COMMENTARY

Land art
1791

Research grant allocation process
1797

LETTERS I BOOKS I POLICY FORUM I EDUCATION FORUM I PERSPECTIVES

LETTERS

edited by Jennifer Sills

Making Waves with the Clean Water Act

THE LETTER OF R. E. DODGE *ET AL*., "A CALL TO ACTION FOR CORAL REEFS" (10 OCTOBER, P. 189), lists actions needed to reverse the decline of coral reefs. Although a primary management tool in nearshore environments, marine protected areas (MPAs) are not designed to protect coral reefs from land-based activities or threats that originate outside MPA boundaries (*1*).

In contrast, the objective of the U.S. Clean Water Act (PL 92-500, Sec. 101, 33 U.S.C. 1251) is to "restore and maintain the … biological integrity of the Nation's waters" for all "territorial seas … measured from the line of ordinary low water … and extending seaward a distance of three miles" [Sec. 502, 33 U.S.C. 1362(8)]. Under the Clean Water Act, and with approval of the U.S. Environmental Protection Agency (EPA), states and territories could define biological thresholds for reef condition as part of their water quality standards. Although thresholds have been defined for coral reefs (e.g., coral cover is greater than 10%), states and territories have yet to adopt them as biological criteria (*2*). Failure to meet defined criteria can trigger regulatory actions to support restoration.

So why has the Clean Water Act never been used specifically to protect coral reefs? Many scientists and managers still mistakenly associate the Clean Water Act with a narrow focus on end-of-pipe chemical contaminants (*3*), but the law actually calls for reduction of all human actions that degrade water resources. Recently, EPA and the states have embraced assessments of fish, invertebrates, and plants as measures of environmental condition (*4*).

Actions taken under the Clean Water Act have vastly improved freshwater and estuarine environments (*5*); similar actions can answer Dodge *et al*.'s call to conserve reefs and nearshore environments. Successful use of the Clean Water Act and biological criteria in U.S. jurisdictions could provide a template for countries with analogous legislation.

LESKA S. FORE,[1]* JAMES R. KARR,[2] WILLIAM S. FISHER,[3] WAYNE S. DAVIS[4]

[1]Statistical Design, 136 NW 40th Street, Seattle, WA 98107, USA. [2]190 Cascadia Loop, Sequim, WA 98382, USA. [3]U.S. Environmental Protection Agency, Office of Research and Development, 1 Sabine Island Drive, Gulf Breeze, FL 32561, USA. [4]U.S. Environmental Protection Agency, Office of Environmental Information, 701 Mapes Road, Fort Meade, MD 20755, USA.

*To whom correspondence should be addressed. E-mail: leska@seanet.com

References

1. B. S. Halpern, *Ecol. Appl.* **13**, S117 (2003).
2. Healthy Reefs Initiative, *Report Card for the Mesoamerican Reef: An Evaluation of Ecosystem Health* (Healthy Reefs for Healthy People, 2008); www.healthyreefs.org/Report_Card/Report_2008/Report_2008index.html.
3. R. H. Richmond *et al.*, *BioScience* **57**, 598 (2007).
4. J. R. Karr, C. O. Yoder, *J. Environ. Eng.* **130**, 594 (2004).
5. T. P. Simon, Ed., *Biological Response Signatures: Indicator Patterns Using Aquatic Communities* (CRC Press, Boca Raton, FL, 2002).

The State of Global Hunger

WITH THE PASSING OF ANOTHER WORLD DAY Against Hunger (on 30 October), it is time to take stock of the state of global hunger. Sadly, Millennium goals are still far from being reached, and over 800 million people suffer from malnutrition in the world. The latest core health indicators from the World Health Organization show that many countries still have high rates of chronic malnutrition (>30%) and under-five mortality (>20%) (*1*). Humanitarian aid is insufficient and is hindered even more by wars, political instability, dictatorships, and corruption.

