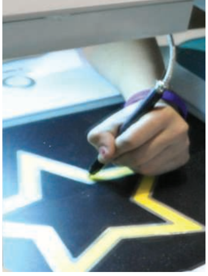

LETTERS

edited by Jennifer Sills

Genetic Future for Florida Panthers

W. E. JOHNSON *ET AL.* ("GENETIC RESTORATION OF THE FLORIDA panther," Reports, 24 September, p. 1641) document genetic changes in the Florida panther population after the 1995 introduction of eight Texas puma females. This translocation has been a great success; the population size has increased more than threefold, and several detrimental traits have substantially decreased in frequency. However, there are compelling reasons to continue the close genetic management and monitoring of the population in the future.

First, only five of the eight female Texas pumas had offspring. The distribution of offspring from these five females was unequal—one female contributed nearly half of the offspring—and the total ancestry from these five females was very high. Specifically, the authors stated that "[t]he estimated relative genetic contribution[s] of the [Texas] females to the descendant population" are 0.20, 0.10, 0.06, 0.04, and 0.01, for a total of 41%. Ordinarily, 50% percent of the ancestry is from each sex; a contribution of 41% is equivalent to saying that about 80% of the female ancestry is from the five Texas females, nearly the maximum possible. In other words, the Texas females may have been too successful and management should evaluate whether to actively preserve the original Florida panther ancestry.

Second, the success may be threatened by inbreeding and low effective population size in the current and future generations. For example, a male offspring of a Texas female and a Florida panther male mated with three of his daughters and produced seven offspring with inbreeding coefficients of 0.25. The effective population size estimate was based only on the number of breeding males and breeding females. If the variance in contributions in males is equal to that found in Yellowstone pumas (*1*), which resulted in the effective number of males being only 18.5% of the observed number of males, and the variance in females reflects the contributions above, the overall effective size in 2007 is probably only between 10 and 15 animals, rather than the 32.1 estimated.

Overall, swamping of the Florida panther ancestry, inbreeding, and low effective population size may endanger the gains made from translocation for genetic restoration (*2*).

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Response

WE AGREE WITH HEDRICK THAT THERE ARE cogent reasons for continuing to monitor the surviving Florida panthers in the future. Inbreeding is by no means solved and may increase as available habitat is developed. It is true that the relative genetic contribution of the Texas pumas was restricted to five of the eight females released in 1995 and that they account for about 50% of the genetic heritage in Florida panthers today. Whether this represents "swamping" or natural subspecies reassortment in the aftermath of demographic and genetic perils experienced by canonical Florida panthers is a matter of opinion. What is clear is that suitable habitat must be preserved and additional populations must be established for the continued survival of this critically endangered group.

The lessons learned from the genetic restoration project highlight the many benefits to the Florida panther population while also demonstrating that there is no quick or universally accepted solution to conserving small, endangered populations. Incorporating interdisciplinary data and the expertise of scientists from varied backgrounds can only improve the development of effective management regimes to help ensure the recovery of endangered animals, including the Florida panther.

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Biodiversity Transcends Services

IN THEIR POLICY FORUM "ECOSYSTEM SERVICES for 2020" (15 October, p. 323), C. Perrings *et al*. discuss possible missing elements in the Convention on Biological Diversity's proposed new targets. They suggest that targets for biodiversity be based directly on ecosys-

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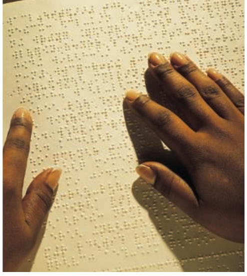

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tem services because people will then have a stake in the program's success.

This approach undersells both biodiversity and the role of ecosystem services. Biodiversity's value extends beyond current ecosystem services and includes likely future benefits we cannot anticipate. Recognizing the benefits of ecosystem services can reduce the cost of retaining relatively intact areas of local biodiversity, but we need to plan for larger-scale conservation. A recognized ecosystem service does more than support some local elements of biodiversity; it makes a low-cost contribution toward conserving the biodiversity of the larger region. Regionally, ecosystem services may be more important as indicators of relative cost and intactness than of biodiversity. When considering regional trade-offs, we cannot simply target ecosystem services and ignore the elements of biodiversity that are not required for the service. Adopting the ecosystem services option for a specific locality may not be as good for balanced regional biodiversity conservation as adopting full conversion of that locality (*1*). An example that has been used to illustrate this point is a locality offering either complete conversion to forestry logging or "sympathetic" logging with partial biodiversity retention. Adopting the ecosystem service based on sympathetic logging, while lowering opportunity costs and maintaining some biodiversity in that locality, nevertheless would mean greater regional biodiversity loss for a given level of regional forestry production.

As an alternative to targets focused on current perceptions of important services, it is time to consider higher-level targets and goals in an effort to better balance overall biodiversity conservation, ecosystem services, and other needs of society. I propose that we implement new systematic conservation planning to more efficiently serve these different needs (*2*, *3*). Because greater efficiency can mean more biodiversity protection for a given rate of land conversion, higher-level targets could allow us to focus on reducing the rate of biodiversity loss as opposed to the more narrow goal of maintaining ecosystem services.

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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Response

FAITH ARGUES THAT OUR APPROACH TO BIOdiversity conservation, which focuses on people's interest in the benefits of ecosystem services, may deprive us of future, unanticipated benefits. This claim is misplaced. In our Policy Forum, we argue that conservation goals should reflect the benefits we get from biodiversity. The argument is not conditional on the type or timing of benefits delivered. We agree that it is not just biodiversity's value in producing marketed commodities that matters. Its indirect value in supporting ecosystem services is often more important (*1*), and its potential value to future users (option value) and to future science (quasi-option value) has been recognized as the most important of all for at least three decades (*2*–*4*).

