Longitudinal zonation of lotic insects in the Bandama River system (Ivory Coast)

Francois Marie Gibon[1] & Bernhard Statzner[2]
[1]*O.R.S.T.O.M., Hydrobiologie, 24 rue Bayard, F-75008 Paris, France*
[2]*Zoologisches Institut I, Universität (T.H.), Postfach 6380, D-7500 Karlsruhe, F.R.G.*

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Abstract

The longitudinal zonation of three lotic insect groups, viz. Hydropsychidae (Trichoptera), Philopotamidae (Trichoptera), and the *Simulium damnosum* complex (Diptera) in the Bandama River system (West Africa) is anomalous when compared to the patterns known from other geographical areas: In general from the highest to the lowest riffles downstream there appears to be no clear species replacement. Instead, there is a steady increase of species numbers due to the occurrence of additional species. These distributions are related to the gradient in the length of the period without flow from the north (temporary streams) to the south (permanent running waters), the consequent lack of well-defined sources and the relatively gentle slopes of the channels.

Introduction

Recently Lévêque *et al.* (1983) evaluated the longitudinal zonation of the macrofauna in the Bandama basin, a river system extending about 1000 km from north to south through the Ivory Coast (West Africa). They distinguished three zones: (1) headwaters and small affluents, (2) a considerable, long mid-reach, which was relatively uniform and (3) a relatively short lower reach (estuary). With regard to invertebrates the mid-reaches in the main courses of the Bandama basin were mainly characterized by the caddisfly family Hydropsychidae, particularly by *Cheumatopsyche falcifera* and *C. digitata* at periods of low discharge (see Fig. 15 and 16 in Lévêque *et al.*, 1983).

This is an odd zonation pattern compared to those found in other geographical areas (Illies & Botosaneanu, 1963; Hawkes, 1975; Botosaneanu, 1979). A recent study of the taxonomy and the distribution of the Hydropsychidae in the Ivory Coast (Statzner, 1984; Statzner & Gibon, 1984) allows a more detailed definition of the above zonation. Results on Hydropsychidae and two other lotic insect groups so far available, the caddisflies Philopotamidae (Gibon, 1984) and the blackflies of the *Simulium damnosum* complex (Vajime & Quillévéré, 1978; Quillévéré, 1979 and person. commun.) give evidence, that the long mid-reaches exhibit no uniform faunistic stream zone.

Methods and the area studied

The papers mentioned in the introduction, as far as they deal with the Ivory Coast, contain detailed information on the methods used and the area studied. Thus only the essentials will be briefly reviewed here.

The distribution patterns of the:

(1) *Simulium damnosum* complex are exclusively based on benthic samples from 35 localities,
(2) Hydropsychidae are mainly based on benthic samples, for some localities additional information from light trap samples was available. Only a few places were surveyed by light trap

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sampling. The number of sampling stations in the Bandama basin exceeded 50,

(3) Philopotamidae are exclusively based on light trap samples, since there are still unsolved problems in the larval taxonomy. 31 localities were considered in the Bandama basin.

8 monitoring points in the Bandama system were sampled for Trichoptera at monthly intervals over more than one year, and therefore more information was available for them than for the other stations. The main courses of the Bandama basin were more intensely studied than the smaller affluents. The differences in the sample techniques, discussed in detail by Statzner (1984), lead us to treat the results as follows: even if a species was missing at a certain locality it was considered to be 'present' there, if we found it north and south of this locality in the appropriate affluent at some time. Thereby we exclude the north-south-north-shifts of species (Quillévéré, 1979; Elouard, 1983), related to the climatic annual cycle, from our considerations, and deal with the 'maximal distribution' reported in any of the above groups. It should be noted that the uppermost distribution limits of the Trichoptera species are less precise (Statzner, 1984), since (1) it was not always possible to sample the northern parts of the streams due to cessation of the flow and (2) no samples were available from the upper Bandama and upper N'Zi from the period before regular insecticide treatment of these stream reaches were introduced through the Onchocerciasis Control Programme. The latter may have affected the presence of Macronematinae in those regions. No data exists from the period before the construction of the Kossou reservoir. We assume that the species composition in the reach now dammed was similar to that we found upstream of the lake. Taabo reservoir was build after the entomological sampling programme in the area.

