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Climate-Induced Forest Dieback as an Emergent Global Phenomenon

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MEETINGS

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PAGE 504

An organized oral session at the annual meeting of the Ecological Society of America in San Jose, Calif., posed this question: Is climate-induced drought stress triggering increasing rates and unusual patterns of forest die-off at a global scale? Twenty-nine researchers representing five continents reported on patterns, mechanisms, and projections of forest mortality.

Observations include widespread forest dieback or reductions in tree cover and biodiversity in response to drought and warmer temperatures in the African Sahel (Patrick Gonzalez, The Nature Conservancy), Mediterranean and alpine Europe (Jorge Castro, Universidad de Granada), and Argentinean Patagonia (Thomas Kitzberger, Universidad Nacional del Comahue). In contrast, although much *Eucalyptus* mortality has resulted from recent droughts in Australia, warming trends have been less pronounced in the Southern Hemisphere and it is unclear if contemporary climate-induced tree mortality differs from previous historical drought impacts (Rod Fensham, Queensland Herbarium).

Die-off in North American ecosystems, especially semiarid woodlands and forests of the southwestern United States, received particular focus. Contemporary tree mortality across millions of hectares is often associated with multiple stress factors, including biotic agents—especially bark beetles—but mortality of other life-forms (grasses, cacti, shrubs) can be attributed to abiotic water stress from climate alone, suggesting that recent warm drought conditions are the primary driver of the forest die-off (Neil Cobb, Northern Arizona University). This perspective was supported by intensive analysis of regional forest inventory data documenting maximum temperature as the key explanatory variable for tree mortality during the recent drought (Amanda White, Los Alamos National Laboratory).

The consequences of such drought-triggered ecosystem changes could fundamentally alter species associations like the current codominance of piñon and juniper species in southwestern U.S. woodlands; these species are projected to become spatially disassociated in the future, consistent with paleoecological patterns under previous climate conditions (Ken Cole, U.S. Geological Survey). More robust understanding of nonlinear physiological threshold responses to both chronic and acute water stress is required to improve future projections of tree mortality, which can result from hydraulic failure for some species and carbon starvation for others, as in the recent piñon-juniper die-offs (Nate McDowell, Los Alamos National Laboratory).

Despite the need for calibrations with additional field observations and experiments, global vegetation simulations generally indicate an increasing risk of large-

scale forest dieback and interactions with multiple stress factors including other disturbances (e.g., fire, insect outbreaks; Dominique Bachelet, The Nature Conservancy).

Although current observations of die-off are insufficient to determine if worldwide trends are emerging due to a lack of a global monitoring system, recently documented regional patterns are consistent with projected impacts of global climate change and highlight the substantial risk for widespread climate-induced forest dieback (Craig Allen, U.S. Geological Survey).

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