

other farming practices have caused the hypoxic condition, and changes in farm policy can correct the problem with relatively little cost to farmers and with little or no loss of agricultural productivity. The idea proposed by Winstanley and E. Krug that modern agriculture has a "cleansing" influence on water quality is absurd, as discussed in the critique by M. David and G. McIsaac, to which the Ferber article refers. The vast majority of the science points to the need to change farming practices in the United States if we are to solve the problem of the dead zone and the deteriorated water quality elsewhere in our country.

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**IN DAN FERBER'S REPORT ON HYPOXIA, HE** tells a good-girl/bad-boy story about N. Rabalais and me rather than describing legitimate differences of scientific opinion. In so doing, he makes inaccurate and misleading statements.

(i) Ferber states that Edward Krug and I conclude that modern agriculture has greatly cleansed the Illinois River. We in fact conclude that reduction in the concentration of nitrogen is attributable to both point- and non-point-source pollution control. The discharge of nutrients from Chicago wastewater has decreased by more than 90% since the 1920s.

(ii) Ferber reports that I argue that the dead zone in the Gulf of Mexico is a natural phenomenon. My position is that the relative contribution of offshore sources of nutrients from upwelling waters of the continental slope is unknown. The White House Committee on the Environment and Natural Resources recognizes that algal blooms in shallow coastal zones can be caused by upwelling of deep nutrients (1). The coastal zone of the Pacific Ocean from Canada south to Chile experiences natural hypoxia (2).

(iii) Ferber also reports that I have led an effort to clear the Mississippi Basin's name. This is false. As the CENR report itself acknowledges, a large body of addi-

tional data is available, but was not used. The failure of the report to incorporate a large body of scientific data reflects a bias with the report, not with me.

(iv) Ferber knows that I support the implementation of agricultural best management practices, but does not mention this in his report.

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#### References and Notes

1. CENR, *National Assessment of Harmful Algal Blooms in US Waters* (White House, Washington, DC, 2000).
2. R. J. Diaz, R. Rosenberg, *Oceanog. Mar. Biol.* **33**, 245 (1995).

## Response

### WINSTANLEY HAS CRITICIZED WHAT HE CALLS

"the fertilizer hypothesis" in Congressional testimony, in public comments he ghostwrote for Illinois officials, and in several speeches, including one at the annual convention of a major farm lobbying group, the American Farm Bureau Federation. (Snyder's claim that fertilizer nitrogen has not been clearly linked to Mississippi River nitrogen dismisses several modeling studies, including Goolsby's, that point to nitrate from fertilizer as the major source.) Also, while the federal action plan does refer to all sources of nitrogen, it clearly aims to cut fertilizer use in the Mississippi Basin by calling for funding of agricultural best management practices, which help reduce wasteful fertilizer application.

DAN FERBER

## A Global Strategy to Defeat Invasive Species

**IN "BLACK CARP AND SICK COWS" (EDITORIAL,** 13 Apr., p. 169), Donald Kennedy illustrates that globalization of trade, travel, and transport can have unintended negative consequences, namely, the relocation and establishment of invasive species (1). He is justifiably concerned that there is too little awareness of this international threat and no general strategy for dealing with the invaders.

In 1996, this same concern was voiced by representatives of 80 countries and the United Nations (2). This led The Scientific Committee on Problems of the Environment, The World Conservation Union, CAB International, and invasive species experts from a wide array of disciplines to establish the Global Invasive Species Program (GISP) in 1997. GISP's mission is to employ its scientific and technical expertise to increase the ability of all nations to minimize the spread and impact of invasive species.

In its first phase of operations, GISP

has produced four books (3) and designed a database for the world's worst invaders ([www.issg.org](http://www.issg.org)) and a toolkit of best management practices. GISP's global strategy recommends actions that governments and other bodies can take to address the invasive species problem. Its recommendations informed the development of the United States' first national invasive species management plan, released by the National Invasive Species Council in January (available at [www.invasivespecies.gov](http://www.invasivespecies.gov)).

GISP's studies indicate that prevention is more economical and feasible than controlling outbreaks of invasives. Thus, the improvement of prevention systems and their expansion to incorporate agricultural and environmental threats should be an international goal. Many invasive species have "lag periods" after introduction when small populations can be eradicated or contained; therefore, limited resources are best expended to detect and respond to newly established invasives. Ultimately, a nation's ability to address its invasive species problems is determined by its access to global information sources, the strength of its taxonomic capacity, and its willingness to cooperate with other countries.

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#### References and Notes

1. "Invasive species" means an alien (non-native) species whose introduction does or is likely to cause economic or environmental harm or harm to human health. U.S. Executive Order 13112, 3 Feb. 1999.
2. O. T. Sandland et al., Eds., *Norway/United Nations Conference on Alien Species* (Norwegian Directorate for Nature Management and Norwegian Institute for Nature Research, Trondheim, Norway, 1996).
3. J. A. McNeely, Ed., *The Great Reshuffling: Human Dimensions of Invasive Alien Species* (World Conservation Union, Cambridge, MA, 2001); H. A. Mooney, R. J. Hobbs, Eds., *Invasive Species in a Changing World* (Island Press, Washington, DC, 2000); C. Perrings et al., Eds., *The Economics of Biological Invasions* (Edward Elgar, Northampton, MA, 2000); C. Shine et al., *A Guide to Designing Legal and Institutional Frameworks on Alien Invasive Species* (IUCN, World Conservation Union, Bonn, Germany, 2000).

## The Identity of Plant Glutamate Receptors

**ION CHANNELS ARE IMPORTANT IN THE** perception and transduction of environmental signals in essentially all organisms. Plants are no exception. Completion of the *Arabidopsis* genome-sequencing project has revealed that among the 600 *Arabidopsis* genes predicted to encode membrane transport proteins of one sort or another are 20

## Letters to the Editor

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