The most obvious longitudinal gradient in the abiotic factors of the Bandama system is to be found in the discharge pattern. On average the northernmost streams in the basin are running waters for only just over half the year. In the southern direction the period without flow becomes shorter and shorter, until the stream is a permanent one. Due to large variations in the annual climate the periods without flow as well as the borderline between temporary and permanent stream are not fixed. In stream reaches in which flow ceases water usually remains in pools during the dry season.

Thus, in contrast to nearly all streams so far studied with regard to the longitudinal zonation of the macrozoobenthos, the main channel and all its large affluents do not start with a well-defined source. Therefore, for most of the year, all streams originate in a lower reach where the slope is gentle.

Compared to the key factor 'discharge pattern' all other abiotic factors so far considered as important in stream zonation studies exhibit relatively weak longitudinal gradients in the Bandama system (Lévêque *et al.*, 1983).

Results and discussion

The longitudinal distribution of the three groups under study (coded in Table 1) gives evidence that the 'zone à Hydropsychidae' sensu Lévêque *et al.* (1983) is not homogeneous in the Bandama River system (Fig. 1). In smaller streams situated west (Niouniourou) or east (Agneby) of the Bandama these three lotic insect groups extend further south than in the Bandama itself, where no rapids occur in the lower reach.

In the main courses of the Bandama basin a steady increase in the species number was generally observed from north to south and almost no loss of northern species on the way south downstream to the lowest riffles of the Bandama. If a species disappears on the way south in the 'zone à Hydropsychidae' it is certainly a rare one, e.g., *Aethaloptera sp.* (2), *Polymorphanisus sp. I* (3) and *II* (4), or *Protomacronema pubescens* (K). The latter was found further south in other stream systems. Apparently major changes in the Trichoptera distribution take place at locations sampled at monthly intervals over a longer period (monitoring points!), and isolated occurrences were usually reported from these localities. The distribution patterns of these rare or isolated species are rather uncertain. The smaller affluents of the Bandama basin contain a fauna similar to that of the headwaters of the main rivers of the system. The example included in Figure 1 is a combination of data from various tributaries studied at various distances from the main courses and therefore represents an ecological and not a purely geographical classification. A typical species of small tributaries is *Macrostemum inscriptum.*

The general pattern of species distribution from 'sources' downstream to the lowest rapids of the Bandama is not a clear species replacement, as is

