new BioLat program at the Smithsonian, Erwin is looking at key taxonomic groups at a few sites in Bolivia and Peru.

How the venture would be funded has not been addressed—the survey has yet to be formally proposed—but one possibility is partly through NSF. The newly established task force on biodiversity, on which Raven and Wilson serve, will recommend what NSF should pursue when it reports to the National Science Board early next year.

Beyond the rough map, agreement breaks down, and fundamental questions remain about the best way to proceed. Perhaps the biggest rift is between conservation biologists and systematists, whose desire for detailed inventories and taxonomic studies are seen as inherently at odds with the rapid action needed for conservation. Their differences would not be so pronounced were not both groups vying for what to date has been a very small pot of funds.

"We can describe everything and then end up with a catalog of extinct species," mutters Soulé, president of the new Society for Conservation Biology.

Responds Raven, a key spokesman for the systematist camp: "I'm all for action, God knows we need it, but you can't neglect the knowledge base and get the job done." Systematics and conservation need not be at odds, Raven says, if they proceed simultaneously.

His gripe is that basic taxonomic research and training of scientists in the tropics—"one of the most vital and urgent things we can do"—are often overlooked or accorded low priority in conservation plans.

Nor is there agreement on which conservation strategies to pursue. Several conservation groups have been advocating a focus on critical areas, or "hotspots" of diversity, such as would be identified in this quick survey. Russell Mittermeier of World Wildlife Fund favors focusing first on the "megadiversity" countries—the 13 countries that house some 60% of the world's species.

But the real heretic at the Davis meeting was Brown, who questioned the two fundamental strategies of conservation, or at least the near-exclusive reliance on them: preserving endangered species and setting up reserves of pristine habitat.

"I am not arguing that those approaches should be abandoned, but that by themselves they are not enough," says Brown. Many species are already doomed, he says, and not all species are essential. Perhaps most important, preserving endangered species is expensive. "We can't afford to be concerned about the loss of some species."

The basic problem with reserves, contends Brown, is that most species don't live there. Reserves now account for only 1% of the world's land area, and though the figure may double soon, there are limits to expansion because few pristine habitats are left. In addition, most reserves are too small to save some endangered species.

Rather than focusing on these two strategies, Brown calls for increased attention to alternatives, especially management of 85% of the world's land that is nonurban and nonagricultural. The fate of most species, says Brown, will depend on what happens in this "semi-natural matrix" where most of the species reside, the land used by humans for mining, timbering, and grazing livestock. If these surrounding lands are degraded, then the reserves—often only small islands of pristine habitat—do not stand a chance, says Brown. He envisions land-use planning on a national scale and, eventually, planning among nations.

People quibbled with some of Brown's conclusions, pointing out, for instance, that in the tropics the only hope for survival for most species is in reserves. But it was the talk of triage, although Brown never uttered the word, that hit a raw nerve.

"Jim Brown has returned to the concept of triage," said Lovejoy. "I find that to be a very unattractive policy, at least if stated to the outside world. Triage is hard to practice wisely, other than what we are doing now, which is spending what money there is in the most intelligent way."

To Soulé, Brown's views reek of "endangered species bashing," which is increasingly popular nowadays. "Everyone has decided that there is too much attention on endangered species, or just species in general, and that they are detracting resources from the problem of ecosystem preservation. But it is an artificial dichotomy. If it weren't for the large mammals like the pandas and elephants, we wouldn't have any habitat left."

He also questions the arrogance inherent in such decisions. Says Soulé: "I am not ready to have experts say thumbs up or thumbs down on some species without letting the public know."

To Lovejoy, it is also a question of strategy. "This is biology's moment in history. We have to set our sights high and not be afraid of the cost, rather than to start admitting defeat and say triage is necessary."

Brown, by contrast, chides his colleagues for their emotionalism. "Most of us are in this business because we love wild creatures and wild places. We start with an emotional involvement. But some of that has to be put aside when we start acting like scientists." He calls on them to use scientific criteria to allocate resources among alternatives.

Brown has an ally of sorts in Raven, who points out that such decisions can be made on a number of grounds, not just scientific. Says Raven: "What species survive is up to us, and we have to make hard choices. I call for intelligent decisions on which species to save and how to do it. We can decide on scientific, aesthetic, emotional, or economic grounds." ■ LESLIE ROBERTS

Chips Made with X-ray Lithography

International Business Machines Corp. recently took an important step toward development of a 64-megabit memory chip, the powerful chip that is expected to be at the heart of advanced computers in the mid- to late 1990s. The company announced it has become the first to use practical x-ray lithography to make advanced computer chips. X-ray lithography, an etching process that can produce smaller circuit patterns than the optical systems now in commercial use, is widely seen as an essential tool for making the tiny circuits needed in coming generations of chips.

The importance of the x-ray lithography work, said IBM's Alan Wilson, is that the company has made complete computer chips using processes and techniques similar to what could be used in a full-scale manufacturing environment, rather than in a laboratory environment. "We tested it in such a way that we weren't cheating," he said.

