LETTERS

edited by Jennifer Sills

Funding Should Come to Those Who Wait

Long-term studies. Studies spanning decades have yielded insights into red deer and other species.

WE APPLAUD THE PERSPECTIVE BY T. CLUTTON-BROCK AND B. C. Sheldon ("The Seven Ages of *Pan*," 5 March, p. 1207) on the value of long-term behavior and ecological research. We pick up where they left off: funding.

Long-term research has cumulative value that far exceeds its annual rate of return. Sadly, quick empirical studies trump long-term research in the reward system for academic promotion in ecology and behavior. If long-term research is to flourish, we must build a reward system for studies characterized by deferred gratification. A sea change in these values must precede attempts to address funding.

To secure the future of long-term field projects, we must act on three fronts:

(i) We must devise funding mechanisms for "legacy" projects deemed too valuable to falter. Whereas the National Science Foundation's (NSF's) National Ecological Observatory Network and Long-Term Ecological Research programs support long-term collaborative, site-based research, there is a compelling need to support the diversity of long-term investigator-initiated programs. As implemented, NSF's Long-Term Research in Environmental Biology program is a first step, but has insufficient support to maintain many valuable projects.

(ii) We must develop mechanisms to fund the establishment of new programs with long-term potential. Such potential may not be initially appreciated, but with vision and support, new systems studied over the long run will produce novel insights.

(iii) Support for ecological research must be increased. We do not advocate robbing Peter (short-term research) to pay Paul (long-term research). However, we maintain that Paul has already been robbed and some balance needs to be restored.

Most of us involved in long-term research have a story to share, in which time-limited funding shortages took our programs to the edge of a precipice. Investigators that succeed and become known for long-term research, almost by definition, have found a way to adapt to funding shortfalls, usually at great personal sacrifice. A recent case at the Los Amigos Biological Station in the Peruvian Amazon speaks to the value of funding continuity (*1*). During a 4-year period of programmatic support, the scientific productivity of the station surged, producing many valuable findings and building substantial scientific capacity for the region. Since the funding evaporated, the station has failed to return to its former glory, at great loss to our ability to make scientific inroads into understanding the ecology of this area, characterized by unrivaled biodiversity.

Of course, long-term programs must remain intellectually vibrant and methodologically rigorous if they are to be supported. In the end, the onus is on ecologists to convince ourselves, society, and funding agencies that long-term research has unique and irreplaceable value.

RONALD R. SWAISGOOD,[1]* JOHN W. TERBORGH,[2] DANIEL T. BLUMSTEIN[3]

[1]Applied Animal Ecology, San Diego Zoo's Institute for Conservation Research, San Diego, CA 92027, USA. [2]Center for Tropical Conservation, Duke University, Durham, NC 27705, USA. [3]Department of Ecology and Evolutionary Biology, University of California, Los Angeles, CA 90095, USA.

*To whom correspondence should be addressed. E-mail: rswaisgood@sandiegozoo.org

Reference

1. N. C. A. Pitman, *Trends Ecol. Evol.* **25**, 381 (2010).

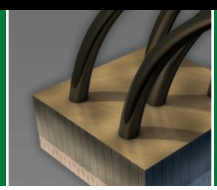
Brazilian Law: Full Speed in Reverse?

IS IT POSSIBLE TO COMBINE MODERN TROPICAL agriculture with environmental conservation? Brazilian agriculture offers encouraging examples that achieve high production together with adequate environmental protection (*1*, *2*). However, these effective practices may soon lose ground to the conventional custom of resource overexploitation and environmental degradation.

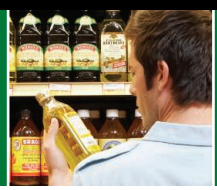
A revision to the Forest Act, the main Brazilian environmental legislation on private land, has just been submitted to Congress, and there is a strong chance that it will be approved. The proposed revision raises serious concerns in the Brazilian scientific community, which was largely ignored during its elaboration. The new rules will benefit sectors that depend on expanding frontiers by clear-cutting forests and savannas and will reduce mandatory restoration of native vegetation illegally cleared since 1965. If approved, CO_2 emissions may increase substantially, instead of being reduced as was recently pledged in Copenhagen. Simple species-area relationship analyses also project the extinction of more than 100,000 species, a massive loss that will invalidate any commitment to biodiversity conservation. Proponents of the new law, with well-known ties to specific agribusiness groups, claim an alleged shortage of land for agricultural expansion, and accuse the current legislation of being overprotective of

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.



Not noncoding
284



Consumer concerns
287

the environment in response to foreign interests fronted by green nongovernmental organizations. However, recent studies (*3*) show that, without further conversion of natural vegetation, crop production can be increased by converting suitable pastures to agriculture and intensifying livestock production on the remaining pasture. Brazil has a high potential for achieving sustainable development and thereby conserving its unique biological heritage. Although opposed by the Ministry of the Environment and most scientists, the combination of traditional politicians, opportunistic economic groups, and powerful landowners may be hard to resist. The situation is delicate and serious. Under the new Forest Act, Brazil risks suffering its worst environmental setback in half a century, with critical and irreversible consequences beyond its borders.

