

An elephant (*Loxodonta africana*) eating an *Acacia brevispica* tree at Mpala Research Centre, Kenya.

# IN THIS ISSUE

October 12, 2021

## ECOLOGY

### Large herbivores and lianas in African savannas

Large herbivores influence populations of grasses and trees in tropical African savannas. However, the effects of herbivores on other types of vegetation, such as lianas, or woody vines, have not been well studied. Tyler Coverdale, Ryan O'Connell, et al. combined diet analyses and field experiments to explore the effects of large herbivores on lianas in a Kenyan savanna. The results of an observational experiment and fecal sample analysis suggest that, despite producing toxic latex, caustic creepers (*Cynanchum viminalis*) were eaten by multiple species of wild herbivores but were rarely eaten by livestock. The authors surveyed plots of savanna that were selectively fenced off for 8–17 years to simulate extirpation. In the absence of wild herbivores, *C. viminalis* increased in abundance and reduced tree growth and reproduction. Additionally, wild herbivores of different sizes played complementary roles in suppressing *C. viminalis*. The authors also performed surveys after 18-year-old fences were removed, thus simulating rewilding, and found that wild herbivores rapidly reduced *C. viminalis* abundance. According to the authors, the results, along with theoretical models, suggest that ongoing declines in wild herbivore diversity may reduce the resilience of savannas to liana encroachment. — M.H.

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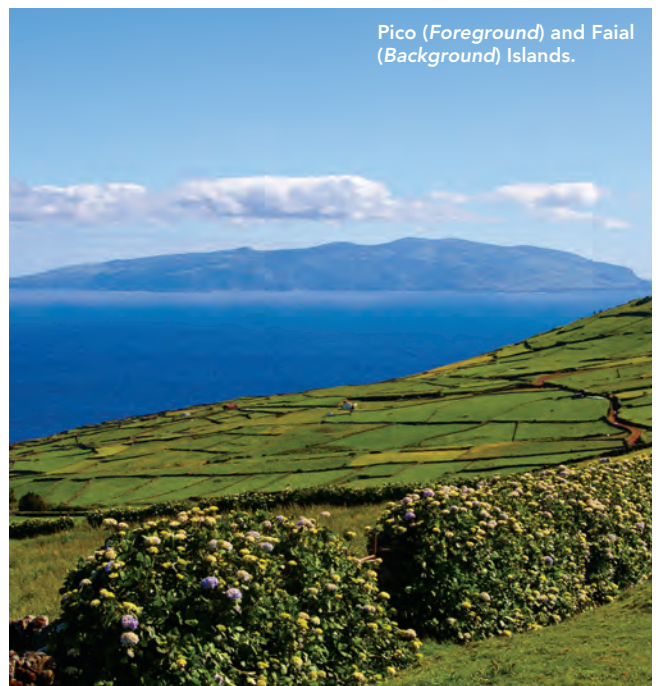
## ENVIRONMENTAL SCIENCES

### Early colonization of the Azores Archipelago

Humans have altered much of Earth's landscape over time. Remote islands may provide insight into how landscapes evolved in response to the impacts of early settlers. However, limited historical records have hampered understanding of how and when such landscapes were colonized. Pedro Raposeiro et al. analyzed and dated fecal biomarkers and coprophilous ungal spores in sediment cores collected from lakes on five islands that are part of the Azores Archipelago. The authors also accounted for climate conditions through time. Island occupation began approximately between 700 and 850 CE, around seven centuries earlier than prior research suggests. Anthropogenic pressure on aquatic and terrestrial ecosystems increased gradually through activities such as

logging, livestock introduction, and slash-and-burn agriculture and eventually resulted in irreversible alterations. Colonization occurred simultaneously with anomalous northeasterly winds and warming Northern Hemisphere temperatures, which may have repressed exploration from southern Europe but benefited Norse explorers from the northeast Atlantic. The findings suggest that the Azores archipelago was not pristine when Portuguese settlers first arrived, and that the Norse may have been the first

Pico (Foreground) and Faial (Background) Islands.



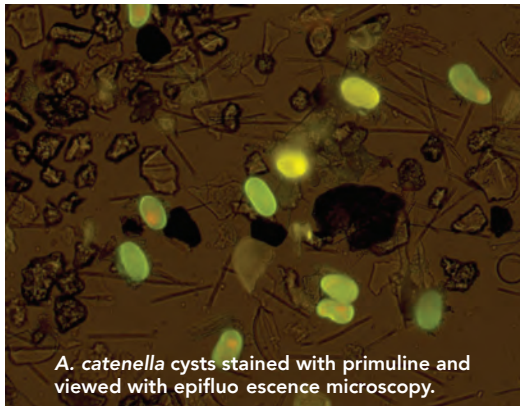
settlers to colonize the region, according to the authors. — M.S.

