

Ecological status of streams of the equatorial forest in Cameroon: Benthic macroinvertebrates structure and physicochemical profile

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Introduction

- This work is part of the research program on freshwater ecology of the hydrobiology and environment laboratory of the University of Yaounde 1.
- In Cameroon, hydrobiological studies are still in their infancy, especially the taxonomic aspect of benthic macroinvertebrates.
- However, some studies are carried out to assess the quality of freshwater using benthic macroinvertebrates.
- This study aim to evaluate the ecology of equatorial forest streams by biological and environmental analysis.
- Specifically, it aims to evaluate the physiochemical parameters of water (i), the structure of the benthic macroinvertebrates (ii) and highlight the biological requirements (iii).

The data were collected from 2019 to February 2020.

Material and methods



Picture 1: Measurement of physicochemical parameters (A), collection (B and C) and Identification (D) of benthic macroinvertebrates following APHA 2017 and Stark et al. (2001) protocols, using Durand & Levêque (1980 and 1980) keys.

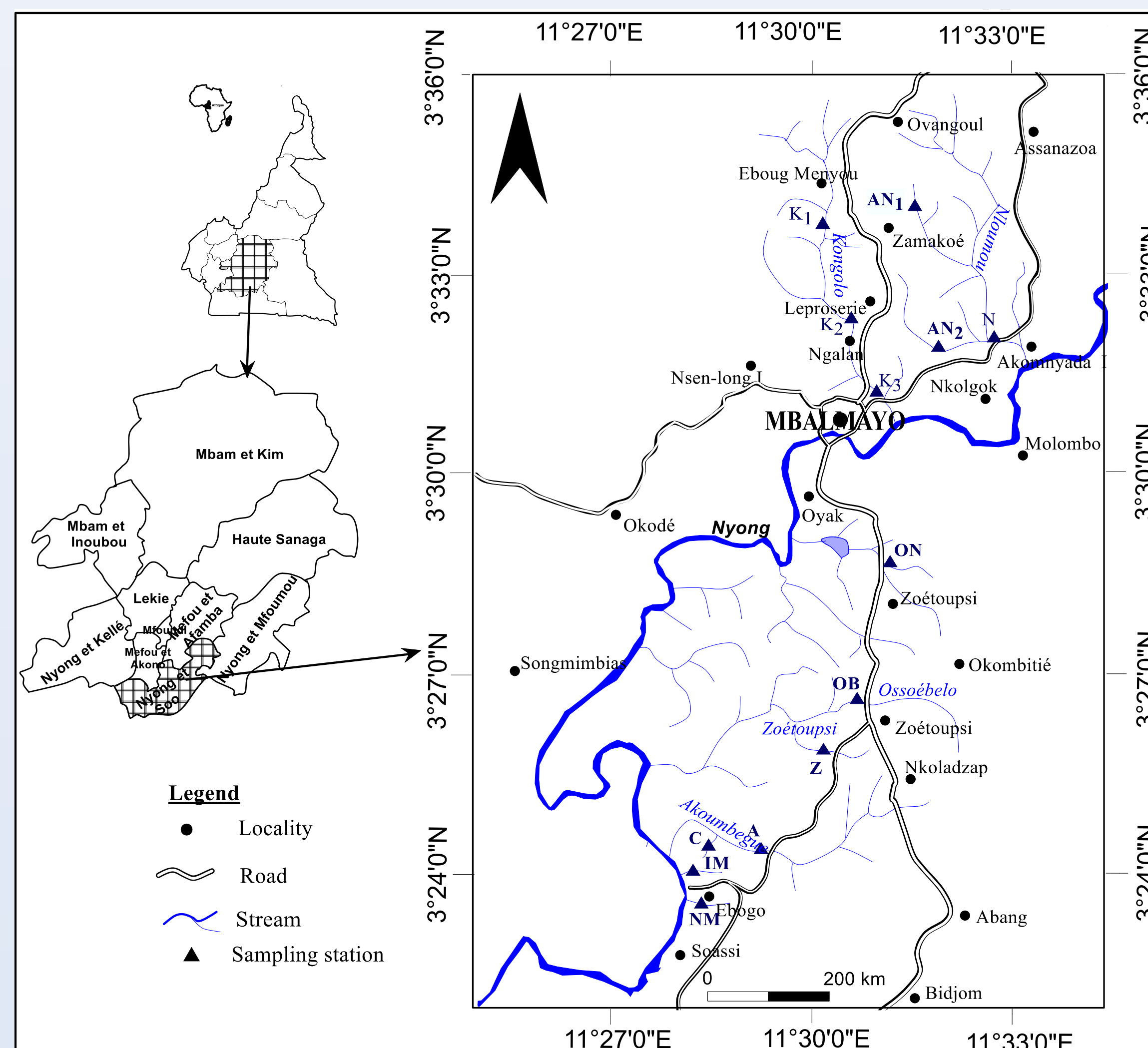


Figure 1: study map showing sampling stations

Results

- Benthic invertebrates collected: 13,690.
 - 4 phyla, 7 classes, 16 orders and 93 families.
- The table 1 shows that:
- Of the seven classes identified, insects were the most abundant.
 - Macrofauna communities were dominated by Decapoda, followed by Coleoptera and Heteroptera respectively.

Table 1: Summary of abundance and taxonomic richness

Orders	Abundances	Abundances (%)	Richness
Triclada	1	0.01	1
Haplotaxida	47	0.34	3
Rhynchobdellida	48	0.35	1
Arhynchobdellida	2	0.02	1
Eulamelibrancha	340	2.48	2
Basommatophora	17	0.12	1
Mesogastropoda	17	0.12	4
Decapoda	5250	38.35	3
Coleoptera	3053	22.30	15
Diptera	755	5.52	17
Heteroptera	1697	12.40	11
Odonata	1147	8.38	10
