In this issue . . .

Investigating anthrax infection dynamics in nature

Much of what researchers know about the transmission and pathology of many infectious diseases comes from controlled experiments using animal models. As a result, the behavior of several infectious pathogens in wild hosts remains unknown. W. Ryan Easterday et al. (pp. 4273–4280) investigated the dynamics of anthrax infections in plains zebra (*Equus quagga*) in Etosha National Park in Namibia. The causative agent of anthrax, *Bacillus anthracis*, is an obligate lethal pathogen, and new hosts primarily get infected by ingesting spores while grazing at sites containing anthrax-infected carcasses. The authors isolated 30 *B. anthracis* colony-forming units from 11 naturally occurring zebra mortalities and genotyped the isolates. Applying a population genetics theory called coalescence modeling to intrainfection populations of *B. anthracis*, the authors estimated both the duration of infection and the founding population size. Founding populations were small, consisting of only a few spores, and infections were rapid and lasted around 1–3 days in the wild. The findings are consistent with previous experimental data, which suggest that a small founding population can infect animals and quickly progress to a lethal infection. The authors estimated the dynamics of anthrax infections post hoc in nature and suggest that the technique could be adapted to other pathogens and settings. — S.R.

Zebras grazing during anthrax season in Etosha National Park.

Smallholder farming and host resistance to parasites

In wild plant communities, coevolution of hosts and parasites boosts diversity in alleles related to host resistance. The limited diversity of cultivated crops in industrial farms can tip the balance in favor of parasites, but the coevolutionary dynamics in smallholder farming systems is unclear. Focusing on the association between the staple crop *Sorghum bicolor* (L.) Moench and *Striga hermonthica* (Delile) Benth., a parasitic weed known to devastate sorghum crops in Africa, Emily Bellis et al. (pp. 4243–4251) tested whether geographic selection mosaics increase diversity in host resistance to parasites at smallholder farming scales. Using a model to predict high-resolution variation in parasite occurrence at continental scales, the authors found that parasite occurrence correlates strongly with the emergence of genetic resistance mechanisms in the host–parasite system. Furthermore, the model—genotype–environment association analyses applied to biotic environmental gradients—reveals that diverse loss-of-function mutations in the sorghum resistance gene *LGS1* influence local adaptation to *Striga*. The authors also performed experiments with CRISPR-Cas9–edited sorghum that suggest that LGS1-mediated resistance depends on parasite

***Striga* growing in a sorghum field in Kenya.**

genotype and abiotic environment and is linked to fitness trade-offs. The findings demonstrate that smallholder farming systems support diversity in host resistance genes and can inform strategies for enhancing resistance in industrial-scale farming, according to the authors. — T.J.

Child mortality in Africa

Over the past 50 years, global mortality rates for children younger than 5 years have declined precipitously. However, the number of mothers who have experienced the death of a child in sub-Saharan Africa remains unestablished. Using demographic and health survey data collected between 1986 and 2017, Emily Smith-Greenaway and Jenny Trinitapoli (pp. 4027–4033) estimated how many mothers aged 20–49 years from 20 sub-Saharan African countries have experienced the death of a child. Mothers who died prior to the study were not included in the analysis, leaving 747,984 mothers in the sample. Between the late 1980s and 1990s, approximately 33% of mothers aged 20–44 years in most of the countries analyzed experienced the death of at least one infant. Throughout the 1980s and 1990s in most sub-Saharan countries, approximately 50% of mothers aged 45–49 years had lost a child younger than 5 years, whereas the percentage of mothers was 75% each in Benin, Burkina Faso, Malawi, Mali, Niger, and Senegal. As recently as 2010, more than 50% of mothers aged 45–49 years had lost at least one child of any age. The findings suggest that despite improved child mortality rates, child mortality remains common in sub-Saharan Africa, according to the authors. — M.S.

Species extinction and survival under climate change

Climate change poses a major threat to biodiversity in the coming century, but which aspects of a changing climate cause extinctions and how species could persist under climate change remain unclear. Cristian Román-Palacios and John Wiens (pp. 4211–4217) analyzed existing data on climate-associated range shifts of 538 globally distributed terrestrial plant and animal species to identify specific changes associated with extinctions, as well as mechanisms that may allow species to persist in the face of climate change. Local extinctions were associated with larger increases in maximum annual temperatures but smaller increases in mean annual temperatures relative to sites without extinctions. Based on species' past rates of upslope dispersal and projected future temperatures, the authors estimated that 57–70% of species would not be able to disperse quickly enough to avoid extinction due to rising temperatures. However, many species were able to shift their thermal niches to tolerate some increases in maximum temperature. Taking this ability to shift niches into account reduced the number of predicted extinctions to 30% of species or less. The results suggest that niche shifts, which are rarely considered explicitly when predicting climate change impacts, may be more important for species survival under climate change than range shifts, according to the authors. — B.D.

