In This Issue

Agricultural benefits of bats

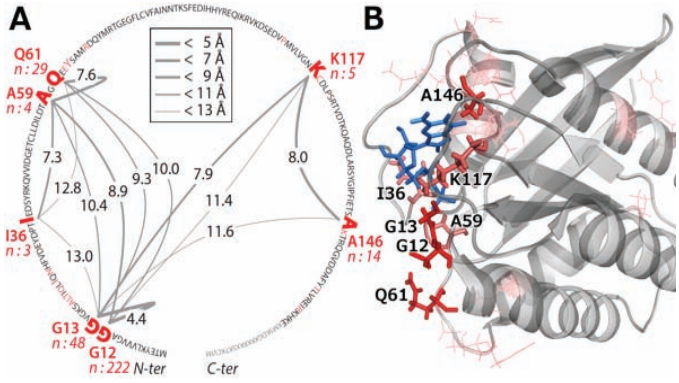
Bats prey on many crop pests and are thought to save farmers billions of dollars every year through pest control. However, this estimate relies on untested assumptions about bats' ecological

Corn earworm moth captured in pheromone trap.

impact, and the precise effect of bats on row crops has not been directly studied. Josiah Maine and Justin Boyles (pp. 12438–12443) conducted a field experiment in which corn plots were enclosed nightly to keep bats out while neighboring plots were left exposed. Larvae of the corn earworm, a significant corn pest, were nearly 60% more abundant in the enclosed plots than in the exposed plots. Enclosure also resulted in over 50% more damaged kernels per ear and significantly greater leaf damage compared with exposed plots. Furthermore, enclosure increased the proportion of ears with fungal growth as well as the concentration of fumonisin, a fungal toxin that poses a serious health hazard to livestock. The authors estimate that the pest suppression provided by bats could be worth more than 1 billion dollars for corn alone, with suppression of fungal growth and toxins providing additional value. The results suggest the importance of conserving insectivorous bats, which are threatened in many parts of the world, according to the authors. — B.D.

Analysis of clustered cancer mutations

Mutations in cancer-associated proteins sometimes cluster within 3D structures, such as substrate-binding pockets of cancer-causing enzymes. Atanas Kamburov et al. (pp. E5486–E5495) developed a statistical method called clustering of mutations in protein structures (CLUMPS) to detect novel cancer genes and mutational hotspots in known genes through analysis of clustered protein mutations. Using CLUMPS, the authors analyzed DNA mutations in 4,742 tumors of 21 types previously uncovered by the PanCancer project, a consortium aimed at sequencing tumor DNA to identify driver and passenger mutations, and compared the mutations with structural and protein interaction data for more than 4,000 human proteins in Protein Data Bank, a longstanding repository of protein structures. Mutation clusters were detected in four known oncoproteins, five known tumor suppressor proteins, and a protein called NUF2, required for proper chromosome separation during cell division, but in which mutations had not been previously linked to cancer. CLUMPS helped confirm tissue and tumor type-specific clustering of mutations in the cancer-associated proteins EGFR and SPOP, respectively. Mutations were also enriched at ion binding sites of cancer-related proteins and at interfaces with their interacting partners, including DNA and RNA. Because clustered rather than scattered mutations are more likely to reflect selection for functions boosting cell growth, 3D mutation cluster analysis might help narrow the search for the drivers of cancer, according to the authors. — P.N.



Clustered mutations in KRAS, a cancer-associated protein. (*A*) Sequence of KRAS with mutated residues (red). (*B*) KRAS (grey) with substrate (blue) in 3D.