Ephemeroptera	532	3.89	10
Plecoptera	235	1.71	1
Trichoptera	419	3.06	12
Blattaria	130	0.95	1
Total	13690	100	93

The table 3 presents Spearman's rank correlation coefficients at the 0.05 threshold between some important variables and trophic groups.

- Hydrogen potential, conductivity and total dissolved solids negatively influence diversity at the expense of abundance.
- The abundance of shredders decreases from upstream to downstream.
- Collectors and filters prefer waters rich in suspended particles, while predators and shredders are positively influenced by oxygen saturation.
- Scrapers are abundant during calm waters, and predators proliferate during floods.

Conclusion and outlook

- ✓ The waters were very well oxygenated, weakly mineralized with low nitrogen levels, but slightly acidic.
- ✓ Macrofauna communities were dominated by Decapoda, followed by Coleoptera and Heteroptera respectively.
- ✓ Deterioration of water quality reduces diversity and balance within the benthic macroinvertebrate community.
- ✓ These results demonstrate a high diversity and adaptation of macroinvertebrates to the specific conditions of the studied streams.
- ✓ Cameroon's freshwater require further studies and investigations to understand the diversity of benthic macrofauna, especially species that are disappearing due to environmental degradation.

Environmental parameters varied very little except for a few isolated values, as we noted for turbidity, alkalinity or for total hardness

Table 2: Summary of environmental variables

Variables	Min-Max	Mean±SD
Current velocity	0.002-37.31	2.72±7.25
Temperature	21.6-28.9	23.91±1.36
pH	4.59-7.9	5.85±0.64
Conductivity	8.2-77.4	25.24±13.52
Oxygen	12.2-98.7	71.27±15.51
Turbidity	1-6138	93.71±473.54
Alkalinity	6-1048	63.60±82
Total hardness	2-592	25.38±45.62
Manganese	0.1-8.36	1.87±1.20
Nitrites	0.03-5	0.39±0.70
Nitrates	0.36-4.86	1.65±1.08
Ammonia	0.02-1.66	0.26±0.24
Orthophosphates	0.05-3.45	0.73±0.70

