LETTERS

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Mass Fruiting in Borneo: A Missed Opportunity

Dipterocarp tree seedlings. Many endangered Indonesian trees rarely produce seeds.

LARGE-SCALE RESTORATION OF tropical forest is increasingly recognized as a credible option for climate change mitigation and biodiversity conservation (*1*–*3*). To implement this strategy, we must collect and nurture vast numbers of tree seeds. Yet, in conservation priority areas such as Indonesia—discussed by D. Normile in his News Focus story "Saving forests to save biodiversity" (10 September, p. 1278)—many tree species (such as the dipterocarps) rarely produce seeds (*4*). In 2010, we witnessed the first large mass fruiting event in Borneo since 1998, both in geographic extent and species involved. Unfortunately, forestry departments, funding agencies, and most research institutes were unprepared for this rare opportunity. These seeds cannot be stored, even in state-of-the-art seed banks (*5*). To contribute to the restoration efforts, they must be collected and planted immediately. We have much of the scientific and botanical knowledge required to achieve successful restoration [discussed in E. Pennisi's News Focus story "Tending the global garden" (10 September, p. 1274) and in (*6*)], but we lack the financial and infrastructural resources for seed collection, propagation, and restoration.

Substantial financial support must be dedicated to enable Southeast Asian countries to respond quickly to these critical but rare opportunities for conservation and restoration. We must prepare now to provide funding, planning, and infrastructure for the next major fruiting event. This may be the last opportunity to collect sufficient seeds from many endangered tree species for conservation and forest restoration.

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Asian Water Towers: More on Monsoons

W. W. IMMERZEEL *ET AL*. ("CLIMATE CHANGE will affect the Asian water towers," Reports, 11 June, p. 1382) overlooked two features of monsoon influence on the future of Asian water resources: Regional climate models disagree on whether monsoon precipitation will increase or decrease in the 21st century, and the resulting changes in precipitation seasonality will affect snowmelt characteristics.

Using data from five global general circulation models (GCMs), Immerzeel *et al*. conclude that a rise in precipitation will partly or entirely offset the reduction in glacial meltwater. Monsoon precipitation, however, is known to be difficult to capture in GCMs (*1*).

Because of their higher horizontal resolution, regional climate models can better represent the important effects on precipitation of moist air climbing over the mountains in the Himalaya region. Experiments in which the regional climate models based on the IPCC Special Report on Emissions Scenarios are used disagree on whether monsoon precipitation will rise or fall (*2*, *3*). The reliability of an impact study built on the sole

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assumption of rising monsoon precipitation thus seems questionable.

Immerzeel *et al*. argue that their basin-scale approach justifies the assumption of a constant linear relationship between positive daily mean temperatures and melt, because characteristics of different glaciers would equal out. However, this does not apply if important features of the melt process change over time. It has been shown that changes in precipitation seasonality, such as a late beginning of the monsoon season, strongly affect the surface albedo and thus snow and ice melt on Himalaya glaciers (*4*).

Lower surface albedos caused by a lack in summer snowfall would lead to higher melt rates for the same temperature scenarios. Immerzeel *et al*.'s use of a constant degree-day factor for the calculation of future glacier extent thus risks a severe underestimation of glacier retreat.

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Response

PITHAN RAISES TWO VALID CONCERNS. WE agree that future precipitation is highly uncertain and that general circulation models (GCMs) have difficulty in capturing monsoon precipitation (*1*, *2*), and we stress that in our Report. For all five of the river basins we analyzed, the multimodel average (MMA) of future precipitation shows limited changes both in total quantity and temporal shifts. The Yellow river basin is an exception, and the MMA shows a positive offset in total winter precipitation. However, there is considerable variation between the different GCMs. Therefore, we do not conclude that a reduction in melt water is offset by an increase in precipitation, but by an increase in rainfall. Given the projected increase in temperature, which is less uncertain than precipitation projections, more precipitation will fall in the form of rain. Because the melt season coincides with the rain season in most regions, this compensates the reduced melt.