JEAN PAUL METZGER,[1]* THOMAS M. LEWINSOHN,[2] CARLOS A. JOLY,[3] LUCIANO M. VERDADE,[4] LUIZ ANTONIO MARTINELLI,[5] RICARDO R. RODRIGUES[6]

[1]Department of Ecology, Institute of Bioscience, University of São Paulo, 05508-900, São Paulo, SP, Brazil. [2]Department of Animal Biology, State University of Campinas, Campinas, SP, Brazil. [3]Department of Plant Biology, Biology Institute, State University of Campinas, Campinas, SP, Brazil. [4]Center of Nuclear Energy in Agriculture, University of São Paulo, Piracicaba, Brazil. [5]Program on Food Security and the Environment, Stanford University, Stanford, CA 94305, USA. [6]Department of Biological Sciences, "Luiz de Queiroz" College of Agriculture, University of São Paulo, Piracicaba, Brazil.

*To whom correspondence should be addressed. E-mail: jpm@ib.usp.br

References

1. D. Nepstad *et al.*, *Science* **326**, 1350 (2009).
2. C. R. Fonseca *et al.*, *Biol. Conserv.* **142**, 1209 (2009).
3. G. Sparovek *et al.*, *Considerações sobre o Código Florestal brasileiro* ("Luiz de Queiroz" College of Agriculture, University of São Paulo, Piracicaba, Brazil, 2010); http://eco.ib.usp.br/lepac/codigo_florestal/Sparovek_etal_2010.pdf.

TECHNICAL COMMENT ABSTRACTS

Comment on "Observational and Model Evidence for Positive Low-Level Cloud Feedback"

Anthony J. Broccoli and Stephen A. Klein

Clement *et al.* (Reports, 24 July 2009, p. 460) provided observational evidence for systematic relationships between variations in marine low cloudiness and other climatic variables and found that most current-generation climate models were deficient in reproducing such relationships. Our analysis of one of these models (GFDL CM2.1), using more complete model output, indicates better agreement with observations, suggesting that more detailed analysis of climate model simulations is necessary.

Full text at www.sciencemag.org/cgi/content/full/329/5989/277-a

Response to Comment on "Observational and Model Evidence for Positive Low-Level Cloud Feedback"

Amy C. Clement, Robert Burgman, Joel R. Norris

Broccoli and Klein argue for additional diagnostics to better assess the simulation of cloud feedbacks in climate models. We agree, and here provide additional analysis of two climate models that reveals where model deficiencies in cloud simulation in the Northeast Pacific may occur. Cloud diagnostics from the forthcoming Climate Model Intercomparison Project 5 should make such additional analyses possible for a large number of climate models.

Full text at www.sciencemag.org/cgi/content/full/329/5989/277-b

CORRECTIONS AND CLARIFICATIONS

News of the Week: "Invisibility cloaks for visible light must remain tiny, theorists predict" by A. Cho (25 June, p. 1621). The size limit on a cloak for infrared or visible light was misstated. It is a few hundred micrometers, not a few micrometers.

News Focus: "Putting light's light touch to work as optics meets mechanics" by A. Cho (14 May, p. 812). In the third paragraph, "pitchfork" should have been "tuning fork."

Reports: "Community structure in time-dependent, multiscale, and multiplex networks" by P. J. Mucha *et al.* (14 May, p. 876). Equation 3 contained a typographical error that was not caught during the editing process: The δ_{sr} term should have been outside of the parentheses within the square brackets. The correct equation, which also appears in the supporting online material as equation 9, is to the right. See the revised supporting online material (www.sciencemag.org/cgi/content/full/sci;328/5980/876/DC2), which also includes a correction to equation 11. The computations supporting the examples described in the Report were all performed with the correct formula for $Q_{\text{multislice}}$. The authors thank Giuseppe Mangioni for pointing out the error.

$$Q_{\text{multislice}} = \frac{1}{2\mu}\sum_{ijsr}\left[\left(A_{ijs} - \gamma_s \frac{k_{is}k_{js}}{2m_s}\right)\delta_{sr} + \delta_{ij}C_{jsr}\right]\delta(g_{is}, g_{jr})$$

Sponsors of Traumatic Brain Injury Project

I'M DELIGHTED THAT *SCIENCE* TOOK THE TIME to highlight the ongoing efforts of the Common Data Elements Project for research in psychological health and traumatic brain injury ("New guidelines aim to improve studies of traumatic brain injury," G. Miller, News of the Week, 16 April, p. 297). The level of interagency collaboration that made the project possible is exactly the type of leadership that Americans should expect from the federal government.

As noted in the story, the project is cosponsored by four federal agencies—three of whom were mentioned. The other agency is the National Institute on Disability and Rehabilitation Research (NIDRR) within the Department of Education. NIDRR has leadership, resources, and subject matter experts without which this project would not have been nearly as successful. Together, all four agencies will continue to develop recommendations and support ongoing efforts to improve and refine the Common Data Elements.

