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ORIGINAL ARTICLE

# Update of ichthyofauna diversity and ecological status of a coastal River Nero (Côte d'Ivoire – West Africa)



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**Abstract** The general aim of this study is to update the inventory of the fish species and to specify distribution patterns in the Nero River ichthyofauna in order to establish some basis for the conservation of these fish communities and their habitat. From February 2009 to January 2010, thirty-three sites were sampled monthly with gill nets and a backpack electrofisher, and environmental variables were recorded. Overall, 46 species included in 33 genera, 24 families and 9 orders were collected. Eleven families and 30 species were the first records for the Nero River. Including all species previously listed in the literature, the number of species presently known in the Nero River and its tributaries is revised to 59. Four families, Alestidae (21%), Schilbeidae (19%), Cyprinidae (17%) and Cichlidae (16%) that made up 73% of the total number of the catches, were the most dominant. The most dominant numerical species were *Schilbe mandibularis* and *Brycinus longipinnis*. Fish species and sampling sites along with eight environmental variables were ordinated with canonical correspondence analysis (CCA) coupled to the Monte Carlo test. Ecological status based on fish assemblage according to environmental variables and anthropogenic pressures showed that miss dead wood leaves and roots, electrical conductivity, total dissolved solids, mud, nitrite, basin width, dissolved oxygen and pH, were the primary factors influencing fish distribution. The environmental tolerance index (ETI), ecological tolerance ( $t_k$ ) and optima ( $u_k$ ) values of 10 species to 8 different environmental variables were analyzed. Six species (*Hemichromis fasciatus*, *Epiplatys chaperi*, *Barbus ablabes*, *B. longipinnis*, *Hemichromis bimaculatus* and *Chromidotilapia guntheri*) have high ETI and a cosmopolitan distribution in the Nero River. In the tributaries of the middle

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course, high concentrations of nitrite in the water, added to the presence of a lot of tolerant species in the ichthyofauna are indications of disturbance of these areas. Subsequent recommendations were formulated for efficient restoration and conservation management of this River.

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## 1. Introduction

Despite vast arid areas, Africa possesses extremely diverse freshwater systems (Lemoalle, 2006). Since the 18th century, ongoing ichthyofaunistic surveys were conducted in most of the basins (Lévêque and Paugy, 2006a, b).

Freshwater fish represent an important component of the aquatic ecosystem and are highly valued for their economic, social and aesthetic importance (Dirican et al., 2012). Fish are already involved in environmental policies as biodiversity and ecological quality indicators (Kestemont et al., 2000; Schmutz et al., 2007) and they have been used successfully in biogeographical studies, ecoregion delineations (Abell et al., 2008), conservation evaluations (Moyle and Randall, 1998) and assessments of ecologically acceptable water regime management (Jowett, 1997).

In Côte d'Ivoire, the investigations have yielded the publishing of several papers (e.g. Daget and Iltis, 1965 on Côte d'Ivoire freshwater rivers and Coastal estuarine basin fish; Paugy et al., 1994 on fish biology and diversity in West Africa rivers; Gourène et al., 1999 on the impact of hydroelectric dams on fish communities in Ayamé lake; Koné et al., 2003a,b on Gô and San Pedro Rivers; Kouamélan et al., 2003 on Boubo River; Yao et al., 2005 on Comoé River; Konan et al., 2006; Aboua et al., 2010, 2012 on fish communities and biotic index integrity of Bandama River) and an increase in the knowledge on the ivoirien ichthyofauna. Those studies have also explored the relationships between fish communities and environment factors. These studies have also helped to enumerate more than 153 freshwater species and subspecies of fish grouped into 71 genera, 28 families and 11 orders in various habitats (Gourène and Ouattara, 2010; Paugy, 2009).

However, ichthyological data are subject to numerous changes inherent to the description of new species, taxonomic revisions, improvement of sampling methods and anthropogenic disturbances. As a result, periodic updates of these data are required. It is in this context that the present study which focuses on the Nero River (Côte d'Ivoire, West Africa) was conducted. Also, for all policy development decisions, preservation of aquatic ecosystems should be based on the knowledge of fish populations and their habitat.

This river flows throughout agro industrial rubber and palm oil plantations where human activity is very intense (e.g. use of ichthyotoxin, discharges of household agriculture, and industry taking with it the reduction of spawning areas and food sources).

The available publications dealing with the species sampled in the Nero River are from Teugels et al. (1988) and Paugy et al. (1994). As Consequences, 22 and 28 species of fish were collected in this river, respectively. But, all these research were mainly based on the collections of fishes housed in Muséum National d'Histoire Naturelle (Paris, France) and in the Royal

Museum for Central Africa (RMCA) (Tervuren, Belgium). Also, those publications did not address the question of patterns of neither distribution nor abundance of fishes.

As part of the project entitled "Characterization, utilization and conservation of freshwater fish biodiversity in Côte d'Ivoire", the current study aimed to describe the fish community of the Nero River under anthropic influences in terms of its composition, distribution and influences of environmental factors.

## 2. Materials and methods

### 2.1. Study area and sampling sites

The Nero is a small coastal river (985 km<sup>2</sup> catchment area; 80 km length) (Iltis and Lévêque, 1982) located in the southwestern Côte d'Ivoire (Fig. 1). It rises at the edge of the Tai National Park and the Haute Dodo Classified Forest and flows southward to enter Atlantic Ocean close to Grand-Berebi town. The climate of the studied areas is typical of humid equatorial climate with four seasons, two dry (August–September and December–March) and two wet (October–November and April–July) season (Fadika et al., 2008). According to the ecological features of the river, three zones were distinguished along the upstream–downstream gradient: (1) the upper reaches (F7–F9 and P17–P24), the Nero river flows into the protected forest reserve where canopy closure was very high (80–90%), (2) the middle course (F4–F6 and P9–P16) is located throughout agro-industrial complexes including rubber industries and banana, palm tree, coffee, cocoa, rice and rubber tree plantations, (3) the lower zone (sites F1–F3 and P1–P8) in which the river flows through an urban agglomeration populated with the presence of towns and villages (Grand-Berebi, Kako village, Mami Berebi) before emptying into the Atlantic Ocean. Human activities occurred mostly in the middle and lower courses of the Nero River.

### 2.2. Data collection

Two types of complementary data (ichthyological and environmental data) were simultaneously collected during monthly campaigns performed from February 2009 to January 2010. A total of 33 sampling sites were collected along the Nero River (Fig. 1). A battery of 17 weighted monofilament gill-nets (bar mesh sizes 8, 10, 12, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 80 and 90 mm), each measuring 30 m long by 2.5 m deep, were used in the deep areas in the main channel (sampling sites F1–F9). In each sampling site, nets were set between 5.00 pm and 7.00 am for night fishing, and between 7.00 am and 12.00 am for day fishing. A backpack electrofisher (Smith-Root Inc. Model 12 Pow) was used in shallow waters in the tributaries (sampling sites P1–P24). Electrofishing was

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