

IN THIS ISSUE


April 6, 2021

EARTH, ATMOSPHERIC, AND
PLANETARY SCIENCES

Observations of tornado intensity and size

Ratings of tornado intensity and estimates of wind speed come from reports of tornado damage, which are biased due to the rural locations of most tornadoes and the minimal damage they cause to well-engineered structures. As a result, the true distribution of tornado wind speeds and sizes is poorly understood. Joshua Wurman et al. analyzed wind speed measurement data from 120 tornadoes, collected by mobile Doppler radar instruments. The direct measurements of tornado characteristics suggest that the median peak wind speeds are around 60 m/s, which is sufficient to merit Enhanced Fujita Scale (EF) scores of 2 to 3. Comparison with National Weather Service ratings showed that the previous EF/wind speed estimates are 1.2 to 1.5 categories lower than those observed by Doppler on Wheels instruments. The authors further found that around 20% of tornadoes are capable of the most destructive EF scores of 4 to 5. The median tornado diameter was around 250–500 m, with around 10–15% wider than indicated by damage-based surveys alone. According to the authors, the results suggest that tornado risk assessments, as well as building wind resistance standards, may need to be upgraded to reflect the observed strength and size of tornadoes. — P.G.

PNAS e2021535118 (2021)



A mobile radar scanning a tornado in Wyoming. Image credit: Center for Severe Weather Research/Herb Stein.

ECOLOGY

Global pet trade and invasive species

The global pet trade is a multibillion-dollar enterprise involving the sale of tens of millions of animals each year. Pets that escape or are released into the wild can become introduced outside their native range, posing a threat to biodiversity, ecosystems, and human health. Jérôme Gippet and Cleo Bertelsmeier performed a meta-analysis to examine whether invasive species are overrepresented in the global pet trade. The authors compiled a dataset of thousands of vertebrate species, including mammals, birds, reptiles, amphibians, and fish. The results revealed that invasive species represent 12.7% of the pet trade and are 7.4 times more frequent in the pet trade than in the global pool of vertebrate species.

Similarly, invasive ant species in the pet trade are 6.6 times more common in the pet trade than in the global species pool and sold by 1.7 times more sellers than noninvasive species. Together, the findings suggest that invasiveness is linked to greater commercial success in the pet trade. According to the authors, strict international regulations should be implemented to curb the global spread of invasive species, and people should be encouraged to purchase pets native to their area. — J.W.

PNAS e2016337118 (2021)

ENVIRONMENTAL SCIENCES

Database of oil and gas well integrity

Information about oil and gas well integrity in the United States is often sparse and varies in availability from state to

state. As a result, little is known about the fraction of wells that have experienced leakage, despite the potential impacts on groundwater supply.

Greg Lackey et al. compiled 474,621 well testing records from 105,031 oil and gas wells in Colorado, New Mexico, and Pennsylvania into a large, publicly available well integrity dataset. The dataset focuses on records of sustained casing pressure (SCP) and/or casing vent flow (CVF), which imply a compromise of internal well integrity; however, the authors caution, additional well details and testing information are needed to determine whether the leaked fluids have affected groundwater. The authors found that 14.1% of tested wells across Pennsylvania exhibited SCP and/or CVF, and the corresponding percentage of tested wells in different oil-producing and gas-producing regions in Colorado and New Mexico varied between 0.3 and 26.5%. Characteristics deemed

sufficient to potentially induce leakage into groundwater were identified in 3% of tested wells in Colorado and 0.1% of tested wells in New Mexico. According to the authors, the results show both the value of statewide well testing programs and the challenge of interpreting disparate well testing data. — P.G.

PNAS e2013894118 (2021)

ANTHROPOLOGY

Pacific and Amazonian natives share Australasian ancestry

Past studies have demonstrated genetic affinity between natives from South America and present-day indigenous groups of South Asia, Australia, and Melanesia. However, this genetic connection between Native Americans and Australasians remains poorly understood. Marcos Castro e Silva, Tiago Ferraz, et al. analyzed

a comprehensive genomic dataset from South American populations, including 383 individuals and 438,443 genetic markers. The results revealed that the Australasian genetic signal, previously thought to be confined to Amazonian groups, is also present in populations in the Pacific Coast region. The findings suggest that the Australasian genetic signal is more extensive in South America than prior reports suggest and that there may have been ancient contact between Pacific and Amazonian populations. Moreover, at least two migratory waves are required to account for the present-day genetic diversity of Central and South American populations. The Australasian contribution was likely introduced in South America through the Pacific Coastal route before the Amazonian branch formed. According to the authors, the study sheds light on the shared genetic ancestry of the early dwellers of South America. — J.W.