There are two major obstacles to collecting food aid from developed countries. One is cost: World Food Programme activities are extremely expensive. The other is motivation: People only think to donate during emergencies such as wars and tsunamis, when in fact aid is needed at all times.

I have two suggestions that may help us move in the right direction. First, to avoid increases in the price of basic food, the Food and Agriculture Organization should buy low-cost arable lands for agriculture production and use the food grown to help populations suffering from hunger. Second, to provide aid more consistently, Western countries that produce surpluses should send extra food to the World Food Programme for distribution. For instance, in Spain in 2007 there were thousands of tons of surplus oranges that were not harvested (*2*–*4*). It is wrong to limit agricultural productivity when there are millions of people dying of hunger in other countries.

JUAN SASTRE

President of Alimentos Mundi and Department of Physiology, School of Pharmacy, University of Valencia, Avenida Vicente Andrés Estellés s/n, 46100 Burjassot (Valencia), Spain. E-mail: juan.sastre@uv.es

Origins of
paternal care

1799

Ethical limits
of robot use

1800

References

1. World Health Organization, *World Health Statistics Report* (WHO, Geneva, Switzerland, 2008); www.who.int/whosis/whostat/en/.
2. V. Alapont, "Las soluciones ante la crisis citrícolas no satisfacen a nadie," *Valencia Fruits*, No. 2.289, S. L. Sucro, Ed. (Valencia, Spain, 16 January 2007), p. 3.
3. A. Alonso, "Desorientación," *Valencia Fruits*, No. 2.290, S. L. Sucro, Ed. (Valencia, Spain, 23 January 2007), p. 4.
4. Asociación Valenciana de Agricultores (AVA-ASAJA), "La crisis citrícola desencadena una oleada de movilizaciones en toda la Comunitat," *Agricultores y Ganaderos* **161**, 6 (2007).

Bird Brains Key to the Functions of Sleep

IN THEIR LETTER "A BIRD'S EYE VIEW OF SLEEP" (24 October, p. 527), N. C. Rattenborg *et al.* argue that birds "provide a largely untapped opportunity to determine the functions of these [sleep] states in mammals." We wholeheartedly agree that birds make excellent model organisms for the study of sleep. However, these authors seem unaware of the fact that the opportunity has in fact been seized, with fascinating results.

Recently, Low and colleagues (*1*) demonstrated that the structure of sleep in zebra finches is remarkably similar to that of mammals. It has become apparent that sleep plays an important part in avian learning and memory. Working with zebra finches, Dave and Margoliash found "replay" of neuronal activity during sleep that was similar to activity observed when the bird was singing (*2*). In addition, Deregnaucourt *et al.* showed that sleep influences song acquisition in young zebra finches (*3*). Further advances were made in the other major avian memory paradigm, imprinting in domestic chicks. Work from Gabriel Horn's laboratory (*4*) has revealed that a period of sleep immediately after imprinting training is necessary for memory consolidation. In both of these avian paradigms, the neural substrate of memory has been localized—an issue that is still contentious in most mammalian models (*5*).

Thus, research on birds has already made considerable advances when it comes to unraveling the functions of sleep.

SHARON M. H. GOBES AND JOHAN J. BOLHUIS*

Department of Behavioural Biology, Utrecht University, Padualaan 8, 3584 CH Utrecht, Netherlands.

*To whom correspondence should be addressed. E-mail: j.j.bolhuis@uu.nl

References

1. P. S. Low *et al.*, *Proc. Natl. Acad. Sci. U.S.A.* **105**, 9081 (2008).
2. A. S. Dave, D. Margoliash, *Science* **290**, 812 (2000).
3. S. Deregnaucourt *et al.*, *Nature* **433**, 7027 (2005).
4. C. Jackson *et al.*, *Curr. Biol.* **18**, 393 (2008).
5. J. J. Bolhuis, M. Gahr, *Nat. Rev. Neurosci.* **7**, 347 (2006).

