EDITED BY KRISTEN MUELLER AND JAKE YESTON

HYDROLOGY

A Watershed Moment

With increasing population and climate change exerting pressures on water resources, efforts to improve water quality are under way across a range of governmental levels. Yet water management strategies such as setting aside land for conservation can be highly variable between jurisdictions, and often watersheds cross national or international borders, making assessment of such efforts difficult. Wickham *et al.* catalogued and analyzed over 5000 drinking water watersheds in the conterminous United States, documenting some of the most important land-use factors controlling water quality, such as natural vegetation ground cover and extent of urbanization. From 1992 to 2001, about five times more watersheds showed a sizable decrease in natural vegetation cover than showed a comparable increase. Urbanization increased in 75% of the watersheds—9% showing more than a 1% increase. Because only a small fraction, particularly in the eastern United States, is conserved land, the growth of urbanization may soon exceed new conservation efforts. — NW

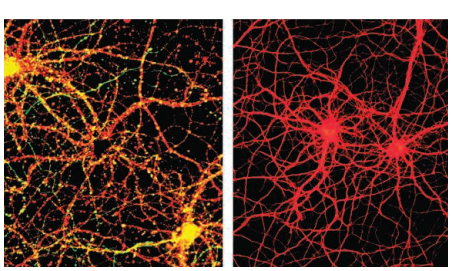
Landscape Ecol. 10.1007/s10980-011-9591-5 (2011).

NEUROSCIENCE

Soluble Aβ Is Trouble, Too

Cognitive impairments from Alzheimer's disease cause considerable loss of independence among the elderly. Insoluble aggregates of amyloid β-protein (Aβ) characterize brains from persons afflicted with Alzheimer's disease. Accumulating evidence suggests, however, that the neurotoxicity is actually due to the soluble forms of Aβ. Jin *et al*. have now analyzed one particular soluble form, the Aβ dimer, and its effects on neurons. Aβ dimers isolated from human brain tissue induced degeneration and cytoskeletal disruption in cultured neurons derived from embryonic rat hippocampi. Aβ monomers were not as effective. Antibodies to soluble Aβ diminished the toxic effects on neurons, lending support to an immunotherapy strategy currently in clinical trials. Soluble Aβ mediated its effects at least in part through tau, which drives the formation of the neurofibrillary tangles that are also a hallmark of Alzheimer's disease pathology. — PJH

Proc. Natl. Acad. Sci. U.S.A. **108**, 5819, (2011).



POLICY

Banking on Wetlands

A regulatory strategy adopted in many countries to promote ecosystem health (such as wetlands preservation) establishes markets in which permits issued to parties who damage ecosystems are traded for credits earned by parties whose projects mitigate damage in other ecosystems. In the United States, such mitigation efforts are undertaken by government agencies that use fees collected from permittees [in lieu fees (ILFs)]; by permittees themselves [permittee responsible mitigation (PRM)]; or by mitigation banks, private firms that conduct mitigation projects to earn credits that can be sold at market. In 2008, recognizing private banks as the lowest-risk option of these three approaches, the United States issued regulations intended to encourage banking growth. A survey of 156 mitigation professionals by BenDor and Riggsbee, however, shows that many perceived barriers persist. Although regulations were intended to streamline approval of projects, 44% of respondents reported no change in timelines. Only 48% of respondents felt that the regulations-established hierarchy of preferring banks over ILFs and PRM was actually applied. Moreover, 75% did not believe that financial risk had been reduced. The authors argue that many of these problems could be addressed by making regulatory policy-making more centralized. This could overcome what respondents perceive as excessive uncertainty resulting from fragmented regulation across several dozen jurisdictions. — BW

Environ. Sci. Policy **14**, 301 (2011).

