# Aquatic macroinvertebrates communities in an agricultural area of a Tropical River Basin. Guayas River (Ecuador)

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## 1. Introduction

➢Macroinvertebrate taxa composition and distribution are mainly associated to the capacity of these organisms to tolerate the environmental disturbances that are regularly linked to the change of land use (Rios and Bailey, 2006).

➢Different studies showed that the expansion of agricultural land is related with modifications in the macrohabitats where these organisms live, resulting in an alteration in the macroinvertebrates community composition (Corkum, 1990 and Quinn and Hickey, 1990).

➢The aim on this study was to analyze the macroinvertebrate communities and water quality parameters in the middle catchment of the Guayas River basin and to explore the relationships between abiotic (physico-chemical) and biotic (macroinvertebrates) parameters.

## 4. Results

➢ Biotic results are presented in Fig 4.1 (Taxa composition per the entire area) and Fig 4.2 (Biotic metrics).
➢ A general overview of the physico-chemical results of water quality is presented in Fig 4.3.
➢ Fig 4.4 shows the ANOVA analysis, which relates physico-chemical parameters results with one of the biotic metrics (BMWP/Colombia index)
➢ Fig 4.5 shows correlations between biotic metrics and physico-chemical parameters
➢ A cluster analysis of the Macroinvertebrate community composition and their similarities is presented in Fig 4.6

## 2. Study Area

**Guayas River Basin** is the most important in the Coastal Region of Ecuador:

➢33000 Km$^2$, 10 provinces, 48% of the Ecuadorian population live, 50% of the non-oil Ecuadorian exports are produced.

➢Agriculture (rice, corn, banana), fisheries and hydropower are the main activities in the area.

➢Non-point sources of pollution, dams and change in land uses are the main environmental problems.

## 3. Sampling

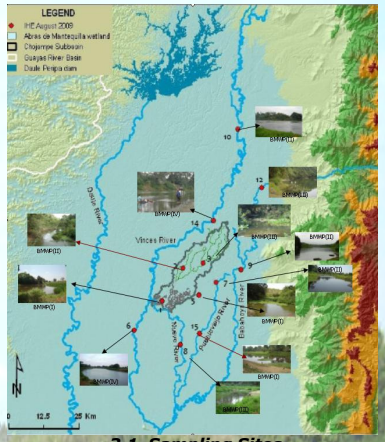
➢ Aquatic macroinvertebrates communities were collected in 12 sites following the methodologies of De Pauw and Vanhooren (1983) and AQEM (2002).

➢The sites were located in the middle catchment of the Guayas River Basin: 3 sites in the wetland "Abras de Mantequilla" (RAMSAR 2000) and 9 in its influence area (Quevedo Sub-basin 5300 Km$^2$ ).

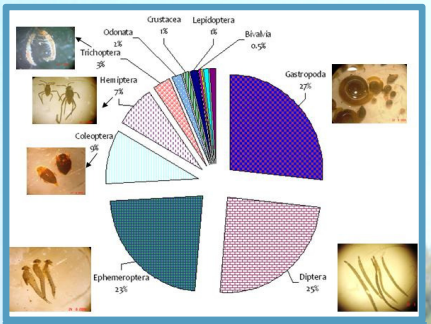
➢ Water samples were collected in the 12 sites to analyze physico-chemical parameters in-situ and ex-situ (temperature, DO, nutrients, Conductivity, BOD, COD, organic carbon, Suspended solids) (Fig 4.3).

➢Fig 3.1 shows the location of the 12 sites, their BMWP/Col WQC and their type of environment.

➢ BMWP/Col is the *Biological Monitoring Working Party index* adaptation Colombia. The index developed a standardized score system based on a score derived from points attributed to different invertebrate families according to their degree of intolerance to organic pollution (Mustow, 2002)



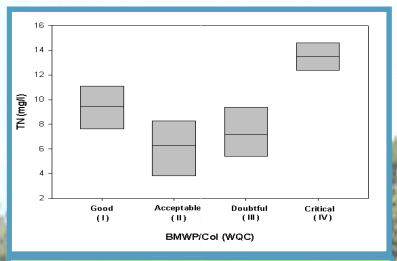

***3.1. Sampling Sites***




***4.1. Taxa composition***

➢A total of **3490 specimens**, belonging to **54 families** and 11 orders were collected in the 12 sites.