Pithan disagrees with our use of a constant degree-day factor. His argument pertains to the spatial variation in melt rates within a basin. We agree in principle that this would be an important factor to consider in projections, and we did not consider it explicitly, due to lack of information about local albedo trends. However, we did implicitly account for uncertainty about the degree-day factor by using an uncertainty analysis around snow and ice degree-day factors (described in the supporting online material of our Report). The case for which melt rates would be higher because of lower albedo would be in the higher regions of our uncertainty envelopes. Moreover, we point out that our extreme case (without any glaciers) results in similar conclusions as our best-guess case.

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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.

The Best Test of Ph.D. Student Success

IN THEIR EDUCATION FORUM "PERFORMANCE-based data in the study of STEM Ph.D. education" (16 July, p. 282), D. F. Feldon, M. A. Maher, and B. E. Timmerman suggest that graduate education could be improved by the implementation of performance-based assessments. They do not acknowledge that a performance-based system already exists in graduate work: quality (not quantity) of publications. Feldon, Maher, and Timmerman downplay publication as an indicator of student performance because of the involvement of mentors and peers, but input from multiple parties is a necessary and productive aspect of collaborative research. Collaboration benefits individual success and leads to innovation. Failing to recognize published work as a predictor of effectiveness as a researcher trivializes employers' ability to distinguish poor research from quality research, and by extension, the graduate student's ability to conduct research and collaborate effectively.

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Adding standardized testing to the graduate curriculum neither benefits research nor serves as an accurate indicator of an individual's problem-solving ability. Recently, Hazari *et al*. (*1*) found that being "learning-oriented" rather than "performance-oriented" predicted success at the graduate level. This research implies that—if assessments were added to the curriculum (a move I discourage)—assessments of student interest in learning would be a better indicator of program effectiveness than the performance-based assessments advocated by Feldon, Maher, and Timmerman.

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Response

NEWQUIST SUGGESTS THAT STUDENTS' PUBlications are important predictors of post-degree research effectiveness, due in part to the importance of collaboration in innovative research. We agree that publication record is important and helpful, but the collaborative aspects of writing render publications a noisy metric by which to assess individual growth on specific skills (*1*). The variable time lags between the execution of an experiment, analysis of its data, and publication of findings [e.g., (*2*)] further limit the ability to identify direct relationships between experiences in a doctoral program and scholarly growth. Doctoral education's overarching goal is to develop competent researchers capable of performing independent research (*3*–*6*). To determine how effectively doctoral programs—and specific features of those programs—prepare individual students for independent scholarship, we suggest the implementation of measures reflecting individual growth in requisite skill sets identified by a discipline [e.g., (*7*)].

Newquist also infers that we advocate some form of standardized testing. This is not the case. The mechanism we do suggest, the rubric, represents a performance-based assessment that faculty at the program or department level can tailor to evaluate localized, authentic student research products (*8*, *9*). Rubrics may also be useful in conceptualizing and operationally defining necessary competencies that represent the consensus of a larger field or discipline at the local level. Far from constraining research creativity or inhibiting problem-solving in graduate students, an effective rubric makes transparent a faculty's expectations of excellence in research. This can help students to align the products of their innovative work with the quality indicators valued by faculty and the larger field to which they wish to contribute.

Newquist then cites findings from a recent study (*10*) that identifies a correlation between doctoral students' goal orientations ("learning-oriented" or "performance-oriented") and their subsequent professional productivity as measured by grants and publications. The definition of "performance-orientation" in this study refers to their indication on a survey that their sole motivation for attending graduate school was either having "received good grades in science" previously or being "awarded [a] scholarship or fellowship." In contrast, those classified as having a "learning-orientation" indicated a sole motivation of "enjoyed thinking about science." These results do not conflict with our position. Certainly, someone who is driven by an inherent interest in scientific inquiry will be more motivated to acquire necessary skills at the Ph.D. level and find productive research opportunities. We merely suggest that assessing those skills in a manner able to meaningfully inform the improvement of doctoral education requires measures that are well defined through faculty consensus, suitable for identifying longitudinal growth, and precisely targeted to measure students as individual learners.

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