Table 3: Summary of Spearman's rank correlations between biotic indices and environmental variables

Variables	Richness	H'	J	N	Collectors	Shredders	Filters	Herbivores	Omnivores	Predators	Scrapers
Altitude (m)	0.208	0.128	0.071	0.066	0.108	0.129	-0.140	0.074	0.221	0.036	0.167
Distance from the source (m)	0.016	-0.140	-0.200	0.153	0.151	-0.220	-0.189	0.095	0.118	0.139	0.000
Temperature (°C)	-0.193	-0.111	0.065	-0.150	-0.156	-0.103	-0.009	-0.090	-0.044	-0.121	-0.101
Hydrogen potential (UC)	-0.109	-0.199	-0.150	0.078	0.051	-0.097	-0.068	0.017	0.046	0.085	-0.031
Conductivity (µS/cm)	-0.122	-0.330	-0.242	0.181	0.016	-0.088	-0.014	-0.079	0.072	0.142	-0.108
Total dissolved solids (mg/l)	-0.150	-0.340	-0.225	0.159	0.007	-0.077	-0.018	-0.043	0.077	0.114	-0.118
Salinity (mg/l)	-0.270	-0.193	-0.035	-0.041	-0.240	-0.146	0.000	-0.069	-0.108	0.116	-0.327
Dissolved oxygen (mg/l)	0.106	-0.033	-0.083	0.105	0.155	0.086	-0.252	0.106	0.205	-0.055	0.329
Colour (Pt-Co)	-0.061	0.077	0.168	-0.128	-0.032	-0.065	0.281	0.000	-0.245	0.070	-0.366
Turbidity (FAU)	-0.090	-0.020	0.072	-0.064	-0.180	-0.045	0.086	-0.034	-0.067	-0.009	-0.117
Suspended solids (mg/l)	-0.164	-0.144	-0.033	0.000	-0.201	-0.081	0.004	-0.034	-0.063	0.111	-0.128
Manganese (mg/l Mn)	0.067	0.121	0.077	0.001	0.091	-0.014	0.230	-0.132	-0.065	0.009	-0.117
Nitrites (mg/l NO ₂)	-0.188	-0.092	0.018	-0.087	-0.091	-0.080	0.010	0.105	-0.005	0.024	-0.160
Nitrates (mg/l NO ₃)	-0.041	0.012	0.015	-0.002	0.079	-0.010	0.137	-0.036	-0.030	0.136	-0.175
Ammonia (mg/l NH ₃)	-0.158	-0.091	0.057	-0.106	-0.090	-0.080	0.116	0.108	-0.022	-0.061	-0.135
Orthophosphates (mg/l PO ₄)	-0.113	-0.026	0.062	-0.038	-0.115	-0.073	0.220	-0.029	-0.022	0.123	-0.194
Current velocity (m/s)	0.093	0.022	0.004	0.149	0.195	-0.016	0.084	0.187	0.082	0.075	0.054