➢The **Class Insecta** dominated the macroinvertebrate community; being **Ephemeroptera** and **Diptera** the most abundant orders with 23% and 25% respectively.




***4.4. Analysis of BMWP (WQC) based on physico-chemical parameters***

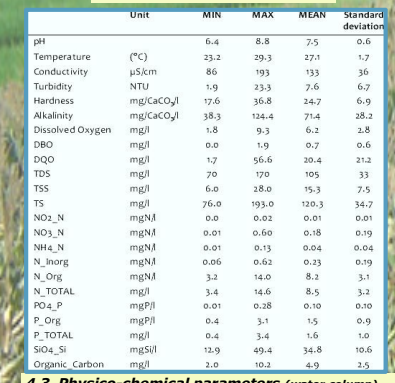
From One way ANOVA analysis, just **nitrogen-related parameters** were significant ($p<0.05$), showing that Nitrogen components: NO3_N; Total inorganic nitrogen (TIN); Total organic nitrogen (TON); and therefore Total Nitrogen (TN), could be used as a good discriminator parameter that can help to distinguish the different **BMWP/Col WQC**.

***WQC** (Water quality classes ):*

*Good (I),Acceptable(II), Doubtful(III), Critical(IV).*

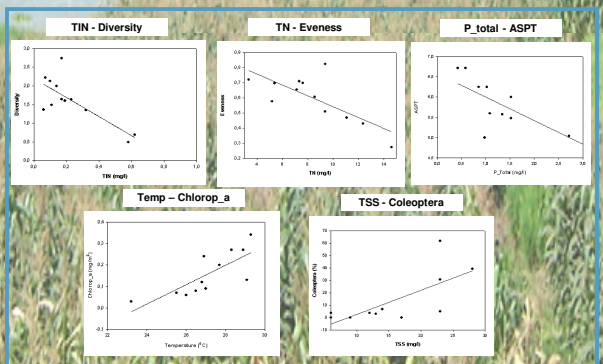
| SITES/ METRICS | S1 | S2 | S3 | S5 | S6 | S7 | S8 | S9 | S10 | S12 | S14 | S15 | min | max | mean | sd |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Abundance | 1714 | 121 | 163 | 147 | 42 | 253 | 47 | 83 | 277 | 54 | 198 | 392 | 42 | 1714 | 291 | 460 |
| No_taxa | 24 | 20 | 14 | 28 | 5 | 15 | 10 | 16 | 17 | 8 | 6 | 24 | 5 | 28 | 16 | 7 |
| Diversity | 1.5 | 2.1 | 1.3 | 2.7 | 0.7 | 1.6 | 1.6 | 2 | 1.6 | 1.4 | 0.5 | 2.2 | 0.5 | 2.7 | 1.6 | 0.6 |
| Evenness | 0.5 | 0.7 | 0.5 | 0.8 | 0.4 | 0.6 | 0.7 | 0.7 | 0.6 | 0.7 | 0.3 | 0.7 | 0.3 | 0.8 | 0.6 | 0.2 |
| ASPT | 6.3 | 4.8 | 4.8 | 5.5 | 5.6 | 5.6 | 6.3 | 6.7 | 6.7 | 6 | 5 | 5 | 4.8 | 6.7 | 5.7 | 0.7 |
| EPT (%) | 26.6 | 6.6 | 33.1 | 20.4 | 2.4 | 42.7 | 23.4 | 40.2 | 43.3 | 18.5 | 6.6 | 14.3 | 2.4 | 43.3 | 23.2 | 14.4 |
| BMWP score | 125 | 76 | 43 | 137 | 28 | 78 | 50 | 94 | 94 | 42 | 30 | 111 | 28 | 137 | 76 | 37 |
| BMWP (WQC) | I | II | III | I | IV | II | III | II | II | III | IV | I | | | | |