Two factors—the size of a chip and the size of the individual components on the chip—determine the chip's maximum capacity. The densest chip made commercially is the 1-megabit dynamic random-access memory (DRAM) chip, which has a resolution of just over 1 micrometer. For comparison, the resolution of the individual components on IBM's chips was 0.5 micrometer, and the 64-megabit DRAM is expected to need a resolution of about 0.35 micrometer to squeeze all the necessary components onto it. IBM's chips were 25 millimeters square, or about twice the projected size of the 64-megabit memory chips.

The race to build chips with higher capacities is in large part a race to make the individual components on the chips smaller, while at the same time keeping the size of the chip relatively large and keeping the manufacturing process efficient and cost-effective.

Integrated circuit chips are laid down layer by layer on a base of semiconducting material, usually silicon. A layer typically consists of a collection of lines or rectangles patterned out of a conductor, semiconductor, or insulator. The pattern for each layer is created by a lithography process, where a beam of light—visible light, ultraviolet, or x-rays—passes through a patterned mask to expose a photosensitive material. The image of the mask that is produced on the photosensitive material then provides the template for the next processing step—laying down a series of conducting lines, for instance, or doping certain areas of a silicon layer. The chip's resolution is limited by how accurately patterns can be reproduced on the photosensitive material.

X-ray lithography offers several potential advantages over optical lithography. One is increased resolution—the wavelength of x-rays is shorter than that of visible or ultraviolet light, and it is the wavelength that ultimately determines how fine a feature can be resolved. Practical engineering problems limit optical lithography to a best resolution of about twice the wavelength of visible or ultraviolet light, or about 0.5 micrometer, while the practical limit to the resolution of x-ray lithography should be around 0.1 micrometer, Wilson guessed. A second advantage of x-rays is that they pass through some objects that visible or ultraviolet light cannot, so that, for example, dust particles on a chip are less a problem in x-ray than optical lithography. A third plus is that x-rays can expose a much larger chip at one time because they do not have to pass through a lens as does optical light.

Transforming those potential advantages into a commercially superior system is the problem facing chip manufacturers. They must learn to use x-ray beams, to fabricate x-ray masks, to align the masks to greater accuracy for each of the successive exposures, and to expose and process the chips in a new setting. IBM's announcement signals they have done all that, at least at the level of making a few chips. "All of the elements necessary are there," Wilson said.

What remains to be done? "Next is the throughput," Wilson said. "We've not demonstrated 80 wafers per hour, but we've demonstrated that the system is capable of that." The company also must reduce defects to a commercially acceptable point. And it needs a small, specialized source of x-rays dedicated to a manufacturing process. For the demonstration, IBM used a beamline at the National Synchrotron Light Source at Brookhaven National Laboratory, but the company is having a smaller synchrotron designed for it by a company in England. Wilson said at least one company in Japan is close to offering a commercial synchrotron to provide x-rays for lithography, but he knew of no American company aiming at one. ■ ROBERT POOL

Ecologists' Opportunity in Yellowstone's Blaze

The recent fires that spread through half of Yellowstone National Park offer insights into important ecological questions

IN 2 WEEKS TIME Montana State University will host a workshop on the aftermath of this year's massive fire that has devastated 800,000 acres of Yellowstone Park's 2.2 million acres. "The concern of many people is that we've lost a national treasure," says John Jutila, who is organizing the gathering. "But the workshop will reveal opportunities that we've not had before, particularly in the scientific area." About 100 investigators are expected to attend—including ecologists, economists, and representatives of the National Park Service and the U.S. Forest Service—and they plan to draw up a wide range of research programs, some of which will extend a decade and more.

"There is a special opportunity here," says Linda Wallace of the University of Oklahoma. "There have been many previous studies of fires, but for the most part they have been on a much smaller scale. Here we have a chance to study the response of the entire ecosystem, not just parts of it." It was Wallace who initiated the idea of having the forthcoming workshop, but her original focus on ecological studies has been widened to include socioeconomic issues, such as the impact on tourism.

The ecological focus itself is rather broad, encompassing ecosystem-level studies on nutrient flow and sediment dynamics, community-level questions on succession, and interactions between just a few species, such as large grazers and the grasses and herbs they eat. The decomposition of huge quantities of organic matter will have a great impact on the immediate ecological response to the fire. Although some proportion of the potential nutrients generated by the fire will have been lost through volatility, the ecosystem will receive a large nutrient fix, one result of which will be a boost in primary productivity.

One aspect of this boost, says Willam Romme of Fort Lewis College, Colorado, will be "a vigorous growth of grasses and herbs." With many of its former food resources destroyed, the grizzly bear will find new ones here, because the new growth of grasses and herbs will support large populations of insects and rodents. Such is the interconnectedness of things.

Romme's principal interest, however, will be in monitoring the recolonization of razed areas, the community-level process known as succession. "It's an excellent opportunity to test some of the theories of succession," says Romme. The current theories—known respectively as facilitation, tolerance, and inhibition—were proposed by Joseph Connell and Ralph Slatyer a dozen years ago, and address the issue of how, in a mature

Alan and Sandy Carey

Life continues: *Elk graze in a patchily burned area of Yellowstone. Grasses and herbs are already beginning to sprout in locations burned a few weeks ago, but hard times are likely to lie ahead for these large mammals, at least in the short term.*