Results

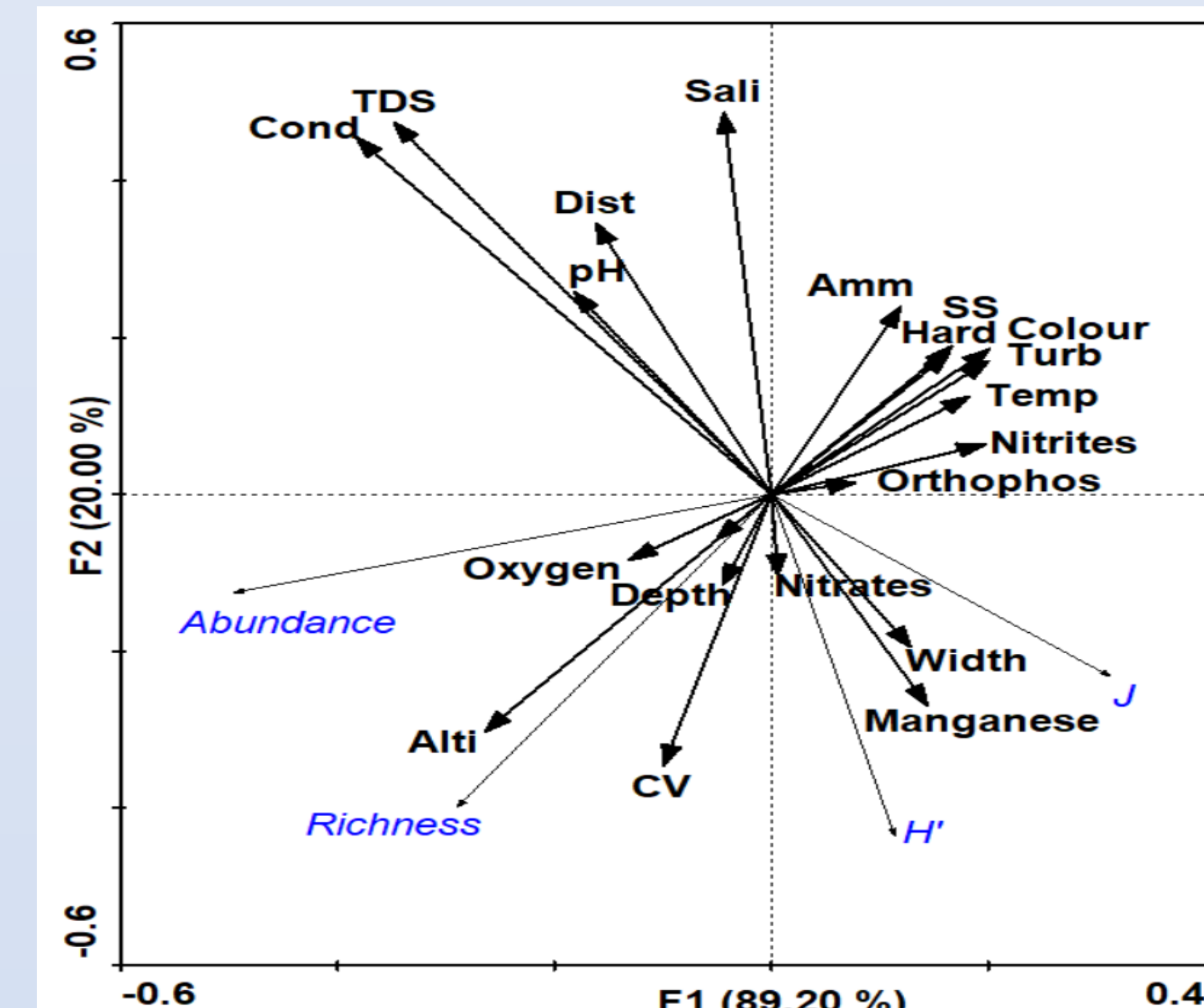


Figure 2: redundancy analysis between biotic indices and environmental variables

Figure 2 shows that abundance and richness decline when water quality deteriorates. This has a significant impact on community structure.

References

- Durand, J. R., & Levêque, C. (1980). *Flore et faune aquatiques de l'Afrique Sahélo-soudanienne* (I). Office des Recherches Scientifiques et Techniques d'Outre-Mer (ORSTOM).
- Stark, J. D., Boothroyd, I., Harding, J., Macted, J. R., & Scarsbrook, M. (2001). Protocols for Sampling Macroinvertebrates in Wadeable Streams. *New Zealand Macroinvertebrate Working Group Report No. 1, Ministry for the Environment Sustainable Management Fund Contract No. 5103*, 65.