Old Seeds Coming in from the Cold

S. SALLON AND COLLEAGUES ("GERMINATION, genetics, and growth of an ancient date seed," Brevia, 13 June, p. 1464) reported the successful germination and growth of a 2000-year-old date seed excavated from underneath a Herodian fortress near the Dead Sea. On the basis of radiocarbon dating of additional seeds recovered from the same excavation as well as seed remains recovered when repotting the palm seedling, S. Sallon *et al.* claimed to have found the oldest seed with the ability to germinate.

However, Sallon *et al.* overlooked a report on a considerably older germinable seed, published in *Science* more than 40 years ago (*1*) [although the paper did appear in the bibliography of one work cited by Sallon *et al.*: Shen-Miller *et al.* (*2*)]. Porsild and co-workers con-

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.

vincingly showed that a seed of the arctic lupine (*Lupinus arcticus*), stored in a lemming burrow since the Pleistocene, could still be germinated. These authors estimated that the seed was at least 10,000 years old, based on the stratigraphic inference of the overlaying frozen silt deposit. Analogous to the dry climate that conserved the date seed, frozen ground provides excellent storage conditions to retain seed viability.

FELIX GUGERLI

Ecological Genetics and Evolution, WSL Swiss Federal Research Institute, 8903 Birmensdorf, Switzerland. E-mail: gugerli@wsl.ch

References

1. A. E. Porsild, C. R. Harington, G. A. Mulligan, *Science* **158**, 113 (1967).
2. J. Shen-Miller, M. B. Mudgett, J. W. Schopf, S. Clarke, R. Berger, *Am. J. Bot.* **82**, 1367 (1995).

Response

GUGERLI CLAIMS THAT ARCTIC LUPINE (*LUPinus arcticus*) are the oldest seeds to be germinated. Much controversy exists over reports of extreme seed longevity under "natural" conditions (as opposed to ex situ storage and conservation of seeds in gene banks). Claims that have been viewed skeptically include alleged viability of ancient cereal grains from Pharonic tombs (*1*); *Chenopodium album* and *Spergula arvensis* from a 1700-year-old site in Denmark (*2*); *Nelunbo nucifera* seeds associated with a 3000-year-old canoe near Tokyo (*3*); and, most extreme, *Lupinus arcticus* seeds retrieved from rodent burrows allegedly dating to the Late Pleistocene period (*4*). In all of these reports, seed dating relied on their association with archaeological artifacts, circumstantial evidence that makes the claims extremely questionable (*1*, *5*–*8*).

The age attribution of the arctic lupine seeds, unearthed 3 to 6 meters below the surface of frozen silt during 1955 mining operations in the Canadian Yukon, was based partly on the identification of a rodent skull also found in the burrow. The modern relative of the *Dicrostoyx groenlandicus* rodent species is apparently found in cooler regions, and the authors assumed that the overlying silt had been frozen during an unspecified geophysical catastrophe. The supporting radiocarbon date of 14,860 ± 840 relates to the nest and remains of an Arctic ground squirrel recovered from burrows similarly buried under permafrost in central Alaska (*9*, *10*).

Without radiocarbon dating of any of the two dozen arctic lupine seeds recovered from the burrows, unequivocal evidence for the contemporaneity of the seeds is lacking. In our Brevia, the claim for germi-

nating a 2000-year-old date seed was based on direct radiocarbon dating of seed coat fragments from the seed itself and indirectly on two ungerminated date seeds from the same archaeological site and locus. Therefore, although we have not claimed that this is the oldest viable seed, it is the oldest seed in which germination has been documented based on validated direct radiocarbon evidence.