GEOFFREY MANLEY

Department of Neurosurgery, Brain and Spinal Injury Center, University of California, San Francisco, CA 94110, USA. E-mail: manleyg@neurosurg.ucsf.edu

Warming, Photoperiods, and Tree Phenology

C. KÖRNER AND D. BASLER ("PHENOLOGY under global warming," Perspectives, 19 March, p. 1461) suggest that because of photoperiodic constraints, observed effects of temperature on spring life-cycle events cannot be extrapolated to future temperature conditions.

However, no study has demonstrated that photoperiod is more dominant than temperature when predicting leaf senescence (*1*), leafing, or flowering, even in beech—one of the species most sensitive to photoperiod (*2*, *3*). On the contrary, the literature [e.g., (*4*, *5*)] supports the idea that spring phenology is highly dependent on temperature during both the endodormancy phase (the period during which the plant remains dormant due

Published by AAAS

to internal factors) and the ecodormancy phase (the period during which the plant remains dormant due to external, environmental conditions). Warming temperatures have a negative impact on endodormancy (the chilling requirement is unfulfilled, delaying dormancy break) and a positive impact on ecodormancy (bud cell growth accelerates). Therefore, tree phenology does not respond linearly to increasing temperature (*6*, *7*). The key concern should be quantitatively assessing the net balance between these antagonistic warming effects on spring phenology.

ISABELLE CHUINE,[1]* XAVIER MORIN,[2] HARALD BUGMANN[2]

[1]Centre d'Ecologie Fonctionnelle et Evolutive, 34293 Montpellier cedex 5, France. [2]Forest Ecology, Institute of Terrestrial Ecosystems, Department of Environmental Sciences, ETH Zürich, Universitätstrasse 22, 8092 Zürich, Switzerland.

*To whom correspondence should be addressed. E-mail: isabelle.chuine@cefe.cnrs.fr

References and Notes

1. N. Delpierre *et al.*, *Agric. For. Meteorol*. **149**, 938 (2009).
2. K. Kramer, *J. Appl. Ecol*. **31**, 172 (1994).
3. Y. Vitasse, S. Delzon, J.-M. Louvet, A. Kremer, R. Michalet, *Agric. For. Meteorol*. **149**, 735 (2009).
4. I. Chuine, K. Kramer, H. Hänninen, in *Phenology: An Integrative Environmental Science*, M. D. Schwarz, Ed. (Kluwer, Dordrecht, Netherlands, 2003), vol. 39, pp. 217–235.
5. H. Hänninen, K. Kramer, *Silva Fenn.* **41**, 167 (2007).
6. X. Morin *et al.*, *Glob. Change Biol.* **15**, 961 (2009).
7. X. Morin, J. Roy, L. Sonié, I. Chuine, *New Phytol.* **186**, 900 (2010).
8. Funded by the European Community's FP7 (BACCARA project number 226299), CNRS and ETH.

Response

IN OUR PERSPECTIVE, WE CONCLUDED NEITHER that temperature is an irrelevant environmental driver for phenology nor that photoperiodism in trees is dominant in all cases. Our Perspective was merely a reminder of the classical research on the influence of photoperiod on phenology in late successional trees. Dormancy release is driven by a finely tuned interplay between chilling requirement, photoperiod, and warm temperatures.

For example, during winter, the transition from endodormancy to ecodormancy is mediated by chilling temperatures. Insufficient chilling during a mild winter is likely to delay the development toward sprouting in spring (*1*). However, a long photoperiod may partially compensate for a lack of chilling. In this way, photoperiodism helps to stabilize the time of dormancy release (*2*–*4*). In photoperiod-sensitive species, sprouting may be considerably delayed in short photoperiods (*4*, *5*), even in fully chilled buds (e.g., after cold winters) (*6*). Warm temperatures are most effective in promoting bud burst only after the photoperiod requirement of adequately chilled buds is met (*3*, *6*). This process prevents trees from sprouting before the risk of freezing damage is over.

Photoperiodism in trees has been known for almost 100 years (*7*, *8*), but is an often-ignored environmental cue when predicting the effects of a future climate.

CHRISTIAN KÖRNER* AND DAVID BASLER

Institute of Botany, University of Basel, 4056 Basel, Switzerland.

*To whom correspondence should be addressed. E-mail: ch.koerner@unibas.ch

References and Notes

1. X. Morin *et al.*, *Glob. Change Biol.* **15**, 961 (2009).
2. O. M. Heide, *Physiolog. Plant.* **88**, 531 (1993).
3. R. Häkkinen, T. Linkosalo, P. Hari, *Tree Physiol.* **18**, 707 (1998).
4. V. Sanz-Perez, P. Castro-Diez, F. Valladares, *Plant Biol.* **11**, 142 (2009).
5. P. F. Wareing, *Physiol. Plant.* **6**, 692 (1953).
6. O. M. Heide, *Physiol. Plant.* **89**, 187 (1993).
7. P. J. Kramer, *Plant Physiol.* **11**, 127 (1936).
8. G. Klebs, *Abh. Heidelb. Akad. Wiss.* **3** (1914).
9. Funded by Velux-Foundation and NCCR-climate of the Swiss Science Foundation.