Amphibians recorded in forest swamp areas of the River Niger Delta (southeastern Nigeria), and the effects of habitat alteration from oil industry development on species richness and diversity

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Abstract. The Niger Delta (Southern Nigeria) is the main oil-producing region in sub-Saharan Africa. Its biodiversity is very important for the concomitant presence of rainforests and mangroves, and many endemic flora and fauna. Six sites in southern Nigeria, four currently affected by oil industry development but formerly inside the rainforest belt and two in pristine protected areas, were surveyed for amphibians during 1996-2002, in both dry and rainy seasons. Amphibian species diversity was reliably assessed at all study sites, as shown by species accumulation curves. The total number of species found in the two pristine sites was much higher than that found in the four developed sites. Nevertheless, a total of over 6300 amphibian specimens belonging to 28 species were captured at these four sites. Species included three Bufonidae (genera Bufo and Nectophryne), two Pipidae (Silurana and Hymenochirus), nine Ranidae (Hylarana, Ptychadena, Aubria, Conraua, Hoplobatrachus, and Phrynobatrachus), one Arthroleptidae (Arthroleptis), one Rhacophoridae (Chiromantis), one Microhyliidae (Phrynomantis), and eleven Hyperoliidae (Hyperolius, Afrixalus, Leptopelis, Phlyctimantis, and Opisthothylax). The four developed study sites were similar in terms of species composition; the most common species were Silurana tropicalis (accounting for about 74% of the total number of specimens captured), Bufo maculatus, Ptychadena spp., Hylarana albolabris, Hoplobatrachus occipitalis, Hyperolius cf. concolor and Afrixalus dorsalis. Greater numbers of species and individuals were captured in the rainy season than in the dry season. In terms of chemo-physical properties of the water at their breeding sites, both adult and larval anurans of several species (e.g., Silurana, Bufo and Ptychadena) were highly adaptable, being able to thrive in anoxic and slightly acidic water with dissolved oxygen from 0.50-1.50 mg l−1 and pH from 5.9-7.2.

Key words: Amphibians; biodiversity; community composition; habitat alteration; Nigeria; oil industry; pollution.
**Introduction**

Petrochemical industry activities may produce serious environmental pollution, which may have strong negative effects on wildlife because of long persistence in the environment, with bioaccumulation through the food chain and resulting toxic effects (Fu et al., 2003). These pollutants may also be carried long distances by air, rivers and ocean currents to contaminate regions remote from the source. Although much petrochemical industrial activity occurs onshore, very little is known about the effects of this pollution on terrestrial organisms, and hardly anything is known about its consequences for amphibians. However, amphibians can be expected to be seriously affected by this type of pollution, because their larvae feed off both the substrate and attached algae, and continuously process water for respiration. Amphibians are thus exposed to a wide variety of pollutants including dissolved toxins, airborne pollution and sediment contamination (Hall and Mulhern, 1984; Luiselli and Lea, in press).

Petroleum-laden effluents may produce serious problems in natural environments because they are strongly persistent: for instance, petroleum residues that impact on organisms were still present in the sediment of a Louisiana waterway more than 25 years after the discharge of petroleum wastes had been discontinued (Anderson et al., 1997). With regard to amphibians, if tadpoles accumulate these substances in their gills then gaseous exchange and the regulation of ion fluxes could be affected, while in metamorphs or adults these poisons could affect cutaneous respiration, osmoregulation and other processes. The toxic effects may or may not be lethal, but even if they only impact slightly on resource acquisition or energy allocation then growth, reproduction, and ultimately populations could suffer. Such non-lethal effects of pollution have been demonstrated in *Rana catesbeiana* tadpoles (Rowe et al., 1996). Among the most persistent petrochemical pollutants is lead, with a half-life in soils of about 20 years (Nriagu, 1978).

There are few data on the direct effects of oil pollution on amphibians except for the studies by Alexander et al. (1981) and Lefcort et al. (1997) on tiger salamanders. The latter found that larvae living in silted and oil-polluted ponds metamorphosed earlier and at a smaller size than those living in pristine ponds. Therefore, these stresses on larval growth and development can profoundly alter adult population structure. Given the regularity of pipeline oil leaks or sabotage in many third world countries (such as Nigeria), one must assume that oil pollution probably directly affects many amphibian populations.

There are also negative consequences of airborne petrochemical pollution, including those on amphibians (Naidenko and Grechkanev, 2002). This situation is likely to be reflected in many ecologically sensitive areas in the world where petrochemical production occurs. These emissions are taken up by vegetation and eventually find their way into the soil to be accumulated by organisms that participate in the destruction and mineralization of proteins and carbohydrates (Khot’ko and Vetrova, 1982). As amphibians are predators of soil entomofauna, they are likely to build up