

YELLOWSTONE INVESTIGATES ACCESS AND PROPERTY RIGHTS TO GENETIC RESOURCES

By BOB LINDSTROM

I RECENTLY ATTENDED A SCIENTIFIC conference sponsored by the U.S.D.A. Agricultural Research Service entitled, Global Genetic Resources—Access, Ownership, and Intellectual Property Rights. Held last May at the Beltsville Agricultural Research Center, Maryland, the conference was attended by 300 scientists, lawyers, and intellectual property-rights specialists from around the world. Yellowstone National Park managers have become interested in this topic particularly as it relates to the commercial use and patenting of products from National Park Service research specimens (figure 1). I participated by presenting a poster discussing “Yellowstone Thermophiles and Biotechnology: An Intellectual Property Dilemma,” which included industrial applications of 11 Yellowstone specimens.

The majority of the conference presentations focused on the loss of biodiversity throughout the world, and what could be done to preserve representative voucher populations. Manipulation of genetic material has been performed by humans since the beginnings of agriculture more than 5,000 years ago. Modern food crops and livestock are crossbred, hybridized, and genetically engineered to meet the dynamic needs of modern society. Much upgrading of our food supply has been accomplished by farmers, fine-tuned by the modern techniques of agricultural research, and marketed in cooperation with the private sector. Such characteristics as semidwarf varieties, fungal rust resistance, and frost hardiness in modern wheat are derived from the biodiversity of developing nations.

Forty percent of modern pharmaceuticals are obtained from plants, most of which are located in the tropical zones of the Third World. Biotechnology has accelerated the manipulation of economically important natural resources by using techniques of tissue cultures, genetic cloning,



Figure 1. Replete with organisms adapted to life at high temperatures and often with considerable commercial potential, hot springs, such as Emerald Pool in Yellowstone's Black Sand Basin, have become symbolic of a dilemma to preserve biodiversity in parks, while allowing for utilitarian research.

ing, and overexpression (abnormal production) of gene products. However, many species—valuable in and of themselves, as well as for food crops or medicines—are threatened with extinction due to habitat loss caused by human expansion and development. The loss of in situ (in the field) genetic diversity is a serious problem in the strategic reserves of the human food supply. The agricultural research community's response is to promote *ex situ* (in the laboratory) preservation including seed banks or germplasm production outside the natural habitat of the species. When a war and famine in Ethiopia caused the extinction of a locally important grain, ex-situ seed stock from the U.S. Department of Agriculture was provided to reestablish the drought-tolerant local variety.

Obviously, we also wish to preserve native resources in situ in places like Yellowstone and other parks and reserves

around the world. A related issue focused on commercial use of these resources, which was of interest to me, representing the National Park Service. Our primary mission is to preserve park resources, but secondarily, we must provide for public enjoyment of the resources, as long as no harm is done. Research permits are the only allowable means of access to genetic resources and are sanctioned under the provisions of the Code of Federal Regulation (CFR) 36 2.5, “Research Specimens.” As global biodiversity is steadily depleted, biosphere reserves such as national parks become increasingly important sources of genetic resources.

Conference participants heard about the 1992 United Nations Convention on Biological Diversity that established an international common law considering genetic resources intellectual property belonging to individual member states. Intellectual property rights (IPR) are simi-

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lar to copyright laws in that they protect the owner of these easily copied or pirated resources. The National Biodiversity Institute of Costa Rica (INBio) is leading the pack with respect to IPR, implementing biodiversity preservation by marketing genetic resources to biotechnology companies. Income from biodiversity is used to preserve and protect conservation areas, substituting ecotourism and research for traditional slash and burn agricultural clear-cuts and grazing monocultures.

Yellowstone has often set the precedent in conservation biology, and once again we find ourselves on the forefront of biodiversity preservation. Genetic material from a single Yellowstone microorganism is now the basis of a product that revolutionized molecular biology and generates sales of over 200 million dollars per year: the PCR (Polymerase Chain Reaction). (See Lindstrom's article on PCR in *Park Science*, 16(1):12-13.) The gene, a segment of DNA producing DNA polymerase, was removed (transformed) from the hot spring bacterium *Thermus aquaticus* Yellowstone type-1 (*Taq* YT-1). This research specimen was collected by Thomas Brock in 1967 from the Lower Geyser Basin. He published a description of *Taq* and deposited a copy of the specimen into the American Type Culture Collection (ATCC), a nonprofit repository of microbiological specimens. Due to its tolerance for near-boiling temperatures, the product of this gene, *Taq* DNA polymerase, performs the enzymatic amplification of DNA on an industrial scale providing a "silver bullet" in the study of DNA science.

Kerry Mullis, working for Cetus Corporation, invented PCR in the 1980s when he came up with the idea of using a heat-stable enzyme to produce unlimited copies of "target" DNA. The enzyme chosen to be named in the patent was DNA polymerase from *Taq* YT-1, ATCC# 25104, as deposited by Thomas Brock in 1967, collected under a research permit signed by John Good, Yellowstone Chief Naturalist. Uses of PCR include DNA fin-

gerprinting, disease diagnostics, and forensic analysis. Since PCR can be used to amplify any type of DNA, even fossil DNA can be reproduced. PCR was basis of the Jurassic Park biofiction scenario, where fossil dinosaur DNA preserved in amber was recovered and amplified into living organisms.

The conference poster "Yellowstone Thermophiles and Biotechnology, an Intellectual Property Dilemma" presented information on several other significant industrial applications based on heat-stable enzymes from Yellowstone, also available through the American Type Culture Collection. One organism, *Thermoanaerobacter ethanolicus* is adept at converting cellulose from waste products into ethanol for use as gasohol. A U.S. patent on this organism has been granted to Dr. Jürgen Wiegand under contract with the U.S. Department of Energy. Other organisms that aid in bioleaching of gold ore, removal of paint from military air-

craft, and facilitate food processing were mentioned among the many uses of heat-stable industrial enzymes.

that the patent alone would be sold for \$300 million. At present, neither the National Park Service nor the American public reaps any intellectual property benefit or royalty from this invaluable genetic resource.

During the conference I had a chance to visit with the president of the American Type Culture Collection. He is interested in working with the National Park Service in establishing an ATCC "Yellowstone Collection." Since there are currently 28 Yellowstone specimens already contained in the ATCC Catalog, 1992 edition, a section on Yellowstone thermophiles would give NPS managers some control over those existing and future deposits of rare thermophiles by including a blanket NPS policy on commercial use of publicly owned resources.

Yellowstone and other national parks are recognized as critical for preservation of biological diversity, for many purposes, including important utilitarian benefits.

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The ownership of specimens collected under authorized research and collecting permits is retained by the National Park Service, according to the Code of Federal Regulations. However, when *Taq* YT-1 was named as the source of DNA polymerase in the PCR patent by Cetus Inc., the inventor used our sample for commercial purposes without notification or permission. Since the National Park Service could be viewed as "resting on its laurels" during the patent application process, a case could be made that no proprietary interest exists. On the other hand, no one knew that *Taq*-based PCR would revolutionize the world of DNA science, and

The potential and existing commercial use of products derived from resources collected from Yellowstone must be evaluated for its impacts, positive and negative, on park visitors and the public who share ownership in the national parks. If funding is ever generated by genetic resources, the money should be used to perpetuate conservation as demonstrated by the Costa Rican model, and not be depended upon for day to day operating expenses.

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Bob Lindstrom is Management Assistant with the Yellowstone Center for Resources. His phone number is (307) 344-2234.