Ecological Water Quality Guadalete River

Factsheets

Research to the impact of humans on the ecological water quality of the Guadalete River

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Fieldweek in Spain
HZ University of Applied Sciences & University of Cadiz
Vlissingen, The Netherlands
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UCA Universidad de Cádiz

Contents

1.0 Introduction

During the period of 3 to 10 October 2014 students from the HZ University of Applied Sciences and the University of Cadiz executed a field study week in the southern of Spain, near Cadiz. The aim of the fieldweek is to assess the present biological state of the The Guadalete River basin. This river basin has several types of ecosystems as it makes its way to the estuary and the Atlantic ocean. It can be divided into different zones by type of microhabitats and expected biodiversity:

1. Natural park zone;
2. Transition zone;
3. Flooding zone;
4. Coastal zone.

There are several land uses downstream that are assumed to have a big impact on the water quality. These are described as pressure factors in the DPSIR methodology. In general agriculture, cattle, dams, waste water treatment plants and other major events are identified along the river course. By assessing the state, the biological status of the river can be determined.

To determine this biological state multiple indexes are used: IBMWP index, Biotic Index, the number of species, and an index for phytoplankton. The outcomes of the IBMWP index and the Biotic Index are compared in order to determine if the results are coincident and representative.

2.0 Material and method

2.1 Sample locations

Multiple points were sampled during the week, but only the most relevant ones are chosen . These sampling points are representative for different types of the ecosystem. The inflow of the Zahara reservoir is considered to be the source and with that the first sampling point. The following sampling points are downstream, till the mouth of the river is reached. In figure 1 the different sampling points are marked on a map of the area. In table 1 each sampling point is explained with a short description of the local situation.

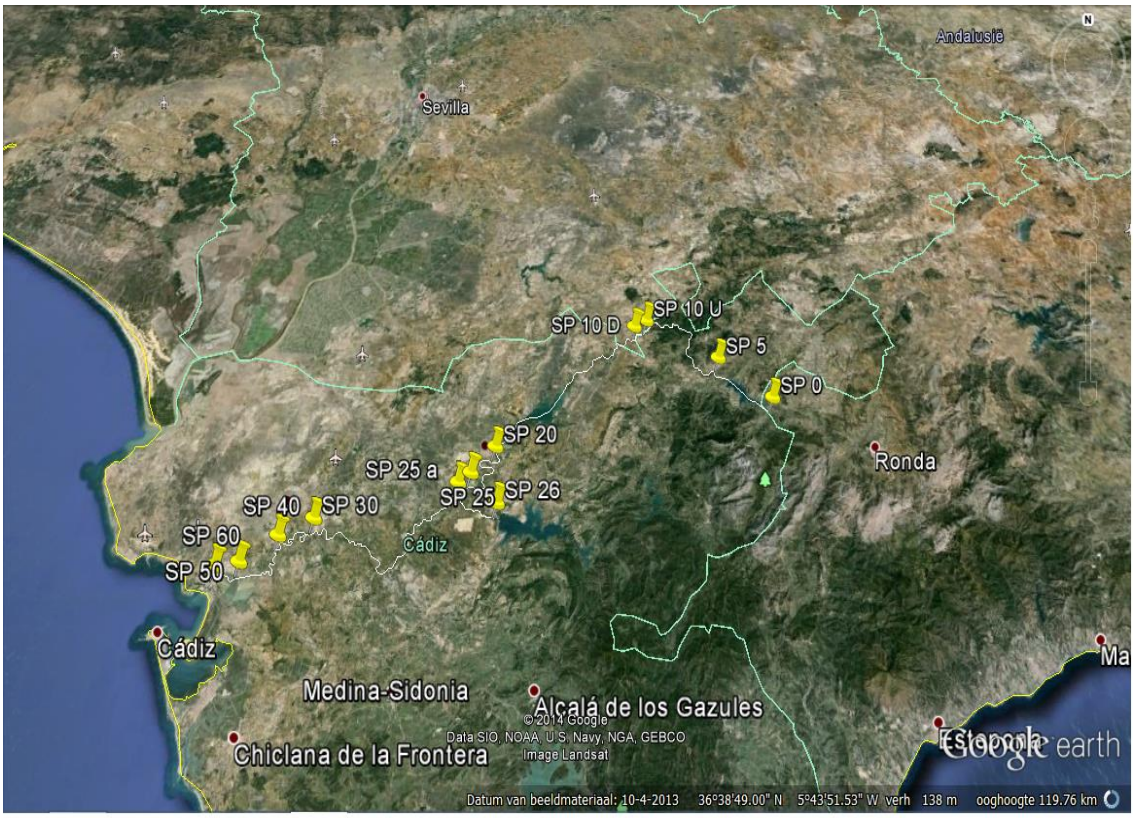


Figure 1: Map of the area with all sampling points (source: google earth)

