LETTERS

edited by Jennifer Sills

Getting His Goat

IN HIS BOOK REVIEW "TWO DOORS and a goat" (9 October, p. 231), the answer D. O. Granberg offers to the Monty Hall problem is incorrect. He assumes that the contestant should try to win the car. In reality, a car pollutes the environment and adds nothing to the car the contestant already owns. In contrast, a goat replaces noisy lawnmowers and provides milk, cheese, and (if absolutely necessary) a tasty curry.

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Cell Therapy Ahead for Parkinson's Disease

THE NEWS FOCUS STORY "FETAL CELLS AGAIN?" (C. Holden, 16 October, p. 358) indicates that fetal cell transplants for Parkinson's disease patients fell out of favor after control studies suggested that placebo effects may have accounted for positive results. However, there were no proven placebo effects in previous clinical trials. The reason that new trials are funded in Europe is that previous trials used outdated methods for cell therapy.

These outdated methods, combined with patient differences, obscured any difference in average improvement. However, some patients do show spectacular recovery in response to neuronal cell therapy. In the future, with the use of rapidly improving genetic tools and diagnostics, we may be able to identify in advance the patients who will be most responsive to cell therapy. According to available data, with improved cell therapy (very likely stem cell–derived), such patients could have a chance of significant motor and behavioral benefits for 10 to 15 years in the absence of drugs. It is true that Parkinson's disease is more complex than just a lack of dopamine, but those that use this argument to discourage physiological cell therapy miss the point: Many patients may respond better and have fewer long-term side effects in response to therapeutic dopamine neurons than they would with the available systemic drug therapy, which relies almost exclusively on dopamine pharmaceutical drugs. For these reasons, it is scientifically and medically shortsighted not to test major refinements of cell therapies for Parkinson's disease.

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Environmental Markets: Concentrate on Criteria

IN THEIR PERSPECTIVE ("RESTORATION OF ecosystem services for environmental markets," 31 July, p. 575), M. A. Palmer and S. Filoso rightly promote rigorous science to link ecosystem functioning with the provision of ecosystem services, but they exaggerate the potential downside of market valuation in restoration outcomes. Well-defined markets delineate which services are relevant and, consequently, the biophysical processes that underlie them, not the other way around. In effect, environmental markets are indispensable compasses for restoration initiatives.

The focus should be on developing and improving valuation criteria, not on adding costly mechanisms that might discourage development. There is currently a large and growing research paradigm, informed by both economists and ecologists, that addresses how economic valuation can better approximate the complexity and nuance of ecosystems (*1*).

Ecological restoration in modern landscapes must be scientifically driven but socially based (*2*). As a matter of pragmatism, it is often better to have imperfectly functioning environmental markets, in which nature has some economic value, than to have no environmental markets, where nature possesses zero value. This fits into the broader notion of ecosystems as assets from which society derives vital services (*3*). Ecological restoration, then, is not merely a rehabilitation of biophysical processes, but an investment in natural capital.

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Letters to the Editor

Letters (~300 words) discuss material published in *Science* in the previous 3 months or issues of general interest. They can be submitted through the Web (www.submit2science.org) or by regular mail (1200 New York Ave., NW, Washington, DC 20005, USA). Letters are not acknowledged upon receipt, nor are authors generally consulted before publication. Whether published in full or in part, letters are subject to editing for clarity and space.

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Amazing maize

1071

Who killed the megafauna?

1072

Environmental Markets: The Power of Regulation

IN THEIR PERSPECTIVE ("RESTORATION OF ecosystem services for environmental markets," 31 July, p. 575), M. A. Palmer and S. Filoso call for direct measurement of ecosystem processes and third-party verification. This step is a critical one for the burgeoning compensatory mitigation industry to preserve, or recover, its credibility. However, Palmer and Filoso did not mention those who actually control ecosystem markets and did not consider how more rigorous restoration quality checks could provide an economic incentive to reduce ecosystem impacts in the first place.

Ecosystem service markets are odd in that they are created and controlled by regulation. For aquatic ecosystems, for example, the Clean Water Act (CWA) and the first President Bush's administration created a cap-and-trade program for wetlands and later for streams. This produced a demand for restored ecosystems through fiat, not through an inherent consumer need for ecosystem service commodities. The U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (USACE) determine the presence of wetlands and streams on the landscape, their condition, and any requirements for compensation when these ecosystems are affected by development. Thus, by regulating the presence of existing wetlands and streams that might be affected, these two federal agencies are responsible for creating demand for these ecosystem services. In turn, these two agencies bear responsibility for the presence of the supply of restored ecosystem services through approval and certification of specific restoration projects. If the quality and integrity of restoration are lacking in existing aquatic ecosystem service markets, the blame rests largely on the shoulders of EPA and USACE, and these are the agencies through which aquatic ecosystem restoration policy changes must occur.

We agree with Palmer and Filoso that more stringent criteria must be established for restoration as part of ecosystem markets, and we suggest that EPA and USACE quickly institute more stringent standards. But we also emphasize the economic and ecological implications of such changes. Making the success criteria of restoration more rigorous will undoubtedly increase the cost of restoration: Project engineering will initially prove more difficult and therefore more costly; financial risks will increase with greater uncertainty, causing investors to increase required rates of return; and verification of project success, whether direct or through third parties, will represent an additional expense.