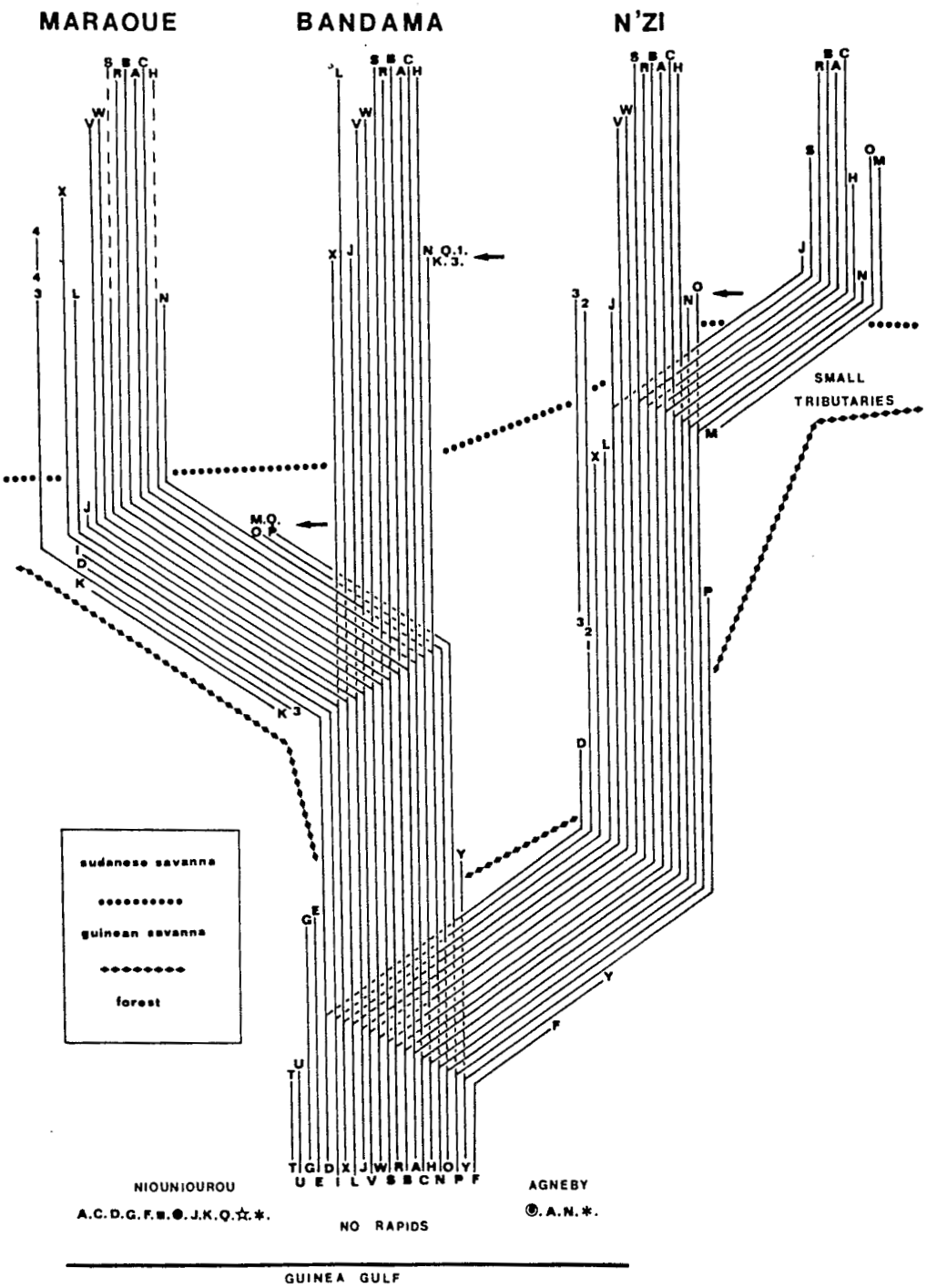
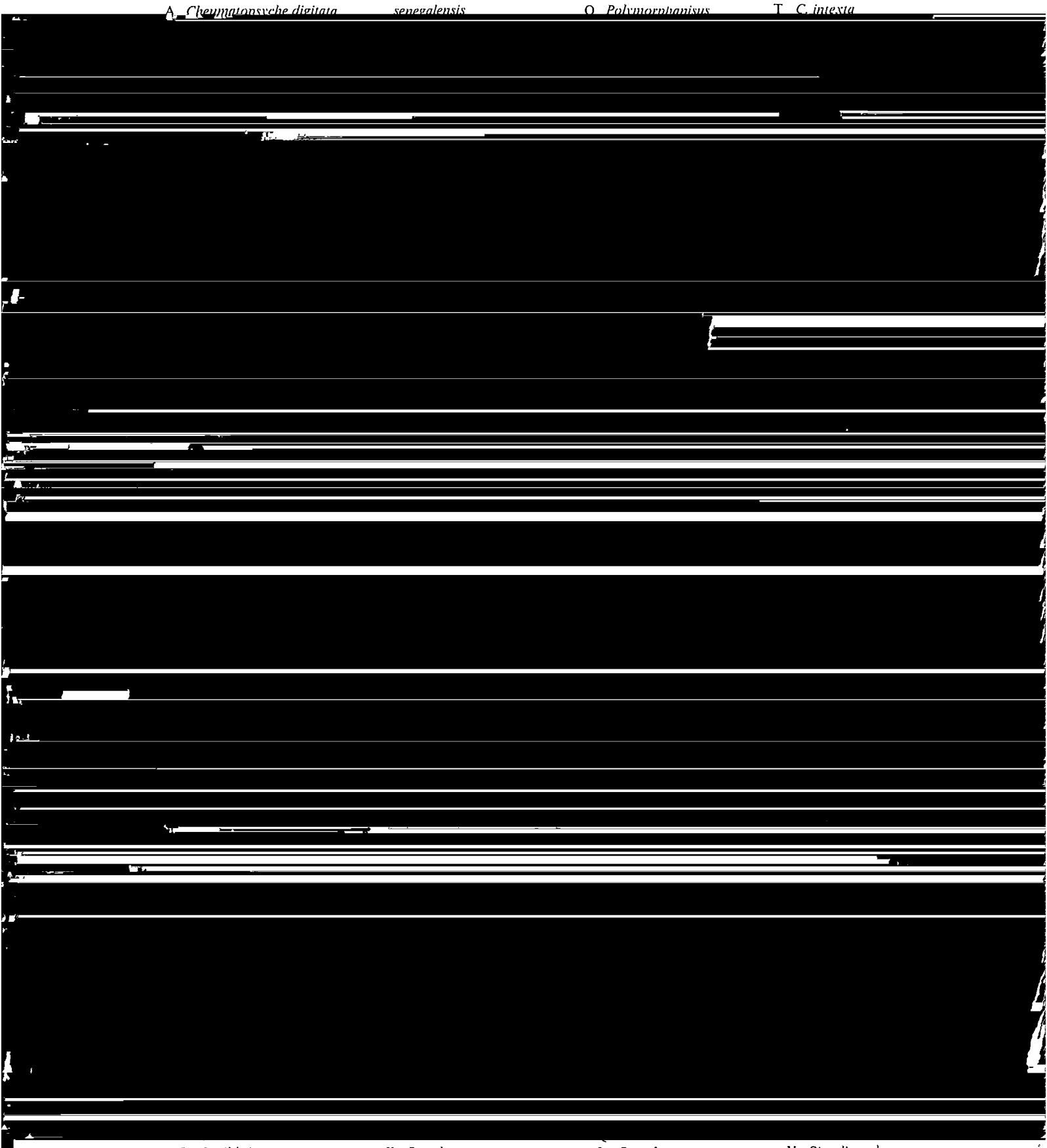