Table 1 Sampling points in the Guadalete River

Sampling point number	Description
0	High up in the mountains where human influence is minimal, clean water
5	After Zahara where the river is narrow and deep. A lot of organic material in and around the river in the form of leaves and dead organic material.
10U	Upstream of Puerto Serrano, with minimal human influence
10D	Downstream of Puerto Serrano, where human influences increase (in the form of cattle close to the river bed)
20	In the city of Arcos de la Frontera
25	In the Guadalete River near La Junta de los Ríos
25A	At the junction of the Guadalete River and La Junta de los Rios
26	Majaceite River
30	Before El Portal, with greyish to green water
40U	Just before the El Portal dam, where the fresh water meets brackish water
40D	Just after the dam, where a lot of fish were observed
50	In the Salt Marshes near El Puerto de Santa Maria, a lot of pollution and trash observed
60	The mouth of the River in El Puerto de Santa Maria, a lot of pollution observed

2.2 Macro invertebrates

Macro invertebrates are sampled with the help of the macro fauna net. With this net as much as possible micro habitats in the surrounding are sampled. By doing so the maximum amount of species is gathered. By turning rocks and with the help of tweezers species like flat worms can be collected. Inside the plants and other organic material, organisms can be found and collected. At certain locations along the river, in the salt marsh, and at the mouth of the river the core or soil sampler can be used to collect organisms. The bottom material is then sieved and the large particles together with the organisms remain in the sieve. These organisms can be gathered with the help of tweezers.

The Biotic index and IBWP index are based on the same principle but are produced separate from each other. The indexes are based on the principle that some organisms need the presence of a lot of oxygen in the water and others do not. When sampled multiple habitats at the location the family of all the species found is determined. The most sensitive organism to low oxygen concentration is determined. This sensitive organism and the amount determines the what grade the waterquality gets. When per example only tubifex and chironomus is found than the waterquality gets a low grade and when Specific families of trichoptera are found the waterquality gets a higher grade. The principle is a result of the pollution of water in industrial rich countries where of organic pollutants are released in the water system. When this happens bacteria start to degrade the material and use oxygen. When the pollution of organic material is relatively high there is a low oxygen concentration and when the is a relative low organic pollution there is and high oxygen concentration.

The macro invertebrates are important indicators of the health or condition of the water bodies. The advantages of using macro invertebrates are:

- They are commonly found in almost all water systems;
- They are an important part of the food web;
- They are responding to a wide range of pollution;
- During their life cycle, macro invertebrates are directly exposed to the physical, chemical and biological conditions of the river. Organisms with longer life cycles like the dragonflies may signal that the conditions remained healthy for the duration of their development.

2.3 Macrophytes

In aquatic ecosystems macrophytes are important because they can increase habitat complexity and heterogeneity, provide physical structures and affect other aquatic organisms. Macrophytes give an idea about the effects of different ecological variables in a water system over a longer period of time. By sampling the macrophytes, the water quality and other variables such as hydro-dynamics are indicated. Furthermore, submerged macrophytes also give an indication for turbidity.

At the sampling points all vegetation that was considered to be in direct relation with the river is sampled. Plants on the shore and submerged plants are collected at the different sampling locations. All collected plants are then stored in plastic bags and at the laboratory the unknown plants will be identified with the help of literature.

2.4 Phytoplankton and zooplankton

For the phytoplankton and zooplankton plankton nets are used, one net with a mesh size of 110 µm and another net with a mesh size of 35 µm. A certain amount of water is first filtered through the net with the largest mesh size and then the same water is secondly filtered through the smaller mesh sized net. The material that not passed through the net (thus too big to pass through the certain mesh size) is collected in a sampling bottle.