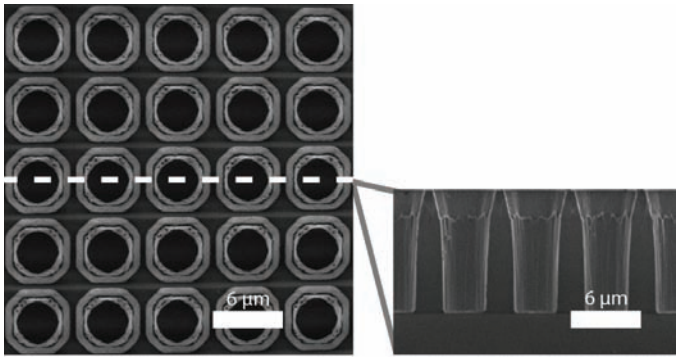
Musical expertise and audiovisual integration

Reading musical scores requires the integration of visual, auditory, and motor skills, but the brain's functional networks involved in audiovisual integration remain unclear. To uncover the effects of music training on brain networks tied to audiovisual integration, Evangelos Paraskevopoulos et al. (pp. 12522–12527) recruited 26 people around 25 years of age, of whom 13 were students at a conservatory in Muenster, Germany and the rest were participants with no comparable music training. Using magnetoencephalography and whole-brain connectivity analysis, the authors uncovered the cortical networks tied to multisensory perception and detection of audiovisual inconsistency based on the participants' reactions to musical notations and scores that included violations of a cardinal rule in music reading, namely that the higher the position of a circle in the note, the higher the pitch of the tone. Brain connectivity across far-flung cortical areas and processing efficiency were

enhanced in musicians, compared with nonmusicians. Whereas nonmusicians primarily relied on the processing of visual cues, musicians largely deployed a dense network tied to the processing of auditory cues to identify auditory pattern violations. According to the authors, cognitive expertise, such as that gained by music training, can reorganize brain networks, bearing witness to the human brain's responsiveness to training. — P.N.

Emitting heat into space

Because the cold universe represents a vast heat sink, emitting heat energy into space can be an effective radiative cooling method for terrestrial objects. However, some objects such as solar panels need to continue absorbing solar energy while radiating undesirable heat. Linxiao Zhu et al. (pp. 12282–12287) constructed a silica photonic crystal that behaves as a visibly transparent thermal blackbody radiator by etching 10-μm-deep holes into a 500-μm-thick silica wafer. When placed between the sun and a solar absorber, the silica photonic crystal decreased the temperature of the absorber by as much as 13 °C, compared with bare solar absorbers. Sunlight absorption was preserved, and in some cases even slightly enhanced, by the silica photonic crystal radiator. The authors note that the shape of the holes changes the refractive properties of the crystal, allowing efficient energy emission. The radiator emitted



Normal (*Left*) and side (*Right*) views of holes etched in square-lattice photonic crystal.

energy within a range of wavelengths between 8 and 13 μm that comprises a window through which the atmosphere is transparent to midinfrared energy, allowing the energy to radiate into space. The results suggest that daytime thermal radiation into space may reduce surface heating while preserving sunlight absorption, and that convective cooling, such as forced air flow, may further enhance cooling, according to the authors. — P.G.

Fairy circle dynamics

Circular patches of sandy soil called fairy circles, which stipple stretches of vegetation such as the vast grasslands of Namibia, represent natural patterns. Previous studies suggested that fairy


Image courtesy of Hezi Izhaq (Ben-Gurion University of the Negev, Beer-Sheva, Isreal).

Fairy circles in NamibRand Nature Reserve.

circles result from the action of noxious gases, feeding by insects, or plant competition for soil water. Given the rapid lateral transport of soil water and high rate of water uptake by dense vegetation, Yuval Zelnik et al. (pp. 12327–12331) used mathematical modeling and high-resolution satellite images of fairy circles, collected from 2004 to 2013 in a Namibian nature reserve, to uncover the dynamics of fairy circles, including their birth and death. Model predictions of relatively increased soil water content in the circles, attributed to water absorption by surrounding grasses, closely comported with field observations. Satellite image analysis revealed that the average number and size of fairy circles varied as functions of total rainfall over different time periods, in agreement with model forecasts. According to the authors, the findings offer an interpretation of fairy circle birth and death as local transitions between so-called hybrid states, which enable gradual, rather than abrupt, regime shifts in spatially extended ecosystems. — P.N.