively few strains of high-yielding plants.

Does this impending loss of vast numbers of unknown species matter? Most participants at the conference would probably agree with Paul and Anne Ehrlich, who state in their new book, *Extinction*, that "the first and foremost argument for the preservation of all nonhuman species . . . is that our fellow passengers on Spaceship Earth, who are quite possibly our only companions in the entire universe, have a *right* to exist." But the meeting revolved around the more prosaic argument that species diversity should be preserved for its economic and scientific value to *homo sapiens*, for among the threatened organisms are undoubtedly many that will ultimately prove useful. Moreover, the argument goes, the rapidly advancing ability to transfer genes across species barriers makes it all the more important to preserve the diversity of the world's gene pool—one species' ability to resist attack by insect pests may, for example, eventually be transferable to other species through genetic engineering.

An often cited example of the potential value that may exist in as yet uncataloged species is the recent discovery of a variety of wild corn *Zea diploperennis*. Unlike cultivated corn, which must be replanted each year, the newly discovered variety is a perennial. It is also resistant to a range of viruses and grows well on wet soils. If some of these traits can be transferred to cultivated strains of corn, the agricultural payoff would be enormous. But even if, for technical reasons, this potential is not realized, the discovery of *Zea diploperennis* provides a salutary lesson; only a few thousand plants are known to exist, and they are on a hillside in Mexico that is in the process of being plowed up.

The eleventh-hour discovery of perennial corn was a fortunate occurrence; many other varieties have not been saved. It has been estimated, for example, that some 95 percent of the varieties of wheat native to Greece have become extinct in the past 40 years, and William L. Brown, president of Pioneer Hi-Bred International, told the conference that many primitive progenitors of red wheat in Turkey have also disappeared.

Larry Daughters/World Bank

Plowing up the hillside

Land clearance and the replacement of traditional crops are contributing to the loss of genetic diversity.

The erosion of genetic diversity among crop plants and the loss of many wild relatives of cultivated species have received much public attention in the past decade. In part, this is due to an epidemic of southern corn leaf blight in the United States that destroyed an estimated 15 percent of the genetically vulnerable U.S. corn crop in 1970. In the wake of that disaster, there has been a major expansion of national and international efforts to collect and store plant germplasm for use in breeding new crop varieties. The collections, however, are generally acknowledged to contain significant gaps, and there has so far been a lack of evaluation and documentation of their contents. (See *Science*, 9 October, p. 161, and 23 October, p. 421.)

One of the principal recommendations of the conference was that more support be given to the collection and storage of

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plant germplasm and that special attention be given to the evaluation of existing stocks. But funding for such efforts is growing increasingly tight. Quentin Jones, who heads the U.S. Department of Agriculture's plant germplasm program, told the conference, for example, that "our present maintenance facilities are generally inadequate in providing storage environments that will maintain seed viability at desirable levels for desirable periods of time." International seed banks are maintained chiefly by the network of agricultural research centers supported by the World Bank, United Nations agencies, and individual governments. A meeting of sponsors of the network, held in Washington in mid-November, approved funding for 1982 that falls $8 million below the level that the centers had been planning for. This funding restriction will make it difficult to step up efforts in the collection and maintainence of germplasm from crop plants.

In some respects, however, the loss of genetic diversity among crop plants is easier to tackle than similar losses among other plants and among animals, insects, and microorganisms. "The scale of the problem," argues Thomas Lovejoy of the World Wildlife Fund, "is so enormous that current efforts can be said to hardly touch it."

The most critical need is the preservation of habitats, so that species diversity can be maintained as far as possible in natural ecosystems. But, as Lovejoy and others pointed out, there is scant information on how large biological preserves should be to ensure the survival of the species they contain, and very little money is being spent on basic studies of the functioning of tropical ecosystems.

There are, moreover, few signs that this will change in the coming years. The National Science Foundation, which funds about half the federal government's research in tropical biology, is planning to cut its support for ecological research by about 10 percent in fiscal year 1982, in response to the Administration's call last September for a 12 percent across-the-board cut in federal spending.