3.0 Result and discussion

3.1 Macro invertebrates

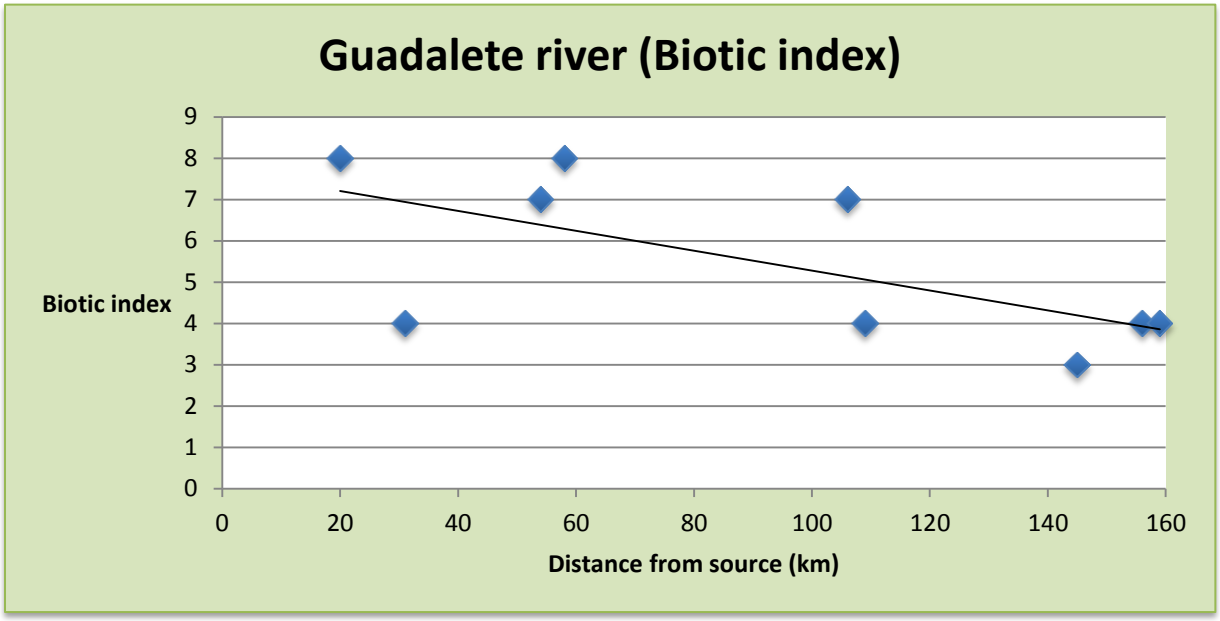
In table 2 the results of the IBWP and Biotic Index calculation are given. The table also gives an overview about the families of the macro invertebrates found at the different sample points.

Table 2 Macro invertebrates results of IBWP index, Biotic index and amount of species

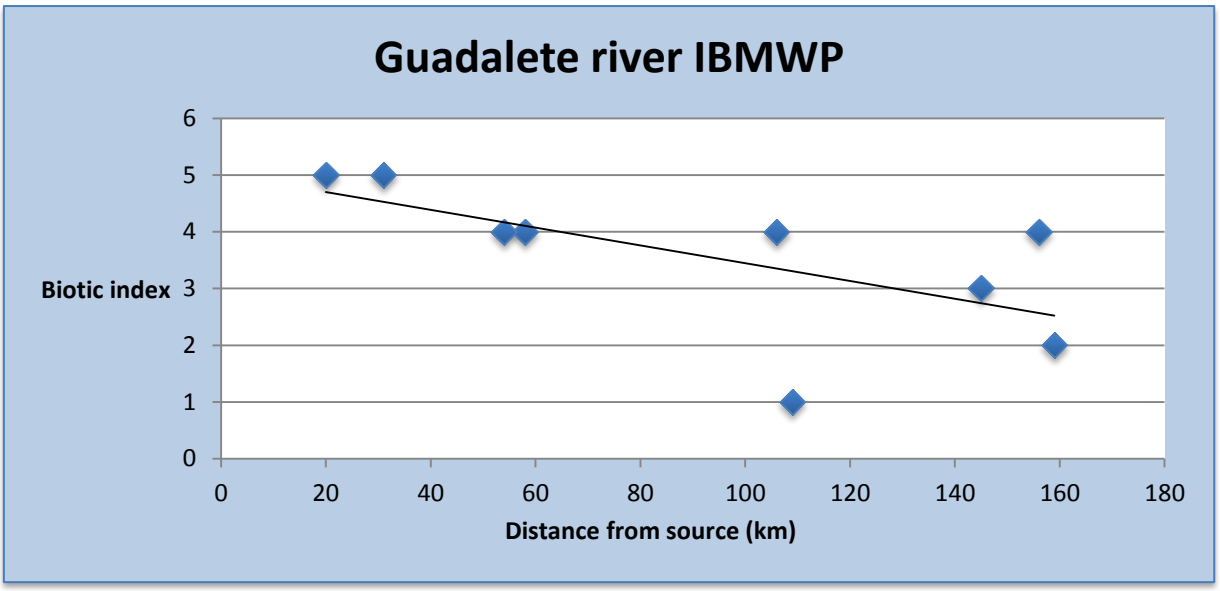
Sampling point	IBWP	Biotic Index	Amount of families
0	88	8	15
5	22	4	4
10U	54	7	11
10D	103	8	14
25	27	7	5
25A	27	4	6
30	20	3	5
40U	11	4	4
40D	9	4	2

In ‘Appendix 1. Macro invertebrates’ a list with all species identified per sampling point can be found. If there is no table for a specific sampling point, no species were identified at this location.

The IBMWP index and the Biotic Index are used for giving a relative view of the ecological water quality with the help of macro invertebrates. The scale of the IBMWP has a range of 1 to over 120 (graph 1), while the Biotic Index has a range in between 1 and 10 (graph 2). In both indexes the best water quality is the maximum value.