***4.2. Biotic Metrics***

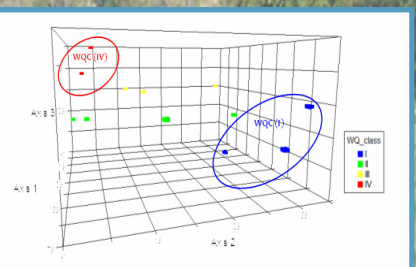


| | Unit | MIN | MAX | MEAN | Standard deviation |
|---|---|---|---|---|---|
| pH | | 6.4 | 8.8 | 7.5 | 0.6 |
| Temperature | (°C) | 23.2 | 29.3 | 27.1 | 1.7 |
| Conductivity | µS/cm | 86 | 193 | 133 | 36 |
| Turbidity | NTU | 1.9 | 23.3 | 7.6 | 6.7 |
| Hardness | mg/$CaCO_3$/l | 17.6 | 36.8 | 24.7 | 6.9 |
| Alkalinity | mg/$CaCO_3$/l | 38.3 | 124.4 | 71.4 | 28.2 |
| Dissolved Oxygen | mg/l | 1.8 | 9.3 | 6.2 | 2.8 |
| DBO | mg/l | 0.0 | 1.9 | 0.7 | 0.6 |
| DQO | mg/l | 1.7 | 56.6 | 20.4 | 21.2 |
| TDS | mg/l | 70 | 170 | 105 | 33 |
| TSS | mg/l | 6.0 | 28.0 | 15.3 | 7.5 |
| TS | mg/l | 76.0 | 193.0 | 120.3 | 34.7 |
| NO2_N | mgN/l | 0.0 | 0.02 | 0.01 | 0.01 |
| NO3_N | mgN/l | 0.01 | 0.60 | 0.18 | 0.19 |
| NH4_N | mgN/l | 0.01 | 0.13 | 0.04 | 0.04 |
| N_Inorg | mgN/l | 0.06 | 0.62 | 0.23 | 0.19 |
| N_Org | mgN/l | 3.2 | 14.0 | 8.2 | 3.1 |
| N_TOTAL | mg/l | 3.4 | 14.6 | 8.5 | 3.2 |
| PO4_P | mgP/l | 0.01 | 0.28 | 0.10 | 0.10 |
| P_Org | mgP/l | 0.4 | 3.1 | 1.5 | 0.9 |
| P_TOTAL | mg/l | 0.4 | 3.4 | 1.6 | 1.0 |
| SiO4_Si | mgSi/l | 12.9 | 49.4 | 34.8 | 10.6 |
| Organic_Carbon | mg/l | 2.0 | 10.2 | 4.9 | 2.5 |

***4.3. Physico-chemical parameters** (water column)*




***4.5. Relationships between biotic and abiotic parameters***




***4.6. Cluster Analysis***

➢A **N**on-metric **M**ultidimensional **S**caling method **(NMS)** was applied to analyze the macroinvertebrate community composition, and to visualize their similarities considering the taxa composition.

➢The method was based on the Bray-Curtis (dis)similarity matrices computed from log (x+1)-transformed taxa abundances.

➢ A clear **cluster** can be seen grouping the sites that belong to the **BMWP/Col WQC I and IV**, showing dissimilarity between both classes.

➢In contrast, sites belonging to WQC II and III were more spread and did not present a defined pattern.

## 5. Ongoing and further research

➢ **Temporal comparison** is being performed with the results of wet season (February 2011) to explore for possible variations in these patterns.

➢An "**integrated ecological model approach**" which includes the different abiotic and biotic components (hydrology, water quality, habitats, plankton, macroinvertebrates, fishes will be developed.

➢ The aim of this integrated approach is to understand the interrelations between physico-chemical and biological parameters in tropical countries, and to asses the current ecological status of this river basin.

Thanks to:
Delft Cluster
Deltares
nuffic
WETWIN
INOCAR

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