fusion power reactors is needed in the immediate future. "It is very difficult to formulate a credible scenario of major irreversible electricity shortages in the early 21st century that would require fusion's development on an accelerated schedule," says OTA.

On the other hand, the agency adds, Congress must weigh the potential effects of the United States falling behind the rest of the world. The European Community appears ready to build its own version of ITER, the "Next European Torus." Likewise, Japan has plans for a "Fusion Energy Reactor." International collaboration, OTA suggests, would provide the United States with an opportunity to at least stay even with other countries. ■

MARK CRAWFORD

Botany Bids for the "Big Science" League

A multimillion dollar proposal to catalog the flora of North America has caused some strife among botanists

NANCY R. Morin, a scientist at the Missouri Botanical Garden, and two dozen other leading American and Canadian botanists have scoured the world looking for rare plants, but they have yet to find the one they need most these days—a money tree.

Morin and colleagues in the botany community have banded together to conduct the first inventory of the entire flora of North America, an enormous task that will take more than a decade to complete. They plan to fill 11 volumes with information on some 17,000 species of plants, forming taxonomic dossiers on each plant with a list of its various names and descriptions of its looks and location. The information will be used also to create the most elaborate online computer database on plant taxonomy to date.

But there's one major hitch: the scientists pushing the multimillion dollar project have barely enough money to get it off the ground. Project leaders have applied twice now to the National Science Foundation for funding, but have so far been unsuccessful. Undaunted, the botanists are volunteering their time and effort to put together the first volume in hopes that more interest and financial support will eventually be generated.

Supporters of the project, known as the "Flora of North America," say that the information will provide botanists with an important scientific tool for research. It will also help in conservation efforts and land management, they say. "We need to know baseline information" about North American flora, says Morin, who is curator of the herbarium at the Missouri Botanical Garden and coordinator of the project. "We can't monitor change if we don't know what's out there to begin with."

They note that the botanists' Bible for the flora of the Northeast, *Gray's Manual of Botany*, written by Harvard's Asa Gray almost a century and a half ago, was last revised in 1950. And, they like to point out that the Soviet Union and Europe have already inventoried their own biota, and China and Australia presently have surveys under way.

The Flora of North America project has substantial scientific support. The American Association of Plant Taxonomists and the Canadian Botanical Association have passed resolutions supporting an effort to catalog the plants in the United States and Canada, for example. The Nature Conservancy backs the project, although it does not make grants. And scientists volunteering to help include many luminaries in the botany community, such as Theodore Barkley of Kansas State University, David Boufford of Harvard, Marshall Johnston of the University of Texas at Austin, John Packer of the University of Alberta, and John Thieret of Northern Kentucky University.

But some scientists, though they support the project in concept, worry that its enormous cost might divert research money from other important work with plants, particularly in the tropics. "To what extent does the project divert systematics from other useful projects? Who will pay for it?" asks Harvard botanist and tropical specialist Peter Stevens. Still others say they are not confident that the plans for the complex computer data bank have been fully thought out.

Morin acknowledges that the project is expensive. She calculates that the survey needs $500,000 annually for 12 to 15 years. This would cover the work of contributors, the development of the computer database, travel to scientific meetings, and overhead costs. Though $500,000 may be a drop in the bucket for other scientific projects (the price tag of the Continuous Electron Beam Accelerator Facility at Newport News, Virginia, is about $250 million), the amount represents a big chunk of money in the botany community.

Morin says she will submit another funding application to NSF this fall. Earlier this month, at an international botanical meeting in Berlin, NSF officials say they encouraged Morin to keep trying.

Lee Fox

Nancy Morin: *"It's very frustrating not to be able to go to one place" for botanical information.*

So far, the only money that the project has attracted is $100,000 from the J. N. Pew, Jr., Charitable Trust, which covers administrative costs until February 1988. The foundation will then put up another $100,000, if the project can match it with $200,000. Despite this modest beginning, Morin is optimistic that sufficient financial support will eventually be generated as people become convinced of the project's importance on scientific and more practical grounds.

The idea to inventory the flora of North America is not new. The Smithsonian started up such a project in 1966 with NSF funding, but abandoned it 6 years later when NSF withdrew its support. The main reason for its demise is that computer technology at the time was cumbersome. Cards were used to feed data to the computer and to program it, recalls Stanwyn G. Shetler, botanist and assistant director of the Smithsonian's Museum of Natural History. In retrospect, Shetler says, "We were ahead of our time, but the technology was ancient."

Morin and other supporters of the project argue that although most of the United States has been inventoried, much of the information, like *Gray's Manual of Botany*, has not been revised for 40 years. These existing catalogs only cover states or regions, so that taxonomists must rely on a hodgepodge of inventories to conduct their research. A few states and regions are now being mapped for their flora, but no comprehensive national survey has been made. Morin says, "We have no single reference to consult for basic information on the kinds of plants that live in North America, where they occur, what their characteristics are, or how they are related. It's very frustrating not to be able to go to one place."