Graph 1 Variation of the Biotic Index from the source to the mouth



Graph 2 Variation of the IBMWP index from the source to the mouth

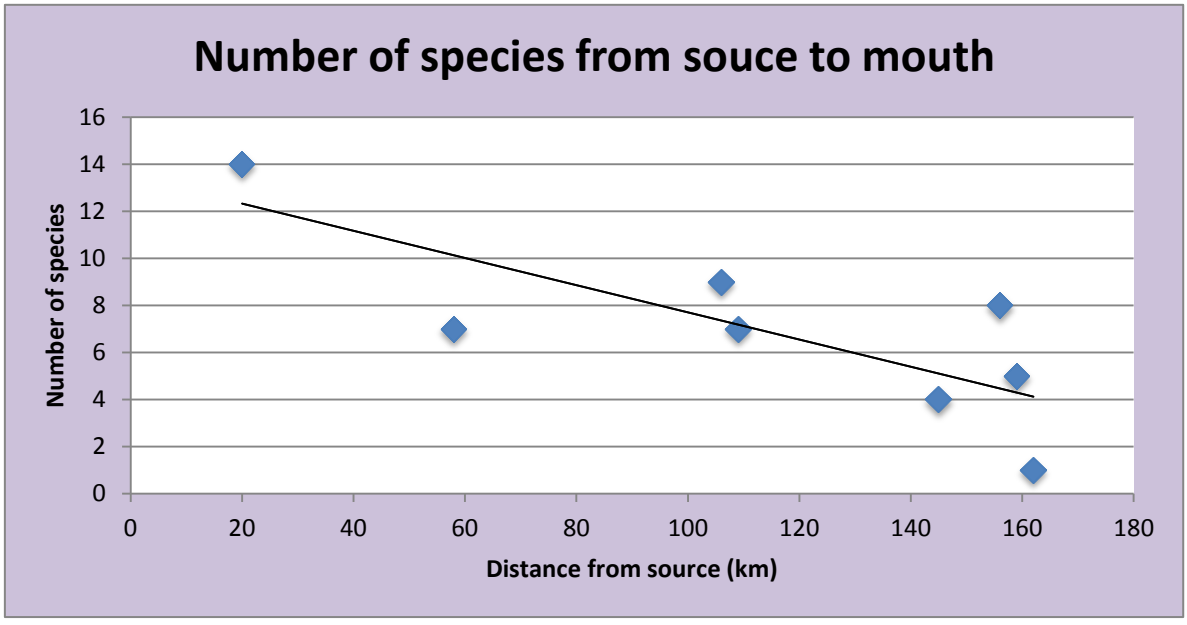
The increase in organic pollution after the reservoir is probably caused by the polluted surrounding in the form of dead organic material. The observations in the graphics of the linear regression in both graphs show an inverse weak relationship between the distance from the source to the mouth. Even though the relation is weak, the biodiversity decreases as it approaches to the estuary.

The decrease of species richness seems related to the oxygen levels in the river, since the oxygen levels decrease from the source to the mouth. From sampling point 25 an enormous decrease of values in both indexes is visible. This is probably caused by the water treatment plant that causes oxygen levels to decrease. It appeared that the water treatment plant was not working according to regulations during the measurements. This implies that the water treatment plant released more pollutants than normal and that the oxygen levels, and thus the species richness, were lower than in the normal situation.

3.2 Macrophytes

During the field week multiple macrophytes species have been collected and identified. For each sampling point the different species are summed up in Appendix 2. In the appendix the Latin name, the English name, the order, and the family are given. If there is no table for a specific sampling point, no species were identified at this location.

The number of identified species is decreasing from source to the mouth (graph 3). When the number of species is decreasing it could be an indicator for nutrient enriched soils. It is visible that the identified species are pioneer species, what indicates a dynamic water system. Areas along the river bed get flooded frequently and pioneer plants are the first to grow back.



Graph 3 The decrease of macrophytes from source to mouth

The results might not be representative for the ecological situation in the river, since no specific monitoring scheme was used while collecting the samples. After observation, all the vegetation in the water and on parts of the shore (that are influenced by the river) were

collected. Because of the random sampling, the abundance was not monitored. The few sampling locations might not give a whole perspective of the total river system. Problems with identification are linked to the sampling period. The available literature for identifying the species was not written specifically for this area. As a result some species could not be identified.

3.3 Phytoplankton and zooplankton

The results of the different sampling points are given in table 3. In this table the saprobic index value is given. The index value describes the state of the water system. The samples that are taken did not contain any zooplankton. All species found per sampling point are gathered in tables in appendix 3. If there is no table for a specific sampling point, no species were identified at this location.

