ECOLOGY

Ocean Sanctuaries

The existence of hot spots of high biodiversity has been well documented on land and also in a few marine habitats—for instance, on coral reefs and at deep-sea vents. However, the patterns of biodiversity in pelagic ocean habitats have been harder to discern. Seamounts—mountains that rise from the ocean floor but whose summits lie well below the surface—are known to aggregate migrating pelagic fish species, but a catalog of their intrinsic biodiversity is not yet available, largely because open-ocean data have been gathered at too coarse a scale. Using records from long-line fisheries in the western and central Pacific Ocean, Morato et al. modeled and mapped the occurrences of pelagic fish species in relation to seamounts. They observed a consistent pattern of higher diversity on and around seamounts, a pattern that can be detected as far away as 30 to 40 km from the summit of a seamount; in contrast, this pattern is not seen at similar distances from shorelines. An underlying cause of this increased diversity may be the greater vertical movement and mixing of nutrients in the neighborhood of seamounts. Another contributing factor may be the seamount magnetic signatures, which are used as navigational aids by migrant species. These findings suggest that seamounts would be good candidates for the establishment of offshore open-ocean conservation areas. — AMS


CELL BIOLOGY

Breaking Out

The basement membrane is a dense extracellular meshwork of collagens, glycoproteins, and proteoglycans that surrounds most tissues in metazoans, providing structural support and regulating cell function. It acts as a barrier to the passive diffusion of molecules larger than 50 nm, but some cells possess the ability to cross the basement membrane, which is important during development, when new tissues are being formed, and during wound healing. Metastasis of epithelial tumors, which often is lethal, also requires the tumor cells first to cross a basement membrane in order to enter the blood or lymphatic vessels and thence to spread to distal sites. Thus, understanding how cell invasion occurs in vivo is important for understanding both development and disease.

During Caenorhabditis elegans larval development, anchor cells initiate uterine-vulval contact in response to cues from underlying vulval precursor cells by breaching the obstructing basement membrane. Matus et al. have combined this in vivo model system with a comprehensive RNAi screen to identify 99 genes involved in cell invasion, some of which were already known to be involved, as well as genes not previously linked to this process. Follow-up analysis of a subset of genes revealed roles in distinct stages of invasion, including the establishment of the specialized invasive membrane in the invading cell and the removal of basement membrane. Many of these genes are conserved in humans, and two of them were found to be required for the invasion of human breast and colon cancer cells in an ex vivo model, and are thus potential targets for limiting cancer metastasis. — HP


GEOCHEMISTRY

Iron’s Icy Fate

The scarcity of bioavailable iron [Fe(II)]_aq in the oceans limits primary productivity. In most marine environments, Fe(II) become available to phytoplankton only upon the reduction of Fe(III)-oxide particles added to the ocean from wind-blown dust or river outflows; however, in polar settings, a substantial fraction of iron is trapped in ice or snow before it enters the water column. Through a series of laboratory experiments and outdoor observations in Arctic ice, Kim et al. show that Fe(II) oxides in ice actually generate more Fe(II) than particles added directly to open water do. This process occurs through enhanced photoreductive dissolution of concentrated Fe(III) oxides at liquid-like ice grain boundaries, even in the presence of oxygen. When aggregated in a confined space, the semiconducting particles facilitate charge transfer much more rapidly than is possible for single particles in suspension. Therefore, Fe(III) oxides in ice or snow may ultimately contribute more to the bioavailable Fe(II) pool after melting than previously expected. — NW


CHEMISTRY

Zipping Up and Down

In general, the first step in deriving electricity from sunlight is to liberate bound charges for current flow. Once such charges are generated in a photovoltaic system, the next challenge is to insure that the carriers separate and travel all the way to electrodes for collection, rather than unproductively recombining in place. Sakai et al. report the stepwise assembly of units consisting of naphthalenediimide chromophores (tuned in gap energy to create an electron transport gradient) attached to either p-oligophenyl hole donors or

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Published by AAAS
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p-oligophenylethynyl hole acceptors. Sequential zipper assembly created stacks of several of these types of units on a gold substrate. Under irradiation with simulated solar emission, the photocurrents reached saturation at about 50 layers, indicating that long-distance carrier transport was achieved in this supramolecular construct. — PDS


DEVELOPMENT

Ratcheting Toward Closure

During Drosophila embryogenesis, there are many movements and rearrangements of cells, leading ultimately to the formation of tissues and organs. One such major morphogenetic event involves the retraction of the germ band, leaving a hole in the embryo that must be covered. Epithelial cells from both sides pull themselves up over the underlying amnioserosal layer to cover the exposed tissue in a process called dorsal closure. Because of the genetic tractability of the fly, the molecular mechanics of this event can be elucidated.

Cables consisting of actin and nonmuscle myosin participate in dorsal closure, and David et al. have probed the mechanics of cable assembly and its regulation. Apical constriction of the amnioserosa is seen to involve cyclic assembly and disassembly of apical actomyosin networks. The phase of the cycle is regulated by several PAR cell-polarity proteins; PAR complexes localized to the apical domain of the amnioserosa transiently associate with the pulsing actomyosin network. Specifically, the polarity protein Bazooka is involved in the timing of the actomyosin pulse and Par-6 and aPKC govern the interpulse periods. This work shows how polarity factors regulate actomyosin dynamics during morphological change in the developing fly. — BAP

Development 137, 1645 (2010).

BIOTECHNOLOGY

Fungal Assistance

Concerns about global warming associated with fossil fuel combustion have spurred great interest in developing alternative fuel feedstocks from renewable biomass. In order to produce liquid fuels and commodity chemical compounds from biomass, it is necessary to break down polymeric cellulose into its constituent six-carbon sugar building blocks. The cellulose in wood is mixed thoroughly with other materials (lignin and hemicellulose), and vigorous research continues to explore what sort of pretreatment methods most efficiently separate it out before the depolymerization is conducted. Approaches range from the application of acids or bases to microbial digestion. Ray et al. now show that a 3- to 4-week treatment of sapwood from pine trees with brown rot fungi—specifically, Coniophora puteana and Postia placenta—significantly enhances the subsequent release of sugars by cellulose enzymes. Controls with other types of fungi proved less effective, bolstering previous findings that brown rot may be a boon for woody biomass processing. — JSY

Biomass Bioenergy 34, 10.1016/j.biombioe.2010.03.015 (2010).