NUS National University of Singapore | Department of Biological Sciences, Faculty of Science

BIOLOGY COLLOQUIUM

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Hosted by Dr Darren Yeo

PEAT SWAMPS AND OIL PALMS: A TRAGEDY IN OUR TIME

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Over half the world's tropical peat swamp forests occur in Indonesia and Malaysia. They are unique, highly biodiverse, extreme and rapidly vanishing ecosystems with trees up to 70 m tall. Organic detritus builds up in waterlogged conditions over thousands of years forming acidic (pH typically 2.9-4.5), toxic, nutrient poor, anaerobic layers of peat up to 25 m deep, sequestering globally significant stores of carbon. Peat accretion results from the inhibition of litter decomposition because leaves of peatswamp flora are highly sclerophyllous and toxic with high levels of phenolic compounds - adaptations to deter herbivory in the low nutrient habitat. Acidity and waterlogging enable plants to increase their phenolic content because they absorb low molecular phenolic acids leached from litter. Conversely, disturbed peatswamps have lower phenolic levels, and there is lower uptake by plants, altering ecosystem functioning. Most regional peat swamp forests have been destroyed or degraded by logging, drainage and fire – mostly for conversion to oil palm. This results in release of carbon >10% of world fossil fuel emissions due to gaseous and particulate fire emissions, as well as fluvial loss of dissolved carbon as the blackwaters are drained. Our metagenomic studies show that regional peat swamp forests support distinctive microbial communities (possibly over 40% novel species or strains) that differ from those of other wetlands, including temperate peatlands. The microbes control the decomposition of plant matter, and consequently their activities are crucial to the formation of peat and sequestration of carbon. Peatland drainage, fires and agricultural conversion alter the microbial communities, causing peat decomposition, peat subsidence and globally detectable carbon emissions – particularly of methane and carbon dioxide. Increasing disturbance progressively enhances microbial activity and peat oxidation leading to escalating CO2 release until the peat is entirely gone, resulting in flooding and exposure of non-arable soils.