PNAS e2025739118 (2021)

SUSTAINABILITY SCIENCE

Value of implicit subsidies for US fossil fuel companies

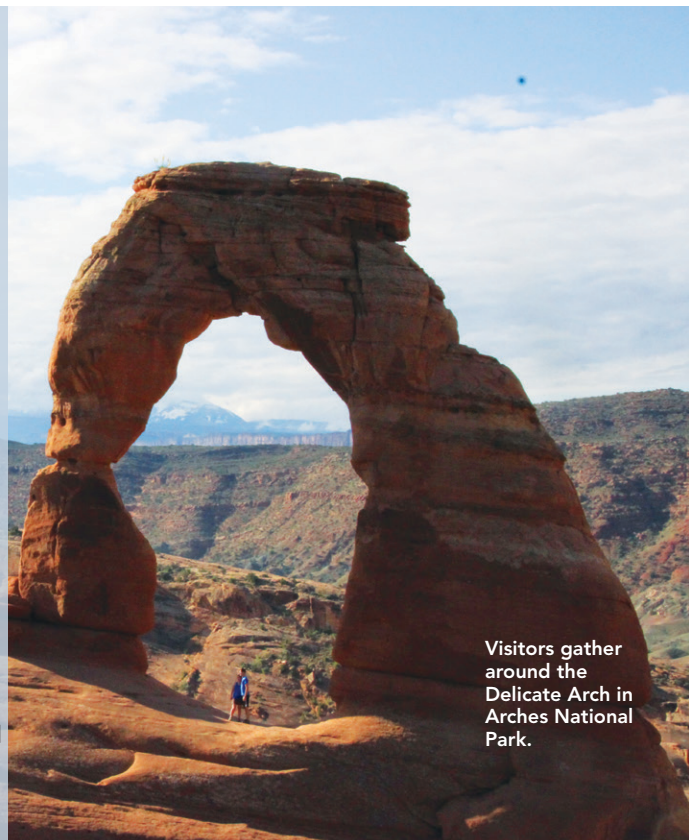
Current fossil fuel pricing in the United States fails to account for external costs to society, including climate change-related damages, adverse health effects from pollution, congestion-based travel delays, accidents, and road damage. As a result, fossil fuel producers receive higher prices than they would if these costs were internalized, creating an implicit subsidy. Matthew Kotchen estimated the value of this implicit subsidy, specifically for US producers of coal, natural gas, gasoline, and diesel. Between 2010 and 2018, the value of this subsidy to all producers averaged \$62 billion per year. Because the number of fossil fuel producers is relatively small, this subsidy translates into a large benefit for individual

ENVIRONMENTAL SCIENCES

Health benefits of natural sounds

Research suggests that natural sounds positively influence human health. To determine whether conserving natural soundscapes could bolster public health, Rachel Buxton, Amber Pearson, et al. conducted a systematic literature review and meta-analysis of 18 publications examining the health benefits of natural sounds. Overall, exposure to natural sounds decreased stress and improved health factors, such as blood pressure, heart rate, cortisol levels, and perceived pain. Compared with an array of natural sounds, water sounds had the greatest positive outcomes on human health, whereas bird sounds had the greatest influence on relieving stress. The authors also examined the distribution of anthropogenic sounds in relation to natural sounds at 221 sites in 68 US national parks. Among all sites, water sounds were audible 22.8% of the time, and bird sounds were audible 42.1% of the time. Compared with parks that received fewer annual visitors, parks with more visitors exhibited similar levels of natural sounds but greater levels of anthropogenic sounds. Most sites with low audibility of anthropogenic sounds and high audibility of biological or geophysical sounds were far from urban areas and located in Alaska, Hawaii, or the Pacific Northwest. The findings suggest that preserving national parks and their natural soundscapes benefit both ecosystem conservation and public health, according to the authors. — M.S.

PNAS e2013097118 (2021)



Visitors gather around the Delicate Arch in Arches National Park.

companies. Among the largest domestic producers, the benefits ranged from tens of millions of dollars to more than \$1.5 billion in 2018 alone. For 2017–2018, the benefit was equal to 18% of

net income from US operations for the median oil and gas producer and exceeded net income for most coal producers. The results highlight the extent to which fossil fuel companies stand

to lose from stricter regulatory reform and may also influence policymakers' views of additional subsidies, according to the author. — B.D.

PNAS e2011969118 (2021)

JOURNAL CLUB

Highlighting recent, timely papers selected by Academy member labs
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In the course of an experiment pushing the length limits of in vitro growth, mouse embryos went from translucent clumps of cells to fetuses with beating hearts and blood cells. Image credit: Jacob Hanna.



DEVELOPMENTAL BIOLOGY

Lab-cultured mouse embryos grown for an extended period, offer a new window on fetal development

Posted on March 26, 2021

Amy McDermott

Within a mouse's 20-day gestation period, the coauthors focused on the critical window between days 5 and 11 when organs begin to form. They collected the embryos, as translucent cylinders of stem cells, from the mother's uterus on day 5, then grew them through the process of tissue formation and organ differentiation. The findings are exciting both for the length of time the embryos survived and for the developmental process captured, says senior author Jacob Hanna at the Weizmann Institute of Science, in Rehovot, Israel. [Continue Reading](#) ➔