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SHORT-TERM EFFECT OF DIESEL OIL ON PHYTOPLANKTON SPECIES IN GREAT KWA RIVER MANGROVE SWAMP, S. E. NIGERIA

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ABSTRACT

Short-term effect of Nigerian diesel oil was tested on the phytoplankton species in Great Kwa River mangrove swamp for 72 hours. *Coscinodiscus excentricus* showed a great enhancement in growth by increasing tremendously from 7 cells/ml to 16 cells/ml 24 hours after pollution while *Hydrodictyon sp*. decreased from 5 cells/ml to 2 cells/ml. *Rhizosolenia obtuse* and *Dictyocysta dilatata* showed intermediate growth enhancement by appearing 48 hours after polluting the site. *Anabaenopsis raciborskii*, *Closterium stirogosum* and *Spirotaenia condensata* were the most sensitive to diesel oil as they never appeared in the 72 hour sample. The present study reveals that these phytoplankton species can recolonize a diesel polluted area with time, and thus be used as bioindicators for pollution monitoring

KEY WORDS: Diesel Oil, Phytoplankton Species, Mangrove Ecosystem, Great Kwa River, Nigeria.

INTRODUCTION

The intertidal swamp of the mangrove community provides a variety of different substrate and different micro-habitat to support a more diverse community of aquatic species. Some benthic organisms attach to the mangrove roots; others reside in or on the mud-flat or mud-bank (Ewa-Oboho and Abby-Kalio, 1993; 1994 and 2006). Apart from the benthic organisms, planktonic organisms such as phytoplankton and zooplankton also occur in mangrove ecosystem (Castro and Huber, 2005).

According to Lalli and Parson (1997), the primary producers in the mangrove ecosystem include not only the mangrove themselves, but benthic algae, sea-grasses and phytoplankton species. Only a few pollution studies have been conducted in mangrove ecosystem because they are difficult environment in which to work on.

Phytoplankton is the basis of aquatic productivity and fishery productivity in general as fish depends directly or indirectly on phytoplankton (Castro and Huber, 2005). Phytoplankton is a primary producer in the aquatic environment. Plant life is the basis of all makes this fundamental contribution by photosynthesis, utilizing radiant energy to synthesize food from inorganic sources (carbon dioxide and water), organic compounds of high potential energy. They contribute directly to the food production, and food availability in the surface waters directly depends on them. Each animal in the sea is directly or indirectly dependent upon this production by phytoplankton.

The Great Kwa River is one of the major tributaries of the Cross River estuary which empties into the Atlantic Ocean. A distinctive feature of the surrounded vegetation is the dominance of mangrove, which covers and estimated 2000 hectares of land in the Cross River estuary (Nawa, 1982). Industrial effluent, municipal sewage and waste water are probably being discharged untreated into the estuary and the upstream rivers (Enin, 1997). Furthermore, offshore petroleum production facilities are located adjacent to the mouth of the estuary. Small scale oil spills and leakages from these facilities are washed into the Estuary and the adjoining mangrove vegetation by tides and through adverse effect at the lower trophic levels (Enin, 1997).

Oil pollution in our water body has become a major source of concern in the last decade. This has spur researchers to investigate their impacts on aquatic biota and water quality. The present study intends to look at the impact of diesel oil spills on plankton population in a mangrove ecosystem adjoining the Great Kwa River, S.E Nigeria.

MATERIALS AND METHODS

The Study Area

The area of study is the Great Kwa River, which is one of the major tributaries of the Cross River estuary. The Great Kwa River takes its rise from the Precambrian base complex of Oban hills in South Eastern Nigeria, and has an estimated length of about 56km from the mouth of the Cross River estuary. According to Akpan *et al*, (2002), the Great Kwa River is located between latitude 4^{0}45'N and longitude 8^{0}20'E. The water is usually turbid with much suspension of detritus especially during the rainy season.

Fish species commonly exploited from the Great Kwa River is the *Macrobrachium* species; the shoreline which is composed of muddy substrate, is usually dominated by crabs and some gastropod mollusc. Prevalent in the area is also the occurrence of *Periophthalmus babarus,* commonly known as the Mud Skipper.

Anthropogenic activities going on the area include sand mining, deforestation which involves the cutting down of trees for constructing fish fences. The area is one of the busiest fishing grounds in the West Coast Africa. However, commercial sand mining activities is currently going on there.