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**ENVIRONMENTAL SCIENCES**

## Harmful algal bloom in the Alaskan Arctic

The cyst-forming algal species *Alexandrium catenella* is toxic to humans and wildlife and prevalent in southeastern Alaska. The species moves into the Arctic



*A. catenella* cysts stained with primuline and viewed with epifluorescence microscopy.

via waters flowing northward through the Bering Strait, but few observations of this dinoflagellate have been recorded north of the strait. During the summer and autumn of 2018 and 2019, Donald Anderson et al. collected sediment and water samples from the Bering Strait and the Beaufort, Chukchi, and Northern Bering Seas, documenting *A. catenella* cyst and cell abundance. The authors found high concentrations of *A. catenella* cysts in bottom sediments of two distinct cyst beds stretching approximately 1,000 km along the coast and


350 km offshore. Based on lab germination experiments, the authors suggest that global warming likely increased levels of germinated cells and led to early bloom initiation. Dense blooms of *A. catenella* vegetative cells, which are key sources of toxins in the marine food web, occurred in both 2018 and 2019, highlighting two bloom mechanisms: southern populations delivered to the region through the strait as well as local development from the cyst beds. Surface water temperatures were 6–12 °C, a range at which cultured Chukchi isolates of *A. catenella* grew up to 75% of maximal rates. The findings suggest that future recurrent blooms of *A. catenella* may imperil regional food security, according to the authors. — M.S.

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**SUSTAINABILITY SCIENCE**

## Global urban population exposure to extreme heat

Urban populations and extreme heat exposure due to climate change have both grown in recent decades. However, the interplay of these phenomena with the urban heat island effect has not been analyzed in detail. Cascade Tuholske et al. combined global fine-grained maximum air temperature and relative humidity estimates with global urban population and spatial extent data to estimate fine-resolution and longitudinal extreme heat exposure for 13,115 urban settlements from 1983 to 2016. The results suggest that global extreme temperature exposure increased by 199%, from 40 billion person-days of extreme heat in 1983 to 119 billion person-days of extreme heat in 2016. The authors estimate that urban warming due to climate change and the urban heat island effect elevated the rate of increase by 52%, compared with the contributions of urban population growth alone. The authors note significant spatial heterogeneity between estimates at the regional, national, and municipality levels, with many of the results exceeding recently published continent-level benchmarks. Trajectories in Africa and Southern Asia suggest that extreme heat exposure may limit the economic benefits of urbanization. However, implementing early warning systems for such regions before individual extreme heat events occur could reduce impacts of urban extreme heat exposure, according to the authors. — M.H.

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View of the Kathmandu Valley from Swayambhunath Stupa, Kathmandu, Nepal. Image credit: Katalyn Voss (photographer).

## ECOLOGY

# Suppression of mosquitoes by *Wolbachia* bacteria

The sterile insect technique, which involves releasing a large number of sterile males to suppress wild insect vector populations, has had limited success in controlling mosquitoes. A maternally inherited, symbiotic bacterial species, *Wolbachia pipientis*, can augment the technique, given that male mosquitoes with a particular strain of the bacteria are often reproductively incompatible with females lacking the strain. Nigel Beebe

et al. assessed the effectiveness of using the *Wolbachia* wAlbB strain to suppress mosquito populations in isolated towns of North Queensland, Australia. Local endemic populations of *Aedes aegypti* mosquitoes initially carried no *Wolbachia*. A separate program released a large number of *A. aegypti* carrying the wMel *Wolbachia* strain to reduce viral transmission risk. The authors released a total of 3 million wAlbB-infected male mosquitoes into the resulting mosaic population, including around 50 males per house, three times per week, over 20 weeks. The authors detected population declines greater than 80% in the treated landscapes compared with controls, with population suppression continuing into the next season. The results suggest that the wAlbB-infected male mosquitoes produce nonviable offspring with both uninfected and wMel-infected females. According to the authors, the findings suggest that *Wolbachia*-infected mosquitoes could enable effective, environment-friendly mosquito population control. — M.H.

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Female *A. aegypti* mosquito. Image credit: Centers for Disease Control and Prevention/James Gathany.

## APPLIED BIOLOGICAL SCIENCES

# Inland mangroves and sea level

Red mangroves (*Rhizophora mangle*) typically grow near the ocean. Octavio Aburto-Oropeza et al. combined population genetic and sediment analyses with a floristic survey and geographic modeling to determine whether a population of red mangroves growing along the San Pedro Mártir River in the Yucatan Peninsula, 170 km from the coast, reached the inland region during a past interglacial event. The authors found that the San Pedro Mártir River red mangroves are genetically distinct from coastal red mangrove populations. Sediment analysis of the region was consistent with a past marine incursion. The authors identified othe

predominantly coastal plant species in the floristic survey of the river. Sea level modeling suggested that a sea level of around 9 meters above current levels could have reached the area currently occupied by the river. The results suggest that the San Pedro Mártir River red mangrove population was established during the last interglacial

period, around 120,000 years ago, when sea levels were 6–9 m above current levels, and subsequently became isolated when sea levels fell. According to the authors, the finding highlight the extensive impacts of past and future climate change on the world's coastlines. — M.H.

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*R. mangle* stand on the banks of the San Pedro Mártir River in Tabasco, Mexico.

# JOURNAL CLUB

Highlighting recent, timely papers  
selected by Academy member labs  
October 12, 2021

A recent study used a video game to show that perceived inequities drive collective violence. Image credit: Shutterstock/Dean Dietrick Jr.



PSYCHOLOGICAL AND  
COGNITIVE SCIENCES

## Frustrations can combust into a riot regardless of age, politics, or gender

Posted on October 1, 2021

Amy McDermott

The most common caricature of riots suggests criminal young men are the culprits. But a recent study in *Proceedings of the Royal Society B* suggests that is not necessarily the case. The study used a video game to incite virtual collective violence in groups of participants and showed that demographics including age, political opinion, and gender did not predict who was most likely to turn aggressive. Rather, a sense that one's own team was consistently being treated unfairly compared to another team led to collective aggression.

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