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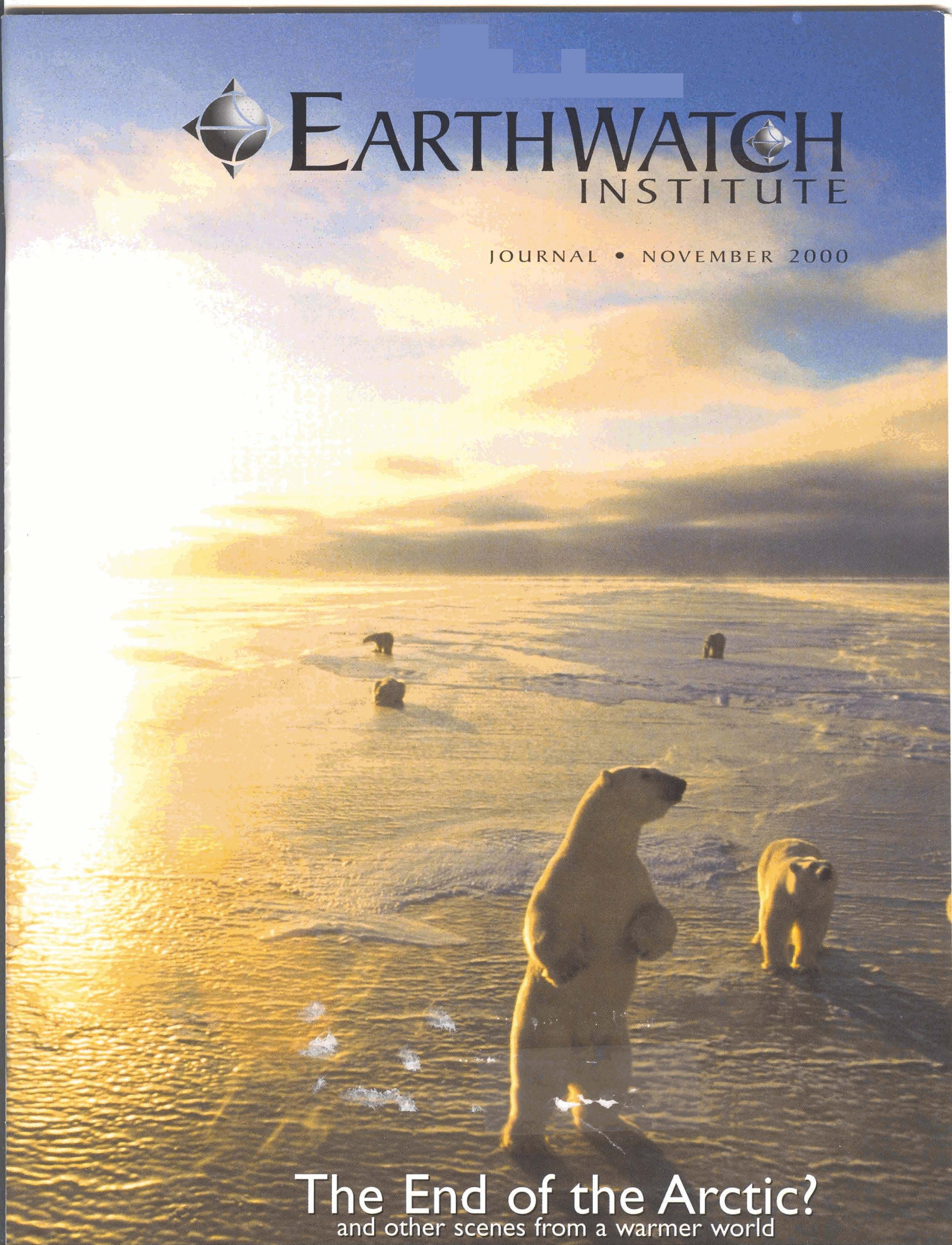

The End of the Arctic?

and other scenes from a warmer world

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Heat Futures

The world's ecosystems have evolved over millions of years to cope with an average rate of climate change on the order of 1° Centigrade per 1,000 years. But already the global surface air temperature has increased about 0.5° C in the past 25 years, and global circulation models predict that the rate will only increase in coming years. Surely this change will have a major effect on our planet's delicately balanced ecosystems, but what will that effect be?