SARAH SALLON,[1]* YUVAL COHEN,[2]
MARKUS EGLI,[3] ELAINE SOLOWEY,[4]
MORDECHAI KISLEV,[5] ORIT SIMCHONI[5]

[1]Louis Borick Natural Medicine Research Center, Hadassah Hospital, Jerusalem 91120, Israel. [2]Department of Fruit Tree Sciences, Agricultural Research Organization, Volcani Research Center, Israel. [3]Radio-Carbon Laboratory, Department of Geography, University of Zurich, Winterthurerstrasse 190, Zurich, Switzerland. [4]Arava Institute of the Environment, Kibbutz Ketura, 88840, Israel. [5]Mina and Everard Goodman Faculty of Life Sciences, Bar-Ilan University, Ramat-Gan, Israel.

*To whom correspondence should be addressed. E-mail: ssallon@hadassah.org.il

References

1. D. A. Priestly, *Seed Ageing: Implications for Seed Storage and Persistence in the Soil* (Comstock Associates, Ithaca, NY, 1986).
2. S. Odum, *Dansk Botanisk Arkiv* **24**, 1 (1965).
3. H. Goodwin, E. H. Willis, *Radiocarbon* **6**, 132 (1964).
4. A. E. Porsild, C. R. Harington, G. A. Mulligan, *Science* **158**, 113 (1967).
5. J. D. Bewley, M. Black, in *Seeds Physiology and Development* (Plenum, New York, 1994), pp. 388–392.
6. H. Godwin, *Nature* **220**, 708 (1968).
7. J. D. Bewley, M. Black, *Viability, Dormancy, and Environmental Control*, vol. 2 of *Physiology and Biochemistry of Seeds in Relation to Germination* (Springer-Verlag, New York, 1982).
8. M. I. Daws, J. Davies, E. Vaes, R. van Gelder, R. H. Pritchard, *Seed Sci. Res.* **17**, 73 (2007).
9. C. A. Repenning, D. M. Hopkins, M. Rubin, *Arctic* **17**, 176 (1964).
10. T. L. Pewe, D. M. Hopkins, J. L. Giddings, in *The Quarternary of the United States*, H. E. Wright, D. G. Frey, Eds. (Princeton Univ. Press, Princeton, NJ, 1965), pp. 355–374.

CORRECTIONS AND CLARIFICATIONS

Editorial: "Scientists and human rights" by L. Rubenstein and M. Younis (28 November, p. 1303). Leonard Rubenstein is a Jennings Randolph Senior Fellow at the United States Institute of Peace, not a Randolph Jennings Senior Fellow as originally printed.

Reports: "Measurement of the distribution of site enhancements in surface-enhanced Raman scattering" by Y. Fang *et al.* (18 July, p. 388). The term $d\eta$ was inadvertently left off the right side of Eq. 4. The correct equation should read

$$P(\eta)\,d\eta = \frac{A}{\eta^{1.75}}\exp\left(\frac{-\eta^{0.25}}{A'}\right)d\eta$$

We thank M.-W. Shao and G. Shao for bringing this to our attention.

Reports: "Declining wild salmon populations in relation to parasites from farm salmon" by M. Krkošek *et al.* (14 December 2007, p. 1772). This correction summarizes small changes to the statistical results written in the main text of the Report on the effects of sea lice infestations on pink salmon population dynamics. Small changes have also been made to data set S1 and tables S2 and S3 in the Supporting Online Material. The changes to the statistical results do not affect the conclusions of the report.

The changes arise due to revisions of 11 escapement estimates for exposed populations that were not present in the original data provided to the authors by the Canadian Department of Fisheries and Oceans. The changes have been confirmed by Brian Riddell, Division Head, Salmon Assessment and Freshwater Ecosystems, Pacific Biological Station, Fisheries and Oceans Canada.

Population growth rates. The population growth rate r was estimated from the Ricker model for four groups of data. There are small changes to the point estimates of r as well as the 95% confidence intervals. The changes are summarized in Table 1. The associated estimate of b for density-dependent mortality has changed from its original value of 0.64 to its corrected value of 0.65.

