Transgenic Fish: A Boon or Threat?

ERIK STOKSTAD'S ARTICLE "ENGINEERED FISH: friend or foe of the environment?" (News Focus, 13 Sept., p. 1797) entertains the premise that the culture of transgenic fish, which grow two to six times faster than conventional fish, "might alleviate pressure on wild stocks." Two key points not addressed by Stokstad challenge this premise.

First, the culture of carnivorous species, such as salmon and trout, already represents a net drain on wild fish populations. Over 2 kg of wild fish are required to produce 1 kg of aquacultured conventional carnivorous fish (*1*). In North America and Europe, fish are usually reared in high densities and therefore rely completely on manufactured feeds for sustenance. Manufactured feeds for carnivorous species are typically composed of 35 to 50% fish meal and up to 20% fish oil (*1*). The accelerated growth rate of transgenic fish will necessitate an enormous increase in the usage of feeds and their constituent marine feedstuffs. Fish meal and fish oil are typically made from menhaden and anchoveta harvested from the wild. As these species are already being exploited near their maximum sustainable levels (*2*), using more of them to create even more feed for transgenic fish can hardly be considered an easing of pressure.

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Second, on the basis of the Law of Conservation of Matter, increased feed inputs will result in more outputs of waste in aquaculture effluents [e.g., (*3*)]. Reclamation of aquaculture waste is already problematic. In net-pen culture, for example, untreated wastes are expelled directly into the surrounding waters and commonly cause local eutrophication, buildup in sediments of feed-borne antibiotics, and benthic anoxia (*4*). Although the degree of these impacts depends on husbandry practices and the hydrodynamics of the site, the potential for serious environmental damage will increase with the increased feed usage required by transgenic fish culture. Add the potential effects of interbreeding between transgenic escapees and wild fish discussed by Stokstad, and transgenic fish culture appears more threat than boon to the wild fishery.

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References
1. R. L. Naylor *et al.*, *Nature* **405**, 1917 (2000).
2. Food and Agricultural Organization (FAO), *The State of World Fisheries and Aquaculture 2000* (FAO, Rome, 2000).
3. H. Ackefors, M. Enell, *Ambio* **19**, 28 (1990).
4. British Columbia Environmental Assessment Office, *Salmon Aquaculture Review*, vol. 3 (British Columbia Environmental Assessment Office, Victoria, Canada, 1997).

Dealing with the Risks of Transgenic Fish

ERIK STOKSTAD'S ARTICLE "ENGINEERED FISH: friend or foe of the environment?" (News Focus, 13 Sept., p. 1797) correctly points out the risk to the environment associated with potential releases of genetically modified aquatic animals. This risk is a function of the specific genes, specific species and strain, and environment, and is independent of whether the genes came from genetic engineering, conventional breeding, or inadvertent selection.

The scientific research community must remain attentive to the details of how these very complex problems are being addressed. Researchers can become "collateral damage" to groups with agendas ranging from real environmental concern, to antitechnology, anti–genetically modified organism activists, to crass commercial interests.

In California, State Senator Byron Sher introduced legislation (*1*) SB 1525 that would have made it "unlawful to import, transport, possess... any live transgenic fish." When it was clear that this legislation would shut down many zebra fish researchers in California, it was amended to allow researchers to get a permit for noncommercial purposes only. This could still affect researchers by impacting zebra fish suppliers like Scientific Hatcheries and Exelixis, along with the added burden of another layer of permits. This bill with its amended variations and reincarnations posed a real risk to scientific research in California, before it was finally stopped for this year.

The proponents of a ban on transgenic fish (*2*) submitted a petition to the California Fish and Game Commission to adopt a moratorium on "transgenic" fish and stated that the moratorium would "specifically apply... [to] ornamental aquatic species, such as transgenic zebra fish." Senator Sher's letter of support (*3*) specified plans for "mass producing a transgenic form of these zebra fish" as "wrong." When the zebra fish research community heard about these plans and showed up at the Fish and Game Commission meeting on 29 August 2002, the proposal was defeated. Efforts are under way to find a solution to the real problem of unwanted gene movement in the environment, without impacting scientific research and other insignificant environmental risk situations.

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References and Notes
1. See info.sen.ca.gov/pub/bill/sen/sb_1501-1550/sb_1525_bill_20020220_introduced.html.
2. Letter to R. Treanor, California Fish and Game Commission by the Natural Resources Defense Council (NRDC), Institute for Fisheries Resources, Pacific Coast Federation of Fishermen's Associations (PCFFA) and The Ocean Conservancy, 23 July 2002.
3. Letter to M. Flores, California Fish and Game Commission, by State Senator Byron Sher, 30 July 2002.

Encouraging Academic Competition in Europe

THERE HAS BEEN CONSIDERABLE DEBATE ON what are seen to be unfair academic recruitment practices in European countries such as Italy and Spain ("Academic recruitment in Spain and Italy," D. Gui *et al.*, Letters, 2 Aug., p. 770; "Reforms spark more jobs—and protests," X. Bosch, News of the Week, 1 Feb., p. 781). A substantial problem lies in the fact that there is a lack of direct competition for funding among the universities of a specific country based on indicators of scientific performance.