The Administration has also proposed a massive cut in the contributions of the United States to the United Nations Environment Programme (UNEP), an agency that helps support international efforts in biological preservation and assists in the training of biologists in developing countries. In September, the Administration proposed that the United States's $10-million contribution to UNEP be eliminated entirely, but it recently agreed to a level of $2 million. Congress, however, is likely to be more generous. The continuing resolution, which will provide funds for the federal

Biologists Buy a Piece of the Tropics

Thanks in part to an unusual appeal that brought contributions from individual scientists, 1500 acres of Costa Rica's tropical rain forest has been purchased for long-term ecological research. The Organization for Tropical Studies (OTS), a consortium of universities and research institutes in the United States and Costa Rica, bought the land last month following an appeal for funds from the scientific community published in an open letter in *Science*.

OTS intends to use the site for large-scale studies of the impact on surrounding ecosystems of logging and forest clearance. Because most of the loss of genetic resources will take place in the tropics as the result of such developments, the Strategy Conference on Biological Diversity pointed to the need for more research of this kind. But buying the land is only the first step: OTS is now seeking support for its research program. A major grant it was hoping to get from the National Science Foundation (NSF) has fallen through.

The site, which adjoins a 2000-acre tract of rain forest that OTS already owns, is ideally suited for research on the fragility of tropical ecoystems, for it consists of one-third virgin forest, one-third secondary growth following logging, and one-third pasture. A committee of the National Academy of Sciences last year selected the site, known as La Selva, as one of the four most promising sites worldwide for such research.

OTS has been interested in buying the tract of land for some time, and it negotiated a purchase price of $400,000. (The land was owned privately by five brothers.) OTS decided to put up $50,000 of its own funds and by last September it had secured pledges of another $150,000, mostly from foundations. Thirteen biologists then wrote a letter to *Science* (18 September, p. 1314) stating that they would each contribute $1000, and asking for support from other scientists.

According to Donald Stone, OTS's executive director, the *Science* letter brought in about $22,000 in individual donations and it was largely responsible for securing another $40,000 from foundations. OTS, in the meantime, negotiated the purchase price down to $310,000. Thus, with some $260,000 in hand, it borrowed the difference and took possession of the property on 24 October.

OTS officials were hoping that the La Selva site would qualify for support from NSF's Long Term Ecological Research (LTER) program, a major effort to monitor ecological changes at selected sites over several years. NSF is now funding research at six sites and it recently asked for proposals to expand the network to 11. OTS put in a proposal for a $15-million research program at La Selva, aimed chiefly at monitoring changes in the watershed and nutrient cycling. But, after expressing initial interest in the proposal, NSF officials annnounced that the LTER program will be restricted to sites within the United States. OTS is, however, still hoping to get a $100,000 grant from NSF to gather basic data on the La Selva site and its biological resources.

Even without major research support from NSF, biologists view purchase of the site as an important achievement. It will provide a buffer zone that will help protect OTS's existing 2000-acre preserve at La Selva from human encroachment. Moreover, La Selva lies only a few kilometers from a major national park, the Parque Nacional Braulio Carrillo, and Costa Rica's President Rodrigo Carazo has proposed extending the park's boundaries to the edge of the La Selva site. Purchase of the new tract of land for ecological research may help speed up the park extension, OTS officials hope. The park and La Selva together would then make up a biological preserve extending from sea level to 2900 meters, which includes a large variety of natural habitats.—COLIN NORMAN

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government until appropriations bills are passed, is expected to contain $7.5 million for UNEP, a cut of about 25 percent from current levels.

The conference came up with scores of recommendations for action by the federal government to help stem the erosion of biological diversity. Few of the recommendations were new, and many will be difficult to implement in view of current budgetary stringencies. Moreover, the gathering generally failed to come to grips with the central issue in the impending loss of one million species. Habitats are being destroyed in the tropics chiefly because people in the developing countries need land to scratch out a living.

Nevertheless, several participants argued that the conference's chief contribution was simply to expose the issue to a broad range of government officials and to the general public. Buckley, in his opening speech to the conference, argued that "we need to impress upon public consciousness that extinction is an act of awesome finality." The conference at least made a start in impressing that upon the federal government.