Madagascar jumping frog (*Aglyptodactylus madagascariensis*), a species affected by climate change.

Industrial revolution and atmospheric contamination in the Himalayas

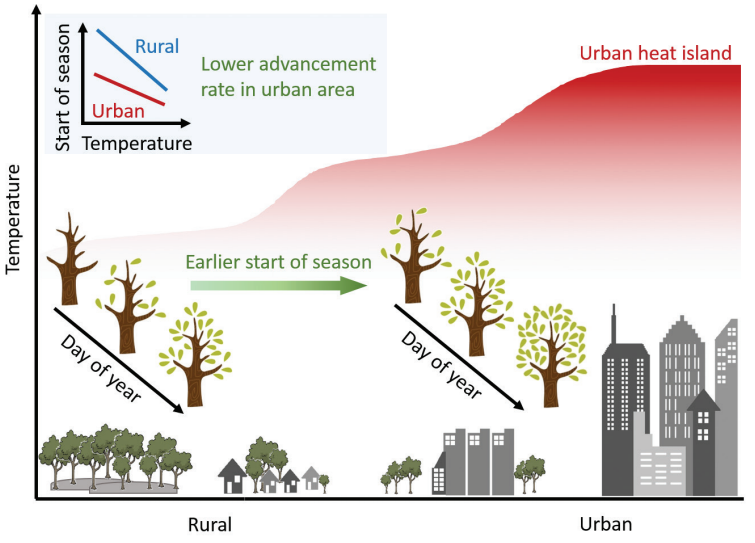
Few ice core records from the Himalayas exist and, therefore, the onset of human impact on the mountain range is unclear. To determine how anthropogenic activity since the European Industrial Revolution, which began around 1780, may have

The Dasuopu ice core drilling site in the central Himalayas at 7,200 m of elevation in 1997. Image courtesy of Vladimir Mikhalenko (Russian Academy of Sciences, Moscow, Russia).

affected the Himalayas, Paolo Gabrielli et al. (pp. 3967–3973) analyzed trace element concentrations in an ice core from the Dasuopu glacier. The authors found records of 23 trace metals that accumulated in the ice between 1499 and 1992. Peak element concentrations occurred during winter and spring. Antimony, cadmium, chromium, molybdenum, nickel, and zinc began accumulating around the beginning of the European Industrial Revolution. Between 1810 and 1880, fine fly ash from western European coal combustion transported by intense winter westerlies may have also contributed to the accumulation of atmospheric toxic metals deposited with snow. The authors posit that an increase in biomass-burning emissions from Northern Hemisphere deforestation may have also contributed to the accumulation of contaminants in trace amounts. Lower-than-expected levels of toxic metal were recorded after 1880, suggesting that changes in atmospheric circulation throughout the decades may help explain the influence of anthropogenic emissions on the troposphere in the Himalayas, according to the authors. — M.S.

Temperature response of phenology in urban heat islands

Air temperatures in cities tend to be warmer than in rural surroundings. Hence, cities can be used as natural laboratories for studying the ecological effects of climate warming. How phenology, or the timing of recurring events in plants' life cycles, differs between urban and rural environments, and the extent to which temperature contributes to this difference, remain unclear. Lin Meng, Jiafu Mao, et al. (pp. 4228–4233) examined changes in the start of plants' greening season (SOS), derived from satellite data, in 85 cities with urban areas larger than 500 km^2 in the coterminous United States from 2001 to 2014. SOS occurred 6 days earlier on average in most urban areas than in corresponding rural areas. However, the rate of SOS advancement with preseason mean air temperature was weaker on average in urban areas compared with rural areas. The reduced advancement rate mostly occurred in relatively cold regions, such as the northeastern and upper midwestern United States; the magnitude of the urban–rural difference in both SOS and advancement rate mainly correlated with the urban–rural temperature difference. The results suggest that phenological responses to temperature become weaker under



Temperature response of phenology in urban heat islands.

warming. Further, although the onset of spring phenology may continue to advance under future warming, the rate of advancement will likely slow down as warming continues, according to the authors. — B.D.