EDITORIAL

Genetic Engineering, Decision Making, and New Challenges for the Environmental Professions

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Every once in a while, really profound change comes along. Economic production, uses of natural resources, politics and government, demographic patterns, and cultural norms are all either swept away or so altered that everyone acknowledges, "Wow, this is new!" Environmental decision making, too, has to embrace the new situation.

This special issue of *Environmental Practice* on environmental decision making is thus an appropriate place to address the problems and opportunities generated by change. Significant change is emerging on several fronts. Well recognized examples include the Internet and global warming. Another example, genetic engineering, provides especially potent and as yet not fully embraced challenges and opportunities for environmental professionals and environmental decision making.

Within the past year, the term "genetic engineering" has changed in the United States. The phrase has gone from one that would at best have elicited a "Say what? What's that?" from most folks to a slogan for street protesters railing against increased global commerce, free trade, the World Trade Organization, the World Bank, and the International Monetary Fund. Many shoppers in the supermarket want genetically engineered foods at least to be labeled if not banned. The US Congress is now beginning the process of inquiring whether genetically engineered foods need labeling or, perhaps, a new mode of regulation.

What a difference a year makes. These battles over genetically engineered organisms were already underway in Europe and Japan a year ago, but they had not yet entered the fray in the United States. Now, citizens of the United States are also engaged.

So what does genetic engineering have to do with environmental decision making and environmental professionals? Quite a bit! While it may be possible for environmental professionals to avoid the topic of genetic engineering, that may not be wise. Developments in aquaculture (salmon), agriculture (maize and hogs), and possibly phytoremediation pose specific challenges for environmental professionals around activities like public participation, environmental impact assessment, dispute resolution, and practical research (Table 1).

By no means are these few examples illustrative of all the issues likely to be raised by the increasingly powerful technology of genetic engineering. What they may suggest, however, is that the work of environmental professionals is very likely to be affected by these new capacities to control the placement and expression of genetic material.

Up to now, the environmental professions have not seriously engaged the prospects of bioengineering with anything approaching the vigor needed. As a profession, we are not yet ready to help the public and decision makers resolve the conflicts emerging. Passage and likely ratification of the Cartegena Protocol on Biosafety will probably define the framework within which decisions are made on agricultural uses of genetic engineering (Mahoney, 2000). The times have changed and with that comes the need for professional growth and development among environmental professionals.

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Reference

Mahoney, R. J. 2000. Opportunity for Agricultural Biotechnology. *Science* 288(5466):615.

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Table 1. Challenges and opportunities from current and future possible developments in genetic engineering

Item	Challenges and Opportunities
Atlantic salmon for aquaculture are engineered, with genes from other fish species, to produce growth hormone constantly and thus reach market weight more quickly	• What happens in freshwater, estuarine, and marine ecosystems if some of these fish escape and are successful breeders? • Are efforts to restore salmon runs in rivers from which they have long been extirpated aided, harmed, or unaffected by the presence of these escaped engineered fish? • Given the current, generally negative image that genetically engineered foods have with the public, how will public participation processes about these engineered fish be affected?
Corn (maize) is altered by insertion of a gene from the bacterium, *Bacillus thurengiensis* to produce a protein toxic to insect pests of corn	• Will wide-spread planting of this genetically engineered corn harm non-target insects, as was recently suggested by experiments showing the larvae of Monarch butterflies to be adversely affected by feeding on milkweed leaves dusted with pollen produced by this engineered corn? • Was release and use of such engineered corn an act that ought to have been subject to environmental impact analysis? If it had, would environmental professionals have had the appropriate tools?
Pigs are genetically engineered to produce phytase, a bacterial enzyme, which in turn helps the pig digest phosphorus so that their manure contains less of it and thus is a reduced threat to water quality	• Do environmental professionals know how to estimate feasibility, costs, risks, and benefits of this "water pollution control technology?" • If such engineered pigs become feral and reproduce outside of domestication, are "unanticipated consequences" to be expected? • Is it possible to conceive of a negotiated rule making process between hog producers and environmentalists to regulate this technology?
A poplar tree might, in the future, be bioengineered to be an efficient absorber of heavy metals and thus an effective alternative for bioremediation of contaminated soils	• Is this the type of technology that should be a candidate for priority funding at a Superfund Hazardous Research Center? • Will people living near such a Superfund site welcome the growth of "Frankentrees" in their neighborhood? • Would such trees, if they were ever created, have any consequences for the existing "natural" flora and fauna of the area?

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