

Biodiversity - 2015: Microbial diversity of a remote aviation fuel contaminated sediment of a Lentic ecosystem in Ibeno, Nigeria

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Abstract

Environmental pollution due to oil and gas exploration and production (O&G E&P) wastes disposal and oil spills following several decades of irresponsible practices and neglects by the operating companies and over-dependence of government on the oil sector remains the major problem in the oil-producing communities in Nigeria. Studies to ascertain the ecological status of a remote Aviation fuel-contaminated sediment of a lentic ecosystem in Ibeno, Nigeria, have been carried out using standard microbiological culture - dependent methods which captures only <1% of all microorganisms present in a sample. The results from these studies were therefore inaccurate and grossly misleading. In this study, sediment samples from this lentic ecosystem in Ibeno, Nigeria previously polluted by Aviation fuel in 2001 (about 14 years ago) were collected and analyzed to assess its microbial diversity using standard microbiological culture - dependent techniques as well as the use of metagenomic techniques involving community DNA extraction, sequencing and bioinformatics analyses. Standard microbiological culture - dependent techniques revealed the presence of only six (6) genera of bacteria and four (4) genera of fungi. The results of metagenomics studies of same sample revealed that the ecosystem harbors complex microbial consortia as shown by the phylogenetic dendrogram to include members of the bacterial, archaeal and eukarya genera. These results corroborate the 'great plate count

anomaly' principle and demonstrate that the use of metagenomic techniques will redefine the actual ecological status of the environment.

The Nigerian economy relies heavily on the revenue derived from the oil sector, as they supply 70% of state revenue and about 95% of exchange earnings. The nonchalant attitude of the oil operating companies in their improper ways of oily wastes disposal, intermittent oil spillages, relatively underdeveloped technology for spill prevention and response measures, and insufficient local capacity and political will power of state to stem the spate of incessant oil spill incidents in Nigeria, all end in increased risks of oil pollution and environmental degradation. Oil and gas reserves in Nigeria are concentrated within the Niger Delta region of the country, and have attracted the presence of multinational oil companies to the world. The Niger Delta region consists of nine states with Akwa Ibom State because the highest oil-producing state and thus attracts the very best financial allocation from the federal. Ibeno government Area hosts the operational base of Mobil Producing Nigeria Unlimited (MPNU), a subsidiary of Exxon Mobil and Qua Iboe Terminal (QIT). Thousands of barrels of oil are spilt into the environment through oil pipelines bursts and oiler accidents within the country since the inception of oil activities, partly as a result of lack of normal maintenance of the oil installations e.g., pipelines replacements after they out-lived their installed lifespan and partly due to sabotage and other causes like oiler

accidents. Notably, a number of these facilities are in use for many years without replacement . for instance , in 2004, an abandoned oiler at Oloibiri, Bayelsa State released about 20,000 barrels of oil into the environment and evidence proved that the well had been leaking for several years without response from the operating company . In January 1998, 40,000 barrels of petroleum from Idoho production platform of Exxon Mobil was spilt into the environment and caused severe damage to the whole Nigerian coastline . Between 1997 and 2001, about 2,097 oil spill incidents were recorded in Nigeria . Oil spill cases occur daily and in most cases quite once during a day within the Niger Delta region of Nigeria. On 8th August 2001, Exxon Mobil's aviation fuel pipeline ruptured releasing about 1000 barrels of aviation fuel into a lentic ecosystem in Inua Eyet Ikot village, Ibeno, Akwa Ibom State. Dispersant was used because the only remedial measure to contain the spill. Microbial diversity of the spill site is monitored using the culture-dependent methods which is understood to reveal only <1% of the microbial population . These results are unrealistic and therefore do not present the true ecological status of the site. Fourteen years after the spill, the ecological integrity of the site is questionable and appropriate remediation action can not be carried out. In conclusion, as low as six species of bacteria with no archaeal representative were detected from the conventional culture-dependent techniques while the 16S metagenomic analysis detected a total of 718 microbial species comprising both bacterial and archaeal diversity. Comparing the efficiency of both approaches adopted, this study confirms and thus supports the "great plate count anomaly" as well as support the adoption of the 16S metagenomic and other complimentary OMICS tools to investigate the true ecological integrity of any investigated environment.

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