Table 3 Eutrophic degree of the sample points of phytoplankton

Sample point	Saprobic index value	Class
0	2	Moderate polluted
10U	2.5	Moderate polluted
10D	2.2	Moderate polluted
25	2.25	Moderate polluted
25 A	2	Moderate polluted
26	2.06	Moderate polluted
30	2.2	Moderate polluted
40U	2.3	Moderate polluted
40D	2.25	Moderate polluted

The saprobic index value can range between 1.0 and 4.0. When the value is 1.0 the water system is not affected, but when the value is 4.0 the water system is highly polluted. All values in the table are between 2.0 and 2.5. This means that the water is in a degraded state of saprobication. It indicates that there is only a small difference in the limiting factors of the phytoplankton growth between the source and the mouth of the river. This is in contradiction with the results of the chemical group, that show the phosphate and nitrate concentrations fluctuating along the river. There are still other factors that influence the species composition (geomorphology of the river, hydrology, structures and turbidity).
The survey of the phytoplankton was executed in a consistent matter. It can be estimated that during the identification of the species between 20 and 30 percent of the algae may have been missed or misclassified. A quick calculations (adding extreme values) shows that this does not significantly influence the score of the Saprobic Index.

4.0 Conclusion

4.1 Macro invertebrates

During the course of the river, the oxygen level decreased. It was observed that:

- There occurs a decrease in oxygen levels in the river as the distance from the source becomes bigger;
- After the reservoir, the decrease of oxygen levels starts;
- The lack in oxygen increases even more after the junction of the Guadalete River and La Junta de los Rios.

The decrease of oxygen levels along the river course leads to a decrease in species richness from the source to the mouth. The species richness decreased radically after the junction of the Guadalete River and La Junta de los Rios.

The decrease in oxygen and species richness can be caused by nutrients present in the water system. Downwards to the see more nutrients enter the river, what causes an increase in biomass and a decrease in number of species. Also the water near the coast showed signs of algae blooms and thus presumable eutrophication. One of the causes for the high decrease in oxygen and species richness could be the presence of a wastewater treatment plant. After the results were gathered information became available that the wastewater treatment plant was not working according the regulations and released a higher amount of organic pollution than normally allowed.

4.2 Macrophytes

From the results it appears that the amount of species decreases with distance from the source. A possible explanation for this could be the increase of nutrients downstream in the water system. Because it is known that the biomass increases or stays stable with an increase in nutrients. When nutrients increase the species richness decreases. Also a lot of the identified species are pioneer species, what indicates a dynamic environment. This can be correct because the water level of the river can fluctuate and therefore overflow the banks and remove plants.

4.3 Phytoplankton and zooplankton

The phytoplankton results suggest that the river is moderately polluted and in a degraded state of eutrophication. In every sample point the index has a value between 2.0 and 2.5. This means that there is a very small difference in the limiting factors of the phytoplankton growth between the source and the mouth of the river. This while the chemical group found that the phosphate and nitrate levels fluctuate along the river.

Appendix 1. Macro invertebrates

Table 4 Sampling point 0 (15 identified species)

Latin Name	English Name	Order	Family
H. gerridae	True bugs	Hemiptera	Gerridae
Plecoptera	Stoneflies	Plecoptera	Perlodidae
Hemiptera	True bugs	Hemiptera	Corixidea
H. notonectidae	True bugs	Hemiptera	Notonectidae
D. chironomidae	Fly	Diptera	Chironomidae
Decapoda	Crabs	Decapoda	Palaemonidae
T. hydropsychidae	Caddisflies	Trichoptera	Hydropsychidae
O. libellulidae	Dragonflies	Odonata	Libellulidae
O. cordulegastridae	Dragonflies	Odonata	Cordulegastridae
O. aeshnidae	Dragonflies	Odonata	Aeshnidae
E. leptophlebiidae	Mayfly	Ephemeroptera	Leptophlebiidae
E. heptageniidae	Mayfly	Ephemeroptera	Heptageniidae
P. lymnaeidae	Snail	Pulmonata	Lymnaeidae
C. hydropphilidae	Beetles	Coleoptera	Hyprophilidae
C. dysticae	Beetles	Coleoptera	Dysticae

Table 5 Sampling point 5 (4 identified species)

Latin Name	English Name	Order	Family
H. gerridae	True bugs	Hemiptera	Gerridae
Pulmonata	Snail	Pulmonata	Lymnaeidea
O. cordulegastridae	Dragonflies	Odonata	Cordulegastridae
O. lestidae	Dragonflies	Odonata	Lestidae

Table 6 Sampling point 10U (10 identified species)

Latin Name	English Name	Order	Family
P. lymnaeidae	Snail	Pulmonata	Lymnaeidae
T. hydropsychidae	Caddisflies	Trichoptera	Hydropsychidea
P. hydrophilidae	Crabs	Decapoda	Palaemonidae
E. heptageniigae	Mayfly	Ephemeroptera	Heptageniigae
E. leptophlebiidae	Mayfly	Ephemeroptera	Leptophlebiidae
P. lymnaeidae	Snail	Pulmonata	Lymnaeidae
D. gyrinidae	Crabs	Decapoda	Gyrinidea
D. oysticae	Crabs	Decapoda	Oysticae
E. baetidae	Mayfly	Ephemeroptera	Baetidae
P. leuctridae	Stoneflies	Plecoptera	Leuctridae