CELL BIOLOGY

Don't Eat Me

Mitochondria, the power plants of the cell, come in a stunning variety of shapes and sizes. One reason for this is that depending on the physiological state of the cells, mitochondria can fuse with one another and then separate from one another in an ongoing process of fusion and fission. When cells are deprived of nutrients, they will often induce autophagy—a process that allows for the degradation of bulk cytosol and whole organelles, including mitochondria, to provide raw materials to maintain essential cellular activities. Gomes *et al.* wanted to understand how and whether the dynamic state of mitochondria is affected by, and in turn affects, autophagy. When autophagy was induced, mitochondria were

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observed to elongate, because mitochondrial fission was inhibited by the phosphorylation of a pro-fission protein, dynamin-related protein 1. These elongated mitochondria were able to resist autophagy and could maintain cell energetics despite nutrient deprivation. Conversely, blocking mitochondrial fusion precipitated starvation-induced cell death. — SMH

Nat. Cell Biol. **13**, 10.1038/ncb2220 (2011).

BIOMEDICINE

Exosomes Deliver

Exosomes are small vesicles secreted from cells that can carry proteins and nucleic acids between cells. Alvarez-Erviti *et al*. have exploited this process to deliver specific RNAs to target cells that lie across a major obstacle: the mammalian blood-brain barrier. Exosomes were isolated from mouse dendritic cells. In order to ensure targeting to the brain, the protein Lamb2b, which is normally expressed by dendritic cells, was tagged with a sequence from rabies viral glycoprotein that binds to a receptor expressed in brain tissue. The exosomes were loaded with small interfering RNA that targets BACE1, a protease that processes β-amyloid protein and produces the aggregates associated with Alzheimer's disease. When injected intravenously into mice, the exosomes crossed the blood-brain barrier and were taken up by brain neurons, oligodendrocytes, and glial cells, thereby decreasing the expression of BACE1 by approximately 60%. Nonspecific uptake of exosomes by other tissues was not observed, nor did the exosomes elicit an adverse immune response. The study suggests that targeted exosomes may have potential value for delivering therapeutic agents into the central nervous system to treat neurodegenerative disorders. — LC

Nat. Biotechnol. **29**, 341 (2011).

CHEMISTRY

Look Out for Traps

The intricate glassware notwithstanding, chemistry at the molecular level has traditionally been a passive activity. Trillions upon trillions of molecules are mixed together somewhat crudely, and then they are left to their own devices in the (often informed) hope that they will collide with one another in just the right way to rearrange into a desired product. With the increasing sophistication of laser technology, however, schemes have been proposed over the past several decades to manipulate the process more actively. The idea is to tailor a laser pulse in fine enough detail to steer atoms or molecules precisely along a landscape of quantum-mechanical energy states, and thereby to direct their behavior. And what should such a control pulse look like? To find out, it's often simplest to try out a few at the outset, and then keep tuning the most effective ones iteratively until the optimal outcome is attained. Analysis of this approach suggested that, if there were an optimum pulse, the iterations would proceed cleanly toward it, without becoming trapped around a local maximum in the ensemble of possible pulses. Pechen and Tannor now show mathematically that the situation is more complicated. They draw a distinction between kinematic and dynamic critical points, dealing respectively with the time evolution operator of the system subjected to the control parameter and the control parameter itself. Even when kinematic traps are absent, second-order dynamic traps can arise, as the authors demonstrate using a three-level model system. — JSY

Phys. Rev. Lett. **106**, 120402 (2011).

CLIMATE SCIENCE

Greenland's Going Rate

One of the most potentially important consequences of global warming is sea-level rise. The Greenland Ice Sheet is expected to be the source of much of the meltwater that raises sea level in the near term, but how much mass loss it will experience in a warmer future is difficult to say with confidence, due largely to the difficulty of modeling the dynamic behavior of the ice-sheet as air and sea temperatures rise. Ren *et al.* present results from a multiphase, multiple-rheology, scalable and extensible geofluid ice-sheet model that has been designed specifically with that problem in mind. Their model incorporates full Navier-Stokes equations to account for nonlocal

dynamic balance and ice flow, and a granular sliding layer between the ice and bedrock to allow large-scale surges like those that are commonly observed now. Forcing their model with monthly atmospheric conditions provided by high-resolution climate simulations, they project that the rate of Greenland Ice Sheet mass loss could reach as high as 220 km^3/year by 2100, significantly exceeding estimates by the IPCC AR4 of ~50 to 100 km^3/year, which were made without considering the dynamic behavior of the ice sheet. — HJS

J. Clim. 10.1175/2011JCLI3708.1 (2011).

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