We asked six past or present Earthwatch ecologists working in wetlands, mountains, deserts, reefs, rain forests, and grasslands to create a mental scenario: Given the regional climate change predictions of a leading global circulation model, how do you expect your particular ecosystem to respond in 50 years? Their scenarios are purely speculative, but based on the most authoritative understanding of local ecology.

The predictions of regional climate changes provided to each scientist were based on a Hadley Centre model, HadCM2GS, one of the newer global circulation models. The model predicted that average surface temperatures would increase between 1 and 3° C for each area in the next 50 years. Precipitation changes varied from 1 mm/day less to 1 mm/day more. While these changes may appear insignificant, the effect on ecosystems could be dramatic, as illustrated by the scenarios that follow.

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Australia's Rain Forests

As the greenhouse makes canopies flourish, it will be bug heaven, followed by rainforest hell.

The impacts of global warming are buffered somewhat in Australian rain forests as compared to other habitats, but the warming temperatures and increasing rainfall associated with local climate change will significantly alter the ecosystem by the year 2050. In particular, the forest edges will erode, as they are already have in recent years. Encroaching fires from the dry pasturelands, outbreaks of herbivorous insects such as boogong moths, and reduction of many populations of seed-dispersing birds such as cassowaries will combine to shrink the remaining patches of rain forest left in Australia. These climate-driven impacts will be abetted by the practices of cane farmers and other agriculturists, and the runoff of toxic substances that affect the regeneration of sensitive edge species.

The wetter, warmer conditions will be followed by the luxuriant growth of the upper canopy, in the short term, creating unprecedented shade on the forest floor and resulting in a lower survivability of the seedlings of several rare rainforest trees. For example, the large fleshy fruits of *Planchonella australis* will be more prone to decay before they can germinate in these warm, wet conditions, and several other tree species prefer slightly drier and sunnier conditions to develop from seedling to sapling. The loss of one generation of these tropical trees might take several thousand years to recover, so the impacts are extremely enduring and far-reaching.

Meanwhile, herbivorous insects will have their heyday, in the short term at least, as they busily enjoy the green flushes of canopy foliage triggered by the warmer weather and higher rainfall. These insects will be quick to respond to the growth in food supplies, but in the end they will devastate the new food resource and may move on to other resources outside their conventional diet, potentially plundering neighboring agricultural crops as well. As the food supply associated with canopy growth declines, the predators will subsequently follow suit.

Antarctic beech forests of South Queensland, for example, will be noisy with the munching of invading caterpillars from a host-specific beetle, *Novocastria nothofagi*, whose millions devour the lush spring growth. These beech trees are the veritable grandfathers of the temperate rain forests of Oceania, some trunks aged at several thousand years, and have experienced centuries of intermittent epidemics of leaf-eating beetles in their canopies. But over the next 50 years the outbreaks will come with unrivaled intensity, as the rising temperatures and higher rainfall associated with global-warming trends will create a climate that favors the beetles more than the trees. These trends could lead to the rapid decline of these magnificent trees that inhabit cooler, moist habitats in Australia and New Zealand. Already, their seedlings are scarce.

Australian rain forests harbor many endangered species, and the number of listed species may triple and these species will be even more threatened as remaining tracts of forest become isolated patches. These pockets of rain forest can not support many unusual animals and birds, such as Tasmanian devils or lyrebirds, which require larger tracts. Invasive alien species will be ever more successful. Already, the cane toad and lantana, an invasive shrub native to the tropical Americas, are thriving in the changing climate regime relative to some of their more sensitive native counterparts.

The decline of Australia's rain forests, both tropical and temperate, will not only represent a devastating loss of biodiversity but also will result in a significant loss of ecotourism and cultural heritage that can never be replaced. The rain forests took millions of years to create, and now we may lose them within one century.

—Dr. Meg Lowman

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