Table 7 Sampling point 10D (11 identified species)

Latin Name	English Name	Order	Family
O. libellulidae	Dragonfly	Odonata	Libellulidae
T. hydropsychidae	Caddisflies	Trichoptera	Hydropsychidae
C. hydrophilidae	Beetles	Coleoptera	Hydrophilidae
D. palaemonidae	Crabs	Decapoda	Halaemonidae
A. gammaridae	Flowcrab	Amphipoda	Gammaridae
P. lymnaeidae	Snails	Pulmonata	Lymnaeidea
p. perlodidae	Stoneflies	Plecoptera	Perlodidae
P. chloroperlidae	Stoneflies	Plecoptera	Chloroperlidae
E. ephemeridae	Mayfly	Ephemeroptera	Ephemeridae
E. caenidae	Mayfly	Ephemeroptera	Caenidae
O. leptophlebiidae	Dragonflies	Odonata	Leptophlebiidae

Table 8 Sampling point 20 (5 identified species)

Latin Name	English Name	Order	Family
P. lymnaeidae	Snail	Pulmonata	Lymnaeidea
N. naviculaceae	Boat shaped algae	Naviculales	Naviculaceae
P. physidae	Bladder snails	Pulmonata	Physidae
D. palaemonidae	Shrimp	Decapoda	Palaemonidae
L. lumbriculidae	Oligochaetes	Lumbriculida	Lumbriculidae

Table 9 Sampling point 25 (5 identified species)

Latin Name	English Name	Order	Family
O. cordulegastridae	Dragon flies	Odonata	Cordulegastridae
P. lymnaeidae	Snail	Pulmonata	Lymnaeidea
D. chironomidae	Mosquito larva	Diptera	Chironomidae
E. caenidae	Mayfly	Ephemeroptera	Caenidae
P. capnia	Stoneflies	Plecoptera	Capnia

Table 10 Sampling point 25A (6 identified species)

Latin Name	English Name	Order	Family
P. lymnaeidae	Snails	Pulmonata	Lymnaeidea
D. palaemonidae	Shrimp	Decapoda	Palaemonidae
D. cambaridae	Crayfish	Decapoda	Cambaridae
H. gerridae	True bugs	Hemiptera	Gerridae
A. gammaridae	Gammarids	Amphipoda	Gammaridae
E. caenidae	Mayfly	Ephemeroptera	Caenidae

Table 11 Sampling point 26 (6 identified species)

Latin Name	English Name	Order	Family
H. naididae	Tubifex	Haplotaxida	Naididae
P. lymnaeidae	Snail	Pulmonata	Lymnaeidea
T. hydropsychidae	Caddisflies	Trichoptera	Hydropsychidae
P. capnia	Stoneflies	Plectoptera	Capnia
O. cordulegastidae	Dragon flies	Odonata	Cordulegastridae
E. baetidae	Mayfly	Ephemeroptera	Baetidae

Table 12 Sampling point 30 (5 identified species)

Latin Name	English Name	Order	Family
D. cambaridae	Crayfish	Decapoda	Cambaridae
D. atyidae	Shrimp	Decapoda	Atyidae
O. libellulidae	Dragonfly	Odonata	Libellulidae
H. naididae	Tubifex	Haplotaxida	Naididae
D. palaemonidae	Shrimp	Decapoda	Palaemonidae

Table 13 Sampling point 40U (4 identified species)

Latin Name	English Name	Order	Family
D. chronomidae	Non-biting midge	Diptera	Chronomidae
P. atlantidae	Sea snails	Pulmonata	Atlantidae
H. corixidae	Water Boatmen	Hemiptera	Corixidae
D. atyidae	Shrimp larvae	Decapoda	Atyidae

Table 14 Sampling point 40D (2 identified species)

Latin Name	English Name	Order	Family
Amphipoda	Sideswimmers	Amphipoda	Gammaridea
Hemiptera	True bugs	Hemiptera	Corixidea

Appendix 2. Macrophytes

Table 15 Sampling point 0 (14 identified species)

Latin Name	English Name	Order	Family
E. equisetaceae	Horsetail	Equisetales	Equisetaceae
M. aquatica	Mint	Lamiales	Lamiaceae
A. apiaceae	Parsley	Apiales	Apiaceae
C. polygonaceae	Knotweed	Caryophyllales	Polygonaceae
M. malvaceae	Mallows	Malvales	Malvaceae
A. asteraceae	Daisy	Asterales	Asteraceae
S. solanaceae	Nightshades	Solanales	Solanaceae
B. brassicaceae	Cabbage	Brassicales	Brassicaceae
M. onagraceae	Willowherb	Myrtales	Onagraceae
L. plantaniginaceae	Plantain	Lamiales	Plantaginaceae
C. amaranthaceae	Amaranth	Caryophyllales	Amaranthaceae
C. characeae	Stoneworts	Charales	Characeae
P. poaceae	Gramineae	Poales	Poaceae
E. primulaceae	Primulaceae	Ericales	Primulaceae

