LETTERS

edited by Etta Kavanagh

A World Without Mangroves?

AT A MEETING OF WORLD MANGROVE EXPERTS HELD LAST YEAR IN Australia, it was unanimously agreed that we face the prospect of a world deprived of the services offered by mangrove ecosystems, perhaps within the next 100 years.

Mangrove forests once covered more than 200,000 km^2 of sheltered tropical and subtropical coastlines (*1*). They are disappearing worldwide by 1 to 2% per year, a rate greater than or equal to declines in adjacent coral reefs or tropical rainforests (*2–5*). Losses are occurring in almost every country that has mangroves, and rates continue to rise more rapidly in developing countries, where >90% of the world's mangroves are located. The veracity and detail of the UN Food and Agriculture Organization data (*2*) on which these observations are based may be arguable, but mangrove losses during the last quarter century range consistently between 35 and 86%. As mangrove areas are becoming smaller or fragmented, their long-term survival is at great risk, and essential ecosystem services may be lost.

Emerging from the embrace of a mangrove tree–lined channel in northern Brazil, these pescadores, like coastal fishers worldwide, know that healthy mangroves mean good fishing and a secure livelihood.

CREDIT: N. C. DUKE

Where mangrove forests are cleared for aquaculture, urbanization, or coastal landfill or deteriorate due to indirect effects of pollution and upstream land use (*3*, *4*), their species richness is expected to decline precipitously, because the number of mangrove plant species is directly correlated with forest size (*6*, *7*). Examples from other ecosystems have shown that species extinctions can be followed by loss in functional diversity, particularly in species-poor systems like mangroves, which have low redundancy per se (*8*). Therefore, any further decline in mangrove area is likely to be followed by accelerated functional losses. Mangroves are already critically endangered or approaching extinction in 26 out of the 120 countries having mangroves (*2*, *9*).

Deforestation of mangrove forests, which have extraordinarily high rates of primary productivity (*3*), reduces their dual capacity to be both an atmospheric CO_2 sink (*10*) and an essential source of oceanic carbon. The support that mangrove ecosystems provide for terrestrial as well as marine food webs would be lost, adversely affecting, for example, fisheries (*11*). The decline further imperils mangrove-dependent fauna with their complex habitat linkages, as well as physical benefits like the buffering of seagrass beds and coral reefs against the impacts of river-borne siltation, or protection of coastal communities from sea-level rise, storm surges, and tsunamis (*12*, *13*). Human communities living in or near mangroves would lose access to sources of essential food, fibers, timber, chemicals, and medicines (*14*).

We are greatly concerned that the full implications of mangrove loss for humankind are not fully appreciated. Growing pressures of urban and industrial developments along coastlines, combined with climate change and sea-level rise, urge the need to conserve, protect, and restore tidal wetlands (*11*, *13*). Effective governance structures, socioeconomic risk policies, and education strategies (*15*) are needed now to enable societies around the world to reverse the trend of mangrove loss and ensure that future generations enjoy the ecosystem services provided by such valuable natural ecosystems.

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16. The 2006 Australian mangrove meetings (MMM) at the Gold Coast and Daintree were sponsored by the University of Queensland, Griffith University, James Cook University, Queensland Department of Primary Industries and Fisheries, and the Ian Potter Foundation. We thank our funding sources for their support of our research on mangroves. F.D.G. is a Postdoctoral Research Scientist from the Research Foundation - Flanders (FWO-Vlaanderen). S.C.'s research is funded by the PUMPSEA project (EU 6th FP). A.M.E.'s research is supported by the Harvard Forest and by the U.S. NSF.

Supporting Undergraduate Research

THE FINDINGS OF THE EDUCATION FORUM "Benefits of undergraduate research experiences" by S. H. Russell and colleagues (27 April, p. 548) confirm the widely held belief that undergraduate research increases interest in scientific and related research careers. Indeed, as student researchers and editors with an international undergraduate journal, the *Journal of Young Investigators* (JYI; www.jyi.org), we have experienced first-hand several of the points that the authors raised.

We at JYI, however, believe that undergraduate research programs should place more emphasis on the art of scientific communication. The benefits include the opportunity to communicate undergraduate research work to a broader audience. Such an experience also develops skills necessary for the fluid but logical nature of scientific writing. These skills are otherwise missed when engrossed in wet lab work or not developed fully when merely writing final lab reports. A culture of responsibility and integrity is also developed as student authors face rigorous demands of scientific review and editing (data integrity, plagiarism, etc.).

Most importantly, the undergraduate publication experience gives students an early introduction to the world of peer review, a cornerstone of science. For JYI, a student-led journal, this benefit is doubly advantageous. Not only do student authors benefit from peer review, our JYI student reviewers are also trained in the art of reviewing, a skill not given much emphasis in undergraduate research.

