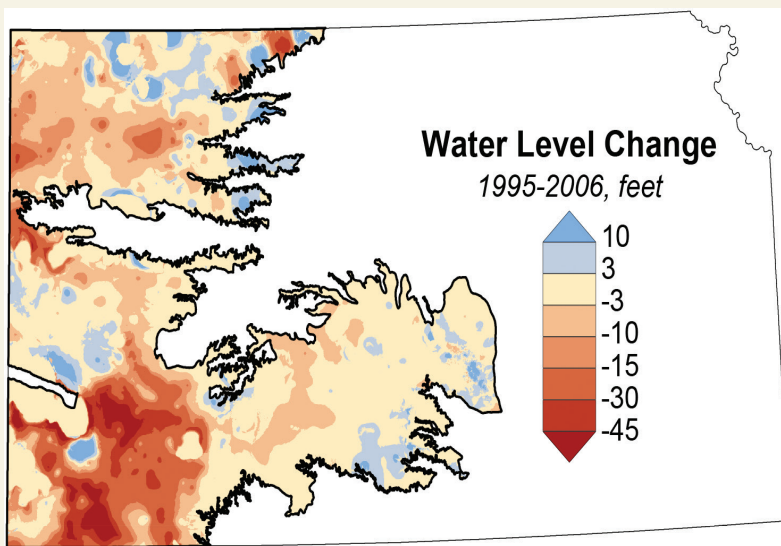


In this issue . . .

Measuring real-world value of natural capital

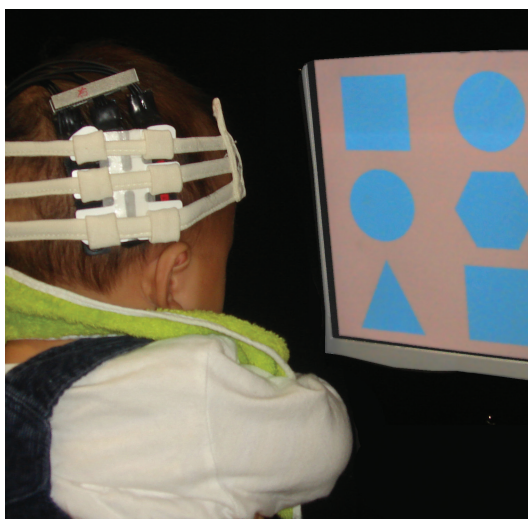
The term “natural capital” refers to all the natural resources that humans can use to support life on Earth. Economists have long attempted to assess the value of Earth’s natural capital within the context of established financial accounting practices and economic capital theory. Eli Fenichel et al. (pp. 2382–2387) describe a framework for quantifying natural capital with prices that can be compared directly with traditional assets such as real estate, factory machinery, and inventory. Conforming with neoclassical economic capital theory, the framework incorporates the dynamics of changing ecosystems and human behavior to account for income derived from nature. As an example, the authors applied their approach to groundwater in the Kansas High Plains Aquifer, a declining source of agricultural water for western Kansas. The case study revealed that groundwater extraction reduced the state’s wealth by approximately \$110 million per year, in 2005 US dollars, roughly equivalent to the state’s budget surplus for that year. According to the authors, implementation of effective groundwater management policies and prudent investment strategies could potentially offset such economic losses. — T.J.



Water volume declines in the Kansas section of the High Plains Aquifer between 1996 and 2005.

Categorical color perception and language acquisition

Humans can distinguish thousands of colors, but individuals across cultures use relatively few words to describe a continuous color space. Past studies have suggested not only that language could influence the perceptual grouping of colors into a few discrete categories, but also that categorical color perception may develop independently of language. Jiale Yang et al. (pp. 2370–2375) examined neuronal responses associated with color perception in 12 5- to 7-month-old prelinguistic infants and six adults. In each 10-second trial, the participants saw a three-by-three array of nine geometric shapes that alternated in color every second. In the between-category condition, the color of the shapes alternated between blue and green, whereas the within-category condition contained shapes that alternated between



Brain activity in infants distinguishes color categories.

different shades of green. Brain imaging through near-infrared spectroscopy revealed that visual regions in the brain's occipitotemporal cortex in both infants and adults responded to the between-category condition, but not to the within-category condition. The findings suggest that the visual system can support the perception of color categories prior to language acquisition. According to the authors, categorical color distinctions might arise before the development of linguistic abilities, but are later shaped by language learning. — J.W.

Brain size and problem solving among carnivores

Correlations between brain size and advanced cognitive skills, such as innovation and self-control, among animal species have recently emerged. However, the difficulty of comparing animals with unique behavioral adaptations to their environments, among other factors, has hampered an understanding of whether species with larger brains than others have superior



Spotted hyena standing by puzzle box.

cognitive abilities. Sarah Benson-Amram et al. (pp. 2532–2537) compared the ability of 140 zoo-reared carnivorous mammals from 39 species and 9 families to retrieve a food reward by opening a steel mesh puzzle box, the size of which was scaled to each species' body size. Species with large brains relative to body mass, such as those from the bear and raccoon families, were more successful at the problem-solving task than species with small brains relative to body mass, such as those from the mongoose family; performance improved with experience and was unrelated to manual dexterity. Social species, with large average group sizes, such as banded mongooses, had no advantage over solitary species, such as black bears or wolverines, in opening the puzzle box. Incorporating volume information from virtual

endocasts of four major brain regions of some species improved the ability of a model to predict the species' performance in the puzzle-box trials, compared with a model that included total brain volume. Relative brain size might thus help predict animals' problem-solving abilities, according to the authors. — P.N.

Observing cellular metabolite production in real time

Cells can be engineered to produce useful chemicals, but the potential of such metabolic engineering has been limited by the arduous methods needed to measure the concentration of cellular metabolites. Jameson Rogers and George Church (pp. 2388–2393) have developed a strategy for fluorescence-based, real-time monitoring of the production of cellular products. The authors used genetically encoded biosensors based on inducible small-molecule systems to link the expression of fluorescent proteins to the intracellular amount of a product. The authors combined these biosensors with cells engineered to produce a particular metabolic product and used fluorescence intensity to track product formation in real time. The authors also used the system to produce various plastic precursors and confirmed that higher fluorescence indicated higher product concentrations. In addition, the authors developed two biosensors for 3-hydroxypropionate (3HP), a renewable plastic precursor, and used real-time observation to improve 3HP production by 23-fold compared with previous reports. Finally, the authors developed a method for in vivo production of acrylate, an important plastic precursor, from glucose, and monitored the production of two other commercially important chemicals, glucarate and muconate, showing that the technique had wide-ranging applications. According to the authors, the technique could be used for high-throughput evaluation of metabolic engineering methods. — S.R.

Restful REM sleep, depression, and anxiety

Insomnia is a common sleep disorder associated with depression, anxiety, and posttraumatic stress disorder. The development of effective treatments for these disorders has been limited by incomplete understanding of the causes of physiological hyperarousal, which is a key characteristic of insomnia. Rick Wassing et al. (pp. 2538–2543) recorded two nights of brain activity, eye movements, and other physiological measures in 32 people, who also completed a questionnaire about nocturnal thoughts. The findings validated that restless rapid-eye-movement (REM) sleep, which is commonly associated with insomnia, could be approximated by the abundance of nocturnal thoughts—a variable measurable in a sufficiently large sample of people. The