Table 16 Sampling point 10D (7 identified species)

Latin Name	English Name	Order	Family
S. solanaceae	Nightshades	Solanales	Solanaceae
A. asteraceae	Daisy	Asterales	Asteraceae
L. lamiaceae	Mint	Lamiales	Lamiaceae
P. cyperaceae	Sedges	Poales	Cyperaceae
L. plantaginaceae	Plantain	Lamiales	Plantaginaceae
A. iridaceae	Irises	Asparagales	Iridaceae
F. fabaceae	Bean	Fabales	Fabaceae

Table 17 Sampling point 25 (9 identified species)

Latin Name	English Name	Order	Family
P. typhaceae		Poales	Typhaceae
M. onagraceae	Willowherb	Myrtales	Onagraceae
C. polygonaceae	Knotweed	Caryophyllales	polygonaceae
P. poaceae	Gramineae	Poales	Poaceae
M. lythraceae		Myrtales	Lythraceae
C. amaranthaceae	Amaranth	Caryophyllales	amaranthaceae
A. asteraceae	Daisy	Asterales	Asteraceae
A. alismataceae	Plantain	Alismatales	alismataceae
P. cyperaceae	Sedges	Poales	Cyperaceae

Table 18 Sampling point 26 (7 identified species)

Latin Name	English Name	Order	Family
P. poaceae	Gramineae	Poales	Poaceae
P. juncaceae	Rush	Poales	Juncaceae
L. lamiaceae	Mint	Lamiales	Lamiaceae
M. lythraceae		Myrtales	Lythraceae
A. asteraceae	Aster	Asterales	Asteraceae
P. cyperaceae	Sedges	Poales	Cyperaceae
C. polygonaceae	Knotweed	Caryophyllales	Polygonaceae

Table 19 Sampling point 30 (4 identified species)

Latin Name	English Name	Order	Family
P. typhaceae		Poales	Typhaceae
C. polygonaceae	Knotweed	Caryophyllales	Polygonaceae
L. plantaginaceae	Plantain	Lamiales	plantaginaceae
M. onagraceae	Willowherb	Myrtales	Onagraceae

Table 20 Sampling point 40U (8 identified species)

Latin Name	English Name	Order	Family
P. typhaceae		Poales	Typhaceae
C. polygonaceae	Knotweed	Caryophyllales	Polygonaceae
A. asteraceae	Aster	Asterales	Asteraceae
L. lamiaceae	Mint	Lamiales	Lamiaceae
P. cyperaceae	Sedges	Poales	Cyperaceae
C. amaranthaceae	Amaranth	Caryophyllales	Amaranthaceae
P. juncaceae	Rush	Poales	Juncaceae
A. apiaceae	Parsley	Apiales	Apiaceae

Table 21 Sampling point 40D (5 identified species)

Latin Name	English Name	Order	Family
P. typhaceae		Poales	Typhaceae
A. asteraceae	Aster	Asterales	Asteraceae
C. amaranthaceae	Amaranth	Caryophyllales	Amaranthaceae
C. polygonaceae	Knotweed	Caryophyllales	Polygonaceae
P. cyperaceae	Sedges	Poales	Cyperaceae

Table 22 Sampling point 50 (1 identified species)

Latin Name	English Name	Order	Family
C. amaranthaceae	Amaranth	Caryophyllales	Amaranthaceae

Appendix 3. Phytoplankton and zooplankton

Table 23 Sampling point 0 (1 identified species)

Latin Name	English Name	Order	Family	Species
N. oscillatoriae	Blue algae	Nostocales	Oscillatoriae	Oscillatoria Agardhii

Table 24 Sampling point 10U (5 identified species)

Latin Name	English Name	Order	Family	Species
	Blue algae			Coelosphaerium kuetzingianum
	Algae			Cryptomonas erosa
C. microcystaceae	Cyanobakteria	Chroococcales	Microcystaceae	Mycroscystis spec.
	Golden algae	-	Crysoficea	Uroglena spec.
P. amphora	Diatoms	Penales	Amphora	Amphora spec.