JYI has been at the forefront of such undergraduate peer review and publication for 10 years since its inception in 1997. From over 500 submissions, we have published 120 undergraduate research articles. Our highlights for the past year include 10 special issues devoted to publishing research articles of various universities' Research Experiences for Undergraduates program, and participation in the recent 2007 AAAS Meeting, during which we hosted a workshop for science writing.

Our aim is to see science writing and communication play a central role in the undergraduate research experience.

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Isoprene, Cloud Droplets, and Phytoplankton

THERE IS AN ERROR THAT MAY INVALIDATE the main conclusion of the Research Article "Phytoplankton and cloudiness in the Southern Ocean" by N. Meskhidze and A. Nenes (1 Dec. 2006, p. 1419). The authors report an increase in cloud reflectivity resulting from a 30% decrease in cloud droplet effective radius and a doubling of cloud droplet number concentration over a large phytoplankton bloom in the Southern Ocean, resulting in an extra 15 W m^{-2} of energy reflected back to space. They attribute these changes to enhanced isoprene produced in the bloom. Our measurements made during the Southern Ocean Iron Experiments (SOFeX) (*1*) were used by Meskhidze and Nenes to scale seawater isoprene values based on measured chlorophyll-*a* concentrations. Unfortunately, they converted our isoprene concentrations incorrectly, resulting in a three-order-of-magnitude overestimation and hence a much greater calculated isoprene flux.

During SOFeX, we measured climate-relevant organic gases in the dynamic headspace of an equilibrator (*2*) in contact with seawater (*1*). We reported isoprene concentrations to be on average 560 pptv (parts per trillion by volume or picomoles $mole^{-1}$ of air) inside of the SOFeX North Patch (NP), which is the mixing ratio that the air above the water would have if the headspace were static. To convert from mixing ratio of static headspace to seawater concentration, we use Henry's Law:

$$C_g \times K_H = C_a \qquad \text{(Eq. 1)}$$

where C_g is the mixing ratio of a gas in equilibrium with the dissolved gas in the aqueous phase, C_a. An average Henry's law constant (K_H) for isoprene of 0.0130 M atm^{-1} was used (*3*). Therefore, the average seawater isoprene concentration in the NP was ~7.3 picomoles L^{-1} (pM). Listed in the authors' Table 2 is an average isoprene concentration of 31.4 nanomoles L^{-1} (nM) in the NP. This leads me to believe that isoprene is not the reason for their observed extra cloud albedo.

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Response

WE THANK WINGENTER FOR HIS LETTER. Indeed, we misinterpreted some of the data in Wingenter *et al.* (*1*). We were unaware that "concentration of dissolved gases measured in and around the fertilized patch" in (*1*) referred not to seawater concentrations but mixing ratios in the headspace of an equilibrator. When corrected, the values of C_w^b in Table 2 should be reduced by about three orders of magnitude (see correction on page 43). This does not, however, alter our conclusions or isoprene secondary organic aerosol (SOA) hypothesis. The fact remains that reported isoprene air-sea fluxes and concentrations in the marine boundary layer (MBL) vary by orders of magnitude, with the average concentrations between 4 and 250 pptv and fluxes of 10^7 to 6×10^9 molecules cm^{-2} s^{-1} (*2*–*6*). For the high end of measured isoprene levels in the Southern Ocean [which are attributed to enhanced phytoplankton productivity (*5*)], our simulations suggest that the amount of SOA is potentially enough to impact cloud droplet number concentrations. This large range may be from highly variable environmental conditions [i.e., photosynthetically active radiation (PAR), sea-surface temperature, wind speed, ocean mixed-layer depth, etc.] and phytoplankton speciation encountered during the experiments. Given the above and the uncertainty in isoprene-to-SOA yield, to state that "isoprene is not the reason for their observed extra cloud albedo" implies a level of understanding that currently does not exist.

We have shown a direct and strong link between phytoplankton and clouds. Given the identified potential of ocean-emitted isoprene (and other volatile organic compounds) on atmospheric oxidizing capacity and new-particle formation (*4*–*7*), the possibility of isoprene SOA contributing to the global CCN budget is real and worth exploring.