Sampling Methods

A pond with (1.5 x 1.5 x 1)m was constructed in the intertidal area of the mangrove swamp adjoining the Great Kwa River. The pond was allowed to stand for three (3) days to give room for phytoplankton growth. An estimated water volume of about 20 litres filled the pond during flood tide.

Three (3) days after the pond was constructed, water samples were randomly collected from the pond, filtered with 0.2m mesh-size plankton net and the residue was stored with

Water samples were thereafter collected from the polluted pond after every 24 hours, for 72 hours (i.e. 3 days). Each water sample was treated as discussed above before being taken to the laboratory for analysis.

Laboratory Methods

After filtering out some phytoplankton samples using 0.2µm plankton net and fixed using 4% formaldehyde, each plankton sample was de-concentrated in a 40mls plankton container. 1ml of the homogenized sample was thereafter collected using a Pasteur pipette and emptied into plankton counting chamber before allowing settling for about 10 minutes.

Standard literature like Newell and Newell (1977) and Sharma (1986) were used to aid identification under a 10x magnification microscope. Each of the identified species was expressed numerically and classified accordingly into its respective phytoplankton class.

RESULTS

Table 1 represents phytoplankton species before and after diesel oil pollution of the study site. Seven (7) species of phytoplankton were collected throughout the study period. These phytoplankton species were classified under three (3) classes. The species of phytoplankton observed include: *Coscinodiscus excentricus* (Bacillariophyceae), *Rhizosolenia obtuse* (Bacillariophyceae), *Dictyocyst dilatata* (Bacillariophyceae), *Anabaenopsis raciborskii* (Cyanobacteria), *Hydrodictyon reticulatum* (Chlorophyceae), *Closterium Stirogosum* (Chlorophyceae), *Spirotaenia condensata* (Chlorophyceae).

Before pollution of the dugged pond with diesel oil, all the seven (7) species were observed in the study site. However, *Coscinodiscus excentricus* had the highest numerical abundance of 7 cells/ml while *Spirotaenia condensata* had the least numerical abundance of 1 cell/ml.

Twenty-four (24) hours after the dugged pond was polluted with diesel oil, it was only *Coscinodiscus excentricus* and *Hydrodictyon reticulatum* that were observed in the sample. *Coscinodiscus excentricus* had an increase numerical abundance of 16 cells/ml while *Hydrodictyon reticulatum* had a decreased dilatata (4 cells/ml) and Hydrodictyon reticulatum (2 cells/ml) re-colonized the area. The three (3) other species were absent from the polluted pond.

Seventy-two (72) hours after pollution of the pond, all the phytoplankton species re-appeared in the study site, though with their respective numerical abundance. Detail of the respective numerical abundance is shown in table 1.

TABLE 1.0: PHYTOPLANKTON SPECIES BEFORE AND AFTER DIESEL OIL POLLUTION

Class	Species	Before Pollution	After Pollution		
		24 hours	24 hours	48 hours	72 hours
Bacillariophyceae	*Coscinodiscus sp.*	7 cells/ml	16 cells/ml	6 cells/ml	3 cells/ml
	Rhizosolenia sp.	3 cells/ml	-	4 cell/ml	2 cells/ml
	Dictyocysta sp.	3 cells/ml	-	4 cell/ml	1 cell/ml
Cyanobacteria	*Anabaenopsis sp.*	2 cells/ml	-	-	2 cells/ml
Chlorophyceae	*Hydrodictyon sp.*	5 cells/ml	2 cells/ml	1 cell/ml	2 cells/ml
	Closterium sp.	4 cells/ml	-	-	1 cell/ml
	Spirotaemia sp.	1 cell/ml	-	-	1 cell/ml