Table 25 Sampling point 10D (8 identified species)

Latin Name	English Name	Order	Family	Species
B. bacillariaceae	Diatoms		Xantophyceae	Nitzschia filiformis
	Diatoms		Xantophyceae	Cymatopleura solea
C. scenedesmaceae	Green algae	Chlorococcales	Scenedesmaceae	Scenedesmus spec.
S. surirellaceae	Diatoms	Surirellales	Surirellaceae	Navicula spec.
C. scenedesmaceae	Green algae	Chlorococcales	Scenedesmaceae	Nautococcos pyriformis
E. euglenaceae	Euglena	Euglenales	Euglenaceae	Euglena spec
	Blue algae		Chroococcophyceae	Coelosphaerium kuetzingianum
	Green algae			Ankyra ankora

Table 26 Sampling point 25 (9 identified species)

Latin Name	English Name	Order	Family	Species
N. oscillatoriae	Blue algae	Nostocales	Oscillatoriae	Oscillatoria Agardhii
N. naviculaceae	Diatom	Naviculales	Naviculaceae	Navicula spec.
V. chlorophyceae	Green algae	Volvocales	Chloromonadae	Pandorina morum
B. bacillariaceae	Diatom		Xantophyceae	Nitzschia filiformis
	Diatom		Xantophyceae	Nitzschia acicularis
E. euglenaceae	Euglena	Euglenales	Euglenaceae	Euglena spec.
	Diatom		Xantophyceae	Amphora ovalis
	Green algae		Chlorophyceae	Klebsormidium flaccidum
	Diatom		Xantophyceae	Cymbella

Table 27 Sampling point 25A (1 identified species)

Latin Name	English Name	Order	Family	Species
N. oscillatoriae	Blue algae	Nostocales	Oscillatoriae	Oscillatoria Agardhii

Table 28 Sampling point 26 (8 identified species)

Latin Name	English Name	Order	Family	Species
	Diatom		Xantophyceae	Stauroneis anceps
	Diatom		Xantophyceae	Gyrosigmas acuminatum
	Plathelminthes			Tetracelis marmaroso
N. oscillatoriae	Blue algae	Nostocales	Oscillatoriae	Oscillatoria Agardhii
	Diatom			Fragilaria capucina var. Vaucheriae
E. euglenaceae		Euglenales	Euglenaceae	Euglena spec
B. bacillariaceae	Diatom		Xantophyceae	Nitzschia filiformis
	Diatom			Surirella biserata

Table 29 Sampling point 30 (9 identified species)

Latin Name	English Name	Order	Family	Species
E. euglenaceae		Euglenales	Euglenaceae	Euglena spec
N. oscillatoriaceae		Nostocales	Oscillatoriaceae	Oscillatoria Agardhii
N. naviculaceae	Diatom	Naviculales	Naviculaceae	Navicula spec.
C. scenedesmaceae	Green algae	Chlorococcales	Scenedesmaceae	Scenedesmus opoliensis
	Green algae	Chlorococcales		Ankistrodesmus stipitatus
	Green algae	Chlorococcales		Coelastrium microporum
	Diatom		Xantophyceae	Gyrosygma attenuatum
E. euglenaceae		Euglenales	Euglenaceae	Phacus pleuronectes
	Green algae			Ankyra ankora

Table 30 Sampling point 40D (9 identified species)

Latin Name	English Name	Order	Family	Species
V. chlorophyceae	Green algae	Volvocales	Chloromonadae	pandorina morum
N. oscillatoriae	Blue algae	Nostocales	Oscillatoriae	oscillatoria Agardhii
	Green algae	Chlorococcales		Ankistodesmus acicularis
	Diatom		Xantophyceae	Hantzschia abundans
	Actinopod		Heliozoa	Elaeorhanis cincta
B. bacillariaceae	Diatom		xantophyceae	Nitzschia filiformis
	Diatom			surirella biserata
E. euglenaceae		Euglenales	Euglenaceae	euglena spec
	Green algae		Chlorophyceae	chlamydamona reinhardii

Table 31 Sampling point 40U (14 identified species)

Latin Name	English Name	Order	Family	Species
S. scendesmaceae	Green algae	Sphaeropleales	Scendesmaceae	Scenedesmus quadricauda
N. naviculaceae	Diatom	Naviculales	Naviculaceae	Naviculo gregaria
C. scendesmaceae	Green algae	Chlorococcales	Scendesmaceae	Pediastrum duplex
N. oscillatoriae	Blue algae	Nostocales	Oscillatoriae	Oscillatoria Agardhii
	Blue algae			Dactylococcopsis fascicularis
	Diatom			Nitzschia acicularis
E. euglenaceae		Euglenales	Euglenaceae	Euglena acus
E. euglenaceae		Euglenales	Euglenaceae	Euglena pisciforma
E. euglenaceae		Euglenales	Euglenaceae	Phacus longicauda
	Green algae	Chlorococcales		Coelastrium microporum
	Green algae	Chlorococcales		Monoraphidium griffithii
	Diatom			Fragilaria capucina var. Vaucheriae
E. euglenaceae		Euglenales	Euglenaceae	Euglena spirogyra
E. euglenaceae		Euglenales	Euglenaceae	Euglena viridis