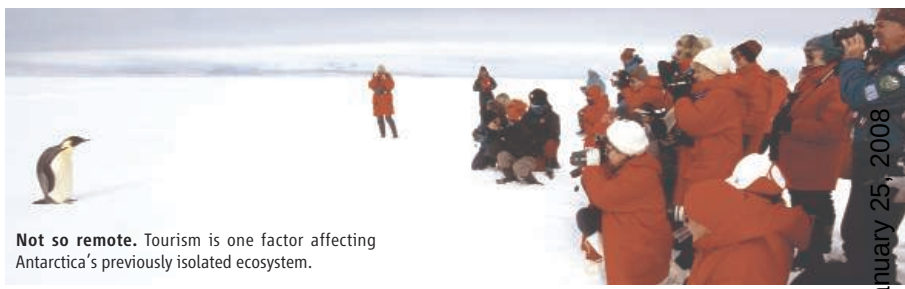
LETTERS

edited by Jennifer Sills

Antarctica Invaded



Not so remote. Tourism is one factor affecting Antarctica's previously isolated ecosystem.

THE PERSPECTIVE "ANTARCTIC BIODIVERSITY" (P. CONVEY and M. I. Stevens, 28 September 2007, p. 1877) highlights endemic fauna and flora on the south polar continent that have persisted through glacial cycles and remained geographically isolated for millions of years. However, this ancient biota is no longer isolated. Despite being surrounded by a vast ocean, Antarctica's isolation has diminished rapidly for a variety of reasons: a burgeoning tourist industry that produces tens of thousands of visitors each year; scientific exploration; increased accessibility by air and by sea; and global warming, which is removing physiological barriers to colonization by species that previously could not survive the inhospitable climate (*1*, *2*).

Human activity in Antarctica is taking its toll. In one alarming example, poultry viruses and *Salmonella* have been found in penguins (*3*). This discovery garnered media attention, but invasions by many other organisms have occurred with less fanfare. Nearly 200 alien species of fungi, terrestrial plants, invertebrates, and vertebrates have colonized the Antarctic continent and its surrounding islands within just the past two centuries (*1*), an astonishing rate for this once intensely remote region. On Gough Island, for example, the modern rate of invasion may be as much as 20,000 times higher than the prehistoric rate (*4*). Although their effects have been poorly studied to date, alien species have already reduced populations of native plants, invertebrates, and seabirds (*5*–*7*), and they have had direct and indirect effects on ecosystem processes (*1*, *8*). The dramatic effects that alien species have had in insular endemically rich regions elsewhere (*9*–*11*) warn that they could play a major role in reshaping Antarctica's diversity.

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A Closer Look at the IPCC Report

IN THEIR POLICY FORUM ("THE LIMITS OF consensus," 14 September 2007, p. 1505), M. Oppenheimer *et al*. make several misleading statements. They suggest that a premature drive for consensus led Working Group I to understate the risk of large future sea-level rise in the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (WGI-AR4). They assert that the "Summary for Policymakers" (SPM) of the WGI-AR4 did not properly consider increasing contributions from rapid dynamical changes in the ice sheets of Greenland and West Antarctica (WAIS). However, in quoting the SPM discussion of sea-level rise, they ignore its explicit statements on the subject, such as "dynamical processes related to ice flow not included in current models but suggested by recent observations could increase the vulnerability of the ice sheets to warming, increasing future sea level rise"; the model projections "[do not] include the full effect of ice sheet flow because a basis in published literature is lacking"; and, crucially, "larger values cannot be excluded, but understanding of these effects is too limited to assess their likelihood or provide a best estimate or an upper bound for sea level rise" (*1*).

We agree with Oppenheimer *et al*. that paleoclimatic observations should be considered in assessing possible long-term future sea-level rise and polar ice sheet changes, but dispute their inference that the SPM omitted the available information. The SPM explicitly noted that "global average sea level in the last interglacial period (about 125,000 years ago) was likely 4 to 6 m higher than during the 20th century, mainly due to the retreat of polar ice" from Greenland and possibly Antarctica as well. The SPM refers to the whole of Antarctica because of the possibility of differing behavior for the East Antarctic Ice Sheet (for which there is currently some evidence for mass gain, as opposed to mass loss of WAIS), in order to communicate with policymakers whose interest lies in understanding the total contribution to sea-level rise.

Oppenheimer *et al*. offer a number of suggestions for handling uncertainty, but they do not address the fact that quantitative model projections of ice-sheet dynamical changes cannot yet be made because of the

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