

## IN BRIEF

**BACTERIAL SECRETION****MIXing up T6SS effectors**

Type VI secretion systems (T6SSs) and their effectors can function in both pathogenesis and interbacterial competition. *Vibrio alginolyticus*, a marine pathogen that can infect humans, encodes two T6SSs, but only a single antibacterial effector, Va02265, had been described for these systems. Of note, Va02265 has a MIX domain, which was recently identified as a marker of five 'clans' of T6SS effectors with diverse toxin domains. Salomon *et al.* used proteomics in deletion mutants to identify an additional six antibacterial effectors secreted by T6SSs in *V. alginolyticus*, including two additional toxins with MIX domains. A comparative genomic analysis indicated that MIX effectors from clan V, which includes Va02265, are horizontally transferred between Vibrionales species, suggesting that T6SSs can secrete newly acquired toxins. In agreement with this, the antibacterial activity of the *V. alginolyticus* toxin Va02265 was retained when exogenously expressed in a related species, *Vibrio parahaemolyticus*.

**ORIGINAL RESEARCH PAPER** Salomon, D. *et al.* Type VI secretion system toxins horizontally shared between marine bacteria. *PLoS Pathog.* **11**, e1005128 (2015)

**FUNGAL ECOLOGY****A surprising find of far-flung fungi**

80% of land plants have symbiotic arbuscular mycorrhizal fungi, which are named after the 'arbuscule' structures that are used for nutrient exchange. Despite their ecological importance, surveys of these fungi have been limited, as these taxa are mostly unculturable, but have pointed to an endemic dispersal pattern. However, Davison *et al.* now use high-throughput sequencing of 836 samples from 161 host plant species to show that many arbuscular mycorrhizal taxa are cosmopolitan, with 34% of taxa found in all six sampled continents. Furthermore, 93% and 90% of taxa were found in more than one continent and climatic zone, respectively, suggesting that the level of endemism is far lower than expected. A phylogenetic analysis showed that long-distance dispersal of these fungi is recent; the authors suggest human activities, birds, seawater, wind and dust storms as possible dispersal agents.

**ORIGINAL RESEARCH PAPER** Davison, J. *et al.* Global assessment of arbuscular mycorrhizal fungus diversity reveals very low endemism. *Science* **349**, 970–973 (2015)

**TECHNIQUES & APPLICATIONS****Lighting up intestinal anaerobes**

Intestinal commensals inhabit an anaerobic environment where conventional fluorescent protein tags are not functional. Now, Kasper and colleagues use bacterial biosynthesis and click chemistry to fluorescently label the polysaccharides that are shed from the capsules of commensal bacteria. As a first step, cultures are grown with an azide-modified sugar substrate of polysaccharide biosynthesis; next, click chemistry is used to covalently attach fluorescent dibenzocyclooctyne derivatives to the azide group. Application to *Bacteroides fragilis* showed that the label had no measurable effect on bacterial growth, carbohydrate metabolism or immunomodulation. The authors demonstrated that this method can be applied to *in vivo* imaging of host–anaerobe interactions, using intravital two-photon microscopy and non-invasive whole-body imaging to monitor *B. fragilis* in a mouse model of abscess formation and during colonization in germ-free mice.

**ORIGINAL RESEARCH PAPER** Geva-Zatorsky, N. *et al.* *In vivo* imaging and tracking of host–microbiota interactions via metabolic labeling of gut anaerobic bacteria. *Nat. Med.* **21**, 1091–1100 (2015)