The net result is an increase in mitigation costs, which will need to be recouped by charging more for mitigation credits. This will, in turn, drive up the costs of affecting aquatic ecosystems, serving as a deterrent to damaging them. That is, increased restoration quality requirements could reduce the demand for compensatory mitigation by providing incentives for avoidance. This is likely the most substantial benefit of more expensive restoration.

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Response

WE AGREE WITH WU AND KIM THAT WELL-defined markets can delineate relevant ecosystem services. However, contrary to Wu and Kim's assertion, the science underpinning aquatic ecosystem restoration is far too underdeveloped for a mere delineation of ecosystem service in a market context to serve as an adequate "compass for restoration initiatives." An ever-increasing number of peer-reviewed studies show that the effectiveness of aquatic restoration projects is falling short of expectations (*1*–*3*). This is particularly true for projects that attempt to create ecosystems or restore damaged ecosystems at sites that are inappropriate (e.g., lack needed hydrological linkages) or at sites vulnerable to impacts (e.g., downstream of a polluted tributary) (*4*, *5*).

To ensure sound investments in natural capital—which we whole-heartedly support—markets should provide incentives for conservation of natural resources. If the only alternative is restoration, then two steps are required. First, we must invest in science and engineering research aimed at improving methods to restore well-functioning aquatic ecosystems. Second, we should extend this research to include the development of cost-effective assessment metrics that dependably represent the ecosystem functions that support a service or suite of services (*6*–*9*).

Wu and Kim asserted that we exaggerated the potential downside of environmental markets. The focus of our Perspective was on the incomplete nature of ecological science needed to inform markets. We did not delve into the economic complexities associated with ecosystem service markets. However, even to us as ecologists it is obvious that the environmental markets are quite different from routine commodity markets that should be self-governing. Typically, the product bought or traded is a permit or an allowance to affect the environment—not an ecosystem service. The permit to affect the environment is the buyer's motivation for entering the market. Profit is the seller's motivation, and it is to his or her advantage to produce a (restoration) product at the lowest possible cost. If the product quality (restoration project outcome) is not easily assessed or if it is not properly evaluated by a regulatory entity, it may not matter to the buyer (*10*). Quality uncertainty is well known to influence markets.

Riggsbee and Doyle astutely point out that it is the regulator and those establishing the rules of the market that are in the position to evaluate quality. If the regulator does not ensure that the ecosystem services being sold or traded are actually delivered, then the market system will result in further environmental degradation. Furthermore, the potential for political influence on regulatory decisions is great. Regulators are under enormous pressures from multiple sources. Thus, the need for an independent entity that does not answer to elected officials and does not stand to benefit financially is required to complete evaluations and monitor trades.

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Training Scientists to Manage

THE NEWS FOCUS STORY "RESHUFFLING GRADuate training" (J. Mervis, 31 July, p. 528) details Roald Hoffmann's proposal to improve the U.S. science system by making students more independent and empowered through an increase in government fellowships granted directly to students. Responses to this story included suggestions to increase funding for fellowships ("Increase grants, too," M. J. Castellano and K. E. Mueller, Letters, 18 September, p. 1498) and to provide more stable funding for students ("Stable funding is key," R. J. Butera, Letters, 18 September, p. 1499).

These suggestions are all related to the theme of financially supporting and maintaining the most important resource to modern scientific research: graduate students. However, although academic culture recognizes the importance of graduate students, it currently does almost nothing to train current and future principal investigators (PIs) to effectively manage this resource. Few Ph.D.s have substantial hands-on experience managing others before they land a faculty position, and even fewer have any formal training in management. Faculty are left to learn this skill on the job at the expense of productivity and the well-being of the people they are managing. Furthermore, there is an emphasis on student independence in this discussion, which is natural; independence is an essential quality in a career researcher. The unfortunate implication is that ideal students are independent from the start. In fact, independence is a skill that can be taught and nurtured, just like the other skills that are explicitly taught in graduate school.

To improve the efficiency of the science industry, I suggest improving the management of its most important resource. Unproductive students are a consequence of student inexperience and poor advising. Better management of students can be achieved through a range of mechanisms that involve both faculty and students (such as regular mutual evaluations and human resources training for current and future PIs). Such efforts may cost time initially, but will certainly pay off in the long run.

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CORRECTIONS AND CLARIFICATIONS

News Focus: "Looking for a target on every tumor" by J. Kaiser (9 October, p. 218). Lung cancer kills 160,000 Americans a year, not 16,000.

Reports: "Grueneberg ganglion cells mediate alarm pheromone detection in mice" by J. Brechbühl *et al.* (22 August 2008, p. 1092). The next-to-last sentence of the text read "The presence of a GG has been identified in all mammalian species looked at so far, including humans (*15*, *30*)." Instead, it should read "The presence of a GG has been identified in all mammalian orders looked at so far, including human embryos (*15*, *30*)."