Our goal was to clarify the trade-offs between these benefits, which are inevitable as we strive to meet the basic needs of a growing world population, alleviate poverty, and protect those species on which our future well-being depends (*5*). Only by being clear about the benefits put at risk by the loss of biodiversity now and in the future can we approach these trade-offs wisely. The ecosystem services approach helps clarify the benefits at risk, whether they are direct, indirect, or options. Science-based information on what we gain and lose from biodiversity change can inform decisions by those charged with representing particular constituencies in forums such as the Convention on Biological Diversity (CBD).

Now that the CBD's 2020 Targets have been set (*6*), the problem has shifted from goal setting to implementation. The best way, now, to prioritize and assess targets is to select appropriate indicators. For example, given that achievement of the goal for sustainable agriculture, target 7, is conditional on achievement of the goal for agricultural subsidies, target 3, the indicators for target 7 should include measures of the achievement of target 3.

To implement the 2020 targets successfully, decision-makers need to be convinced that the costs of biodiversity loss are real. The ecosystem services approach provides the evidence base to argue this case. Trumpeting "intrinsic value" has had little effect in the past and is likely to have less effect in the future as other environmental concerns escalate in policy significance. Using the resources of science to identify and value the consequences of biodiversity change is likely to be the most effective strategy.

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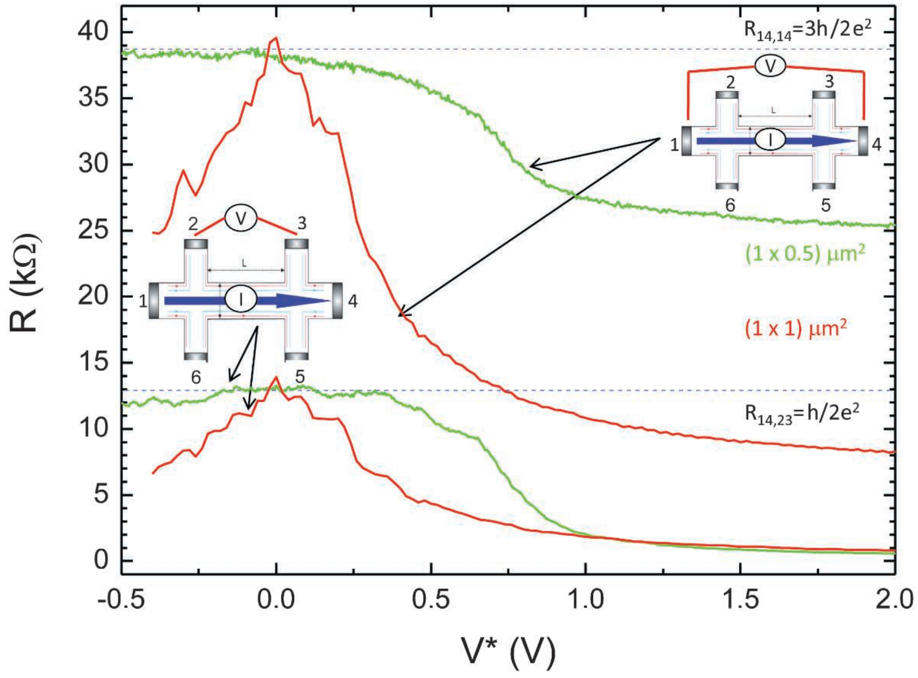
CORRECTIONS AND CLARIFICATIONS

News Focus: "What shall we do with the x-ray laser?" by A. Cho (10 December, p. 1470). The story mistakenly states that Linda Young, an atomic physicist at Argonne National Laboratory in Illinois, and colleagues shined x-rays from the Linac Coherent Light Source onto xenon gas. The physicists used neon.

News Focus: "Genes link epigenetics and cancer" by J. Kaiser (29 October, p. 577). The article failed to note that a Canadian team is among the researchers who have found cancer genes involved in modifying chromatin [K. C. Wiegand *et al.*, *N. Engl. J. Med.* **363**, 1532 (2010)].

Research Articles: "Nonlocal transport in the quantum spin Hall state" by A. Roth *et al.* (17 July 2009, p. 294). An unintended duplication of figure elements was introduced during manuscript preparation. Despite their different horizontal scales, the red $R_{14,23}$ curve in Fig. 1 is the same as that in Fig. 3A; likewise, the red $R_{14,14}$ curve in Fig. 1 is the same as the green curve in Fig. 3A. The configuration of current contacts and voltage probes shown in Fig. 3A is fully equivalent to the four- and two-terminal configurations of a standard Hall bar as shown in Fig. 1. Therefore, this unintended duplication does not affect any claims in the paper. A corrected version of Fig. 1, based on data taken from a Hall bar device different from the one shown in Fig. 3A, is shown here. The original caption is correct.



Research Article: "Identifying autism loci and genes by tracing recent shared ancestry" by E. M. Morrow *et al.* (11 July 2008, p. 218). The authors wish to add an acknowledgment to the contribution of the late Ahmad Teebi to the work presented here. He pioneered the study of genetic disorders in the Arab world and inspired the idea of studying complex disorders in consanguineous populations. We are indebted to his generous collaboration and dedicate this work to his memory.