Population viability analysis. In this section, a population viability analysis was applied to pink salmon populations in the Broughton Archipelago during sea lice infestation years. Small changes to the results are summarized in Table 2.

Louse-induced salmon mortality. The Ricker model was extended to test whether including louse-induced mortality of wild pink salmon improved the fit of the model. The analysis consisted of estimating a parameter a. The point estimate for the parameter has changed from 0.89 to 0.90. The 95% credible intervals for the parameter a from the analysis using the unconstrained data changed from 0.46 to 1.34 in the original analysis to 0.47 to 1.34 using the corrected data set.

Reports: "Evolution of scleractinian corals inferred from molecular systematics" by S. L. Romano and S. R. Palumbi (2 February 1996, p. 640). In Note 14, the coral-specific primer 16Sc-H was erroneously described as 5′-AACAGCGCAATAACGTTTGAGAG-3′. It should have been reported as being in the 3′-5′ direction, that is, 5′-CTCTCAAACGTTATTGCGCTGTT-3′.

Point estimates and 95% confidence intervals for the population growth rate *r* from the Ricker model fit to grouped pink salmon escapement data.			
Data set used	**Group**	**r**	**95% confidence interval (CI)**
Original	Unexposed	0.62	0.55 to 0.69
	Exposed pre-lice	0.68	0.46 to 0.90
	Exposed infested	−1.17	−1.71 to −0.59
	Exposed fallow	2.50*	1.28 to 3.62*
Corrected	Unexposed	0.63	0.56 to 0.70
	Exposed pre-lice	0.70	0.47 to 0.92
	Exposed infested	−1.16	−1.68 to −0.62
	Exposed fallow	2.63	1.39 to 3.78

*Results shown as reported in the paper. This should actually read r = 2.63 with 95% CI of 1.38 to 3.77.

Table 1.

Population viability analysis of Broughton Archipelago pink salmon populations subjected to sea lice infestations.	
Data set used	
Original	Population growth rate −1.17
	Variance of environmental stochasticity 1.92
	Mean time to 99% collapse 3.9 (95% CI 3.7 to 4.2)
Corrected	Population growth rate −1.16
	Variance of environmental stochasticity 1.90
	Mean time to 99% collapse 4.0 (95% CI 3.7 to 4.2)

Table 2.

TECHNICAL COMMENT ABSTRACTS

COMMENT ON "Declining Wild Salmon Populations in Relation to Parasites from Farm Salmon"

Brian E. Riddell, Richard J. Beamish, Laura J. Richards, John R. Candy

Krkošek *et al.* (Reports, 14 December 2007, p. 1772) claimed that sea lice spread from salmon farms placed wild pink salmon populations "on a trajectory toward rapid local extinction." Their prediction is inconsistent with observed pink salmon returns and overstates the risks from sea lice and salmon farming.

Full text at www.sciencemag.org/cgi/content/full/322/5909/1790b

RESPONSE TO COMMENT ON "Declining Wild Salmon Populations in Relation to Parasites from Farm Salmon"

Martin Krkošek, Jennifer S. Ford, Alexandra Morton, Subhash Lele, Mark A. Lewis

We evaluated the effect of sea lice (*Lepeophtheirus salmonis*) infestations on wild pink salmon (*Oncorhynchus gorbuscha*) populations in the Broughton Archipelago, British Columbia. Riddell *et al.* suggest that we ignored factors and selectively used data. Here, we clarify misunderstandings and provide analysis to test the strength of our conclusions.

Full text at www.sciencemag.org/cgi/content/full/322/5909/1790c

Science

Old Seeds Coming in from the Cold

Felix Gugerli

ARTICLE TOOLS	http://science.sciencemag.org/content/322/5909/1789.2
REFERENCES	This article cites 8 articles, 2 of which you can access for free http://science.sciencemag.org/content/322/5909/1789.2#BIBL
PERMISSIONS	http://www.sciencemag.org/help/reprints-and-permissions

Use of this article is subject to the Terms of Service