—COLIN NORMAN

Reviewers Pan Agent Orange Study Plan

A much-delayed study of veterans' exposure to dioxin-containing herbicides has been delayed again. The Veterans Administration (VA) told the team designing the protocol to head back to the drawing boards and gave the University of California at Los Angeles (UCLA) investigators 35 days to come up with a revised protocol after three review groups rejected the plan.

The study in question was mandated by Congress in December 1979 to supply a definitive answer as to whether Agent Orange has wreaked adverse health effects on American ground troops in Vietnam. The VA was to arrange the study, which was to be approved by the Office of Technology Assessment (OTA). A contract was awarded last May to Gary Spivey of the UCLA School of Public Health and public health school dean Roger Detels.

The first draft of the protocol, which was submitted in August, contained a description of a proposed historical cohort study that would track the health of veterans believed to have been exposed to the herbicides in Vietnam and those who had not. Five smaller studies were also proposed that would compare rates of morbidity and mortality among troops who served in Vietnam with those of other Vietnam-era veterans.

A flock of government work groups and task forces has been hovering over the project, which has been reviewed by the VA's advisory committee on the health-related effects of herbicides and the Agent Orange working group of the Department of Health and Human Services (HHS) as well as by the OTA. The protocol was so lacking in detail that one reviewer, Vernon Houk of the Centers for Disease Control, told a Senate committee, "we did not indeed even classify this as a protocol."

A fundamental problem was that the investigators did not specify how they would develop an exposure index. Without a reliable estimate of who was and who was not exposed to Agent Orange, as well as some idea of the severity of exposures, the study will be impossible. Yet the protocol indicated that it would take 14 months to determine whether an exposure index could be developed.

The OTA reviewers were also critical of the secretiveness of the protocol, which proposed to withhold from participants investigators' assumptions about the exposures as well as what health effects they were looking for. Reviewers pointed out that this was impractical and would undermine the public credibility of the study. The protocol was also faulted for its cursory description of the physical examination to be given the participants: no mention was made of testing for neurological, psychological, or reproductive problems. (Detels explained to Science that since the issue of public access to the protocol has not been settled, they did not want to give information that would jeopardize a double-blind study.)

The General Accounting Office (GAO) has also weighed in with criticism of the data bases that the investigators proposed to use. The GAO pointed out, for example, that the VA's Agent Orange registry, which lists all Agent Orange–related complaints from people who have been examined at VA hospitals, was never intended for use in an epidemiologic study, that it contains a self-selected sample of men, and that it contains no information on degree of exposure to the herbicide.

Whatever the drawbacks of the protocol, there is no doubt that this will be an extraordinarily difficult study to conduct. The subject is highly charged emotionally, and anything sponsored by the VA is going to be regarded with suspicion by many vets. There will have to be heavy reliance on subjective information. And there will be no way to decide which health effects may be significant until a reliable exposure index has been established. Investigators will also have a formidable job in grappling with Army combat files. According to Richard Christian of the Army's Agent Orange task force, the history of the movements of each battalion in Vietnam takes up about 20 linear feet on the shelves, contributing to a total of 40,000 feet of combat records. These records, which are not indexed for the convenience of epidemiologists, will have to be put together with data from tapes that contain records of herbicide sprayings in order to establish whether an individual was in the vicinity of a spraying. Combat records will also have to be matched with records of 39 aborted spraying missions where pilots jettisoned thousands of gallons of herbicide. (The UCLA people didn't have this in their proposal because HHS Secretary Richard Schweiker only revealed it in September.)

The study, if it gets under way, should get some assist from preliminary findings of the Air Force's Ranch Hand study, expected late next year. The Ranch Hand project is designed as a 20-year study of the health of 1200 pilots engaged in spraying missions.

Veterans' groups are not wildly enthusiastic about the project that UCLA is trying to design, and their concerns were aggravated in September by reports that Spivey had told the California State Assembly that the biggest problem created by Agent Orange was probably "fear." But says Detels, Spivey was only stressing that it was important not to prejudge the outcome.—CONSTANCE HOLDEN

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