Another problem with many of the previous catalogs is that they were each written primarily by one scientist. As a result, information about plants outside the author's expertise is often incomplete.

Morin and other participants in the project hope to avoid the pitfalls of these older inventories. According to their plan, the descriptions of each plant for the Flora of North America project would be written by researchers who are expert in that particular species. The botanists who have volunteered to help with the production of the first volume make up an editorial committee that would oversee the compilation of this massive amount of data and edit it as well. The use of a computer data bank would allow researchers to update the inventory. This is viewed by many as an important selling point of the project.

The information has a practical use too, supporters argue. Conservationists would be able to make a better case for protecting a piece of land if they know exactly what plants are there, according to Daniel H. Janzen of the University of Pennsylvania.

Federal regulators say they can use the information, too. Mary E. Carter, associate administrator of the Agricultural Research Service of the U.S. Department of Agriculture, remarks that an inventory is "important in managing plants and protecting agriculture." Leafy spurge, a weed growing rampant in the Great Plains, is believed to have been introduced inadvertantly to the United States through foreign shipments of wheat germ plasm. An inventory of U.S. plants would help in the rapid identification and monitoring of potentially troublesome foreign plant species, she says.

Growing interest in maintaining biodiversity is bound to help the proponents of the flora project. Hugh Iltis, curator of the herbarium at the University of Wisconsin, says "We're so rich in this country, and we are so arrogant about losing something. What good is a weed? It may contain something mysterious. It's a [genetic] library."

NSF has not been persuaded by these arguments. Several factors have worked against the project. A major one is that the study of plants in temperate zones just is not hot these days. Studying the tropics is in. "It's hard to get people jazzed up about the temperate zone," Shetler says with a sigh. James Rodman, acting program director for systematics at the National Science Foundation's biology division, notes, "The fact is, if they're not doing [an inventory] in the tropics, it's a hard sell."

Rodman says, "Nancy's project needs a large budget and is managerially complex." Indeed, the money she is asking for is an order of magnitude greater than most other grants in biological systematics. NSF's total annual budget for floristics—the writing of inventories and monographs—is $2 million. Of this, 70% goes toward tropical systematics. That leaves only $600,000 for the entire budget for systematics related to U.S. flora. In addition, the project competes indirectly with plant molecular systematics, which NSF funds at about $1.5 million a year.

"While there is a great deal of sympathy for the project," Rodman says, Morin's $500,000 request, if funded, would put "significant pressure on the budget." Rodman notes that outside peer reviewers have not recommended approval of Morin's grant applications.

Some observers, such as Michael Strauss, a botanist and senior staff officer at the National Academy of Sciences' board on basic biology, suggest that the project has not caught the fancy of NSF because it does not really involve basic research. The information included in the inventory will largely be culled from recent publications, so not much fieldwork or original research will be required.

Rodman and others suggest that supporters of the project have hurt themselves because they have not pitched their arguments very well or built a constituency. "There are all sorts of practical uses of [the project], but it's just not been well argued," Rodman says. "The botanists have undersold its importance. That's part of my problem" when he tries to sell the idea to convince others at NSF to fund the project.

Morin has now changed strategy. She says she will apply for only $200,000 from NSF on the next go-around in October. She plans to go to foundations and other sources in the private sector to raise money. At the suggestion of Rodman, she will organize a workshop next summer to explain the project to potential users and solicit suggestions about how the computer information can be made "user friendly."

Morin is steadfastly optimistic. The completion of volume number one, which will include ferns and conifers, will spur more interest, she says. When asked if she believes she faces an uphill battle, she responded, "It may be an uphill battle, but it's a short hill." ■ MARJORIE SUN

A Direct Approach

Nancy Morin, coordinator of the Flora of North America project, could pick up a few tips in salesmanship from Hugh Iltis, curator of the herbarium at the University of Wisconsin at Madison.

Iltis recently won a $60,000 grant from U.S. Department of Agriculture to catalog the grasses of North America. As Iltis describes it, he successfully demanded a spur-of-the-moment meeting with Agricultural Research Service administrator Terry Kinney while in Washington, D.C., on business this spring.

"I took two volumes from the Soviet [flora collection] and banged them on the table before Kinney and said, 'We don't have this! Why not?' I'm a bit of a ham, you know. Six weeks later, I got funding. I have chutzpah."

USDA official Mary E. Carter, who was present at the time, said that his proposal went through peer review. But she adds with a chuckle, "Hugh was in his best show form that day." ■ M.S.