DISCUSSION

Sometimes 24 hours before the introduction of the diesel oil into the dugged pond in the sampling site, all the seven species of phytoplankton were present. However, after diesel oil pollution, there was a marked increased in *Coscinodiscus excentricus* number of cells from 7 cells/ml to 16 cells/ml after the diesel oil pollution. This may be as a result of *Coscinodiscus excentricus* being able to utilize the diesel oil as a source of nutrient. Murday *et al*., (1988) earlier reported that blue-green algae exhibited a bloom after spill on Escravos mudflat. After assessing the toxicity of crude oil to fresh water algae, Akpan *et al.* (1998) also reported that *Brotryococcus bunni* and *Sphaerocytis aerugomisis* exhibited growth enhancement. Other species disappeared from the area indicating sensitivity, while *Hydrodictyon reticulatum* reduced to 2 cells/ml. The reason for the disappearing of other phytoplankton species can be inferred that amongst the seven species of phytoplankton recorded in the area, only *Coscinodiscus excetricus* could thrive in this low oxygen environment, and same *Hydrodictyon reticulatum*. Apart from this, it can also be possible that microbial oil decomposers used up the available oxygen thereby reducing the concentration of dissolved oxygen that would have supported phytoplankton growth (Clark, 1992). After assessing the effect of a spill of marine diesel on the meiofauna of a sandy beach at prince bay, Hong Kong, Wormald (1976), observed a drastic decrease of nematode population.

After 48 hours of pollution, other species such as *Rhizosolenia obtuse*, *Dictyocyst dilatata* and *Hydrodictyon reticulatum* were observed in the area. Apparently, there must have been a reduction in the concentration of the diesel oil with time through evaporation and washing away by tides. Clark (1992) also earlier reported that the fact that the pond might have been so diluted during flood tide and the effect of the diesel oil now had become minimal.

The present studies have shown that phytoplankton species differ considerably in their sensitivity to diesel oil pollution. It is also inferred that phytoplankton species can recover from the stress of diesel pollution with time if the pollution is not chronic. This study revealed that these phytoplankton species can potentially be used as bioindicators of diesel oil pollution.

REFERENCES

Akpan, E. R., Ekanem, S. B. and Odaro, J. G., 1998. Toxicity of crude oil to fresh water algae. African Journal of fisheries and Aquaculture 1, 56-61.

Akpan, E. R., Offem, J. O and Nya, A. E., 2002. Baseline ecological studies of the Great Kwa River, Nigeria: Physico-chemical studies. Afr. J. Environ. Pollut. Health 1 (1): 83-90

Castro, P. and Huber, M. E., 2005. Marine biology. McGraw-Hill Companies Inc., New York. 466pp.

Clark, R. B., 1992. Marine pollution. Garden Press, Oxford. 169pp.

Enin, U. I., 1991. The Cross River Estuary as a model for integrated coastal zone management in Nigeria Trans. Nig. Soc. Biol. Conserv. 15: 16-23.

Ewa-Oboho, I. O. and Abby-Kalio, N. J., 1993. Seasonal variation and community structure of Epibenthic Algae on the root of mangrove Rhizophora mangals at a shallow Tropical Estuary. Tropical Estuary 34 (2): 160-173.

Ewa-Oboho, I. O. and Abby-Kalio, N. J., 1994. Effects of simulated oil Exposure on Two intertidal macro-zoa Benthos. Typanotomus Fuscata (L) and Uca tangeri (Eydoux, 1935) in a tropical Estuary Ecosystem. Ecotoxicology and Environmental safety 28: 232-243.

Ewa-Oboho, I. O. and Abby-Kalio, N. J., 2006. Theoretical Basis of Allometric Relationship in Juvenile Brachyra Data From a West African mangrove swamp crab population West African Journal of Applied Ecology. 10:35-45.

Lalli, C. M. and Parsons, T. R., 1997. Biological Oceanography. an introduction (2ed). Butterworth-Heinemann, Oxford 314pp.

Murday, M. J; Murday, J. H., Sezton, W. J. and Powell, C. B., 1988. Atlas of Environmental sensitivity of spilled oil from operational Areas of Gulf oil company (Nig) Limited. Chevron Overseas Petroleum Inc, San Ramon, USA.

Nawa, I. G., 1982. Ecology of Cross River Estuary PhD Thesis, University of Kiel, Germany 148pp.

Newell, G. E. and R. C. Newell, 1977. Marine *Plankton*: a practical guide, (5th Ed) Hutchinson and Co. (publishers) Ltd, London 245pp.

Potter, A. D., 1973. Pollution. A study in survival palm publishers, Canada 676 pp.

Sharma, O. P., 1986. Text book of algae. McGraw-Hill publishing Company Limited, New Delhi; 346p.

Wormald, A. P., 1976. Effect of a spill of marine diesel on the meiofauna of a sandy beach at prince bay, Hong Kong, Environmental pollution. 11: 117-130.