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CORRECTIONS AND CLARIFICATIONS

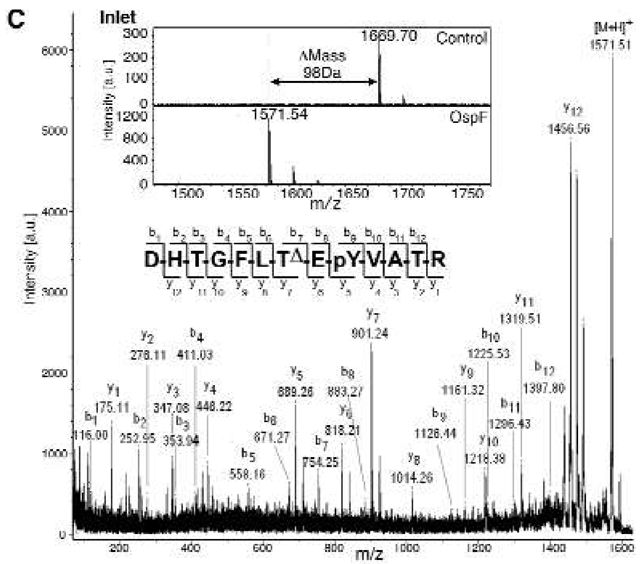
Perspectives: "Reassessing carbon sinks" by D. F. Baker (22 June, p. 1708). The summary sentence is incorrect. It should read, "Less carbon dioxide is taken up by the Southern Ocean, and more by tropical land areas, than previously thought."

Perspectives: "Recent progress and continuing puzzles in electrostatics" by L. B. Schein (15 June, p. 1572). The summary sentence is incorrect. It should read, "Insight into the adhesion of charged insulating particles is affecting laser printing technology and may have other industrial applications." In the figure caption, "200-µm" should read "300-µm."

Policy Forum: "Danger of deep-sea mining" by J. Halfar and R. M. Fujita (18 May, p. 987). The deep-sea mining activities were erroneously described as strip-mining operations. The correct term should be pit-mining operations, implying an absence of overburden, as stated later in the article.

Perspectives: "A promising mimic of hydrogenase activity" by T. B. Rauchfuss (27 April, p. 553). The Perspective states that the compound discovered by S. Ogo *et al.* [*Science* **316**, 585 (2007)] catalyzes the hydrogenation of benzaldehyde to the corresponding alcohol. This statement referred to a preliminary result that was not presented in the published paper.

Reports: "The phosphothreonine lyase activity of a bacterial type III effector family" by H. Li *et al.* (16 Feb., p. 1000). A production error caused some of the data labels in Fig. 3C to be obscured. A corrected version appears below on the left.



Research Articles: "Phytoplankton and cloudiness in the Southern Ocean" by N. Meskhidze and A. Nenes (1 Dec. 2006, p. 1419). In Table 2, the C_W^ASOFeX, C_W^B F_B, isoprene, and SOA values were incorrect. The corrected table is shown above. For detailed table legend, see original paper.

Table 2. Ocean chlorophyll *a*, fluxes, and atmospheric concentrations of isoprene

	[Chl *a*] (mg m^{-3})		Dissolved isoprene concentration (pM)			Isoprene flux (10^8 molecules cm^{-2} s^{-1})			Estimated MBL concentration (pg m^{-3})	
	Bloom	SOFeX	C_W^A	SOFeX	C_W^B	F_A	F_B	Amazon	Isoprene	SOA
Average	3.0	2.4	30	7.6	8.4	1.8	0.6	18200	500	20
Max	12.7	2.6	130	>10	34	8.6	2.2	20000	2000	60
Min	0.1	0.1	3.0	<2	1.4	0.2	0.1	7000	80	2

TECHNICAL COMMENT ABSTRACTS

Comment on "Wandering Minds: The Default Network and Stimulus-Independent Thought"

Sam J. Gilbert, Iroise Dumontheil, Jon S. Simons, Chris D. Frith, Paul W. Burgess

Mason *et al*. (Reports, 19 January 2007, p. 393) attributed activity in certain regions of the "resting" brain to the occurrence of mind-wandering. However, previous research has demonstrated the difficulty of distinguishing this type of stimulus-independent thought from stimulus-oriented thought (e.g., watchfulness). Consideration of both possibilities is required to resolve this ambiguity.

Full text at www.sciencemag.org/cgi/content/full/317/5834/43b

Response to Comment on "Wandering Minds: The Default Network and Stimulus-Independent Thought"

Malia F. Mason, Michael I. Norton, John D. Van Horn, Daniel M. Wegner, Scott T. Grafton, C. Neil Macrae

Gilbert *et al*. suggest that activity in the default network may be due to the emergence of stimulus-oriented rather than stimulus-independent thought. Although both kinds of thought likely emerge during familiar tasks, we argue—and report data suggesting—that stimulus-independent thought dominates unconstrained cognitive periods.

Full text at www.sciencemag.org/cgi/content/full/317/5834/43c