Fig. 1. Schematic presentation of the longitudinal distribution reported for three lotic insect groups in the Bandama River system before the construction of reservoirs as well as their occurrence in smaller streams situated west (Niouniourou) or east (Agneby) of the Bandama. Presence of species in small tributaries of the Bandama system consisting of samples from several streams. The streams generally flow from north to south, starting in the sudanese savanna, crossing the guinean savanna, and then entering the forest area. The length of the Bandama is approximately 1000 km. Codation of species in Table 1. Arrows: monitoring stations (higher sampling frequency); dot behind the species code: isolated occurrence.

Table 1. Code for Hydropsychidae, Philopotamidae (*Chimarra spp.*), and Simuliidae (*Simulium spp.*) used in Fig. 1. Letters: adults and associated larvae; numbers: unassigned larvae; graphic symbols: species found only in small stream west or east of the Bandama system.

A *Chevmatopsyche digitata* *senegalensis* O *Polymorphanisus* T *C. intexta*



E *C. gibbsi*
F *C. akana*
G *C. sexfasciata*
1 *C. sp VIII*
■ *C. sp XI*
H *Amphipsyche*
K *P. pubescens*
L *Macrostemum alienum*
M *M. inscriptum*
● *M. pulcherrimum*
N *Aethaloptera dispar*
2 *A. sp*
3 *P. sp I*
4 *P. sp II*
∴ *Leptonema sp II*
R *Chimarra sassandrae*
S *C. petri*
V *Simulium damnosum ss.*
W *S. sirbanum*
X *S. soubrense*
Y *S. sanctipauli*
O *S. yahense*