9. IBGN study: Murgat

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This study used the Standardized Global Biological Index (IBGN) to assess the benefit of the aquaculture effluent treatment system at Murgat farm, France, on the quality of the recipient river. The aim of this index, determined by the study of benthic macro-invertebrates, is to assess the biological quality of a watercourse against a standardized general typology. The method (French National Standard NF T 90-350) records changes in the biological quality of a watercourse over a period of time. Tables used to determine the SGBI are provided at Annex 1 and 2.

project: in July 2006 and in April 2007. The results were compared with the same type of assessment carried out at Murgat in 1985-1986, when the farm was releasing effluent without treatment. The same protocol was used for both studies (1985-86 and 2006-07).

1. Materials and methods

The assessment was made twice at Murgat during the AquaETreat
Determination of the IBGN for a watercourse uses 138 taxa (Annex 2) with the family as the taxonomic unit, or sometimes the branch or the class. Thirty-eight (38) of the 138 determinant taxa are bio-indicators. They are assigned different colours according to their sensitivity to pollution (see Annex 2).

Each sampling site has to be 10 times greater in length than in width. Eight samples, representing the natural diversity of the site, are needed for the determination of each IBGN. Each sample is characterized by a substrate category (10 substrates, designated 0 - 9) and a water flow rate (5 levels). If the site does not present eight different substrates, several samples are made for one substrate at different spots characterized by different water velocities. The area covered by the sampling site, and the water level, are recorded in a sampling table (Annex 1). Cells in the table are completed for each substrate/flow rate pair.

2. Protocol

A "Surber" sampler (Figure 1) is placed on the substrate with the net facing into the water flow direction. The sampler characteristics are standardized, with a surface area of 1/20 m^2 and a mesh size of 0.5 mm.

After sorting, the macro-invertebrate samples are preserved in a 10% formalin solution. Identifications are made using a key to determine the branch, the class, the order and the family of each macro-invertebrate in each sample.

Figure 1: IBGN Surber sampler

3. Determining the Index (IBGN)

The total number of different taxa recorded for the sampling area is calculated and tables are used to determine the Taxonomic Variety (TV) (from 1 – 14). The Taxonomic Variety gives information about the substrate quality: the higher the Taxonomic Variety, the better is the biogenic quality.

The faunal indicator group number (IG) (from 1 to 9) is also required to determine the Index. It gives information on the water quality of a sample and is obtained by reference to the Table shown at the end of Annex 2.

Finally, the IBGN (from 0 – 20) is read from a Table (Annex 3) at the point of intersection between the TV column and the IG row. The maximum IBGN is 20. Each IBGN can be interpreted according to a standard colour category (Table 1).

Table 1: IBGN and corresponding colour categories

IBGN	>16	15-13	12-8	8-5	<5
Class	Blue	Green	Yellow	Orange	Red
Quality	Excellent	Good	Fair	Poor	Very poor

4. Conditions and limits

The IBGN is not appropriate for estuaries, wells and large watercourses (water depth has to be less than 1 m). This may be considered as a problem, at least a limitation in our case, since the water used by the farm originates from a spring from which the water flow is partly pumped.

The flow rate of the watercourse must have been stable for 10 days. To allow meaningful samples, the water flow rate should not be too high and water turbidity must be low.

The Index can change according to the season, as a consequence of biological cycles and changes in environmental conditions.

5. Murgat farm effluent monitoring : the recipient ecosystem quality

The Murgat farm uses two water springs, the Oron well water and the water from the "bief Lacour" (figure 2).

Farm effluent is discharged into the Oron, and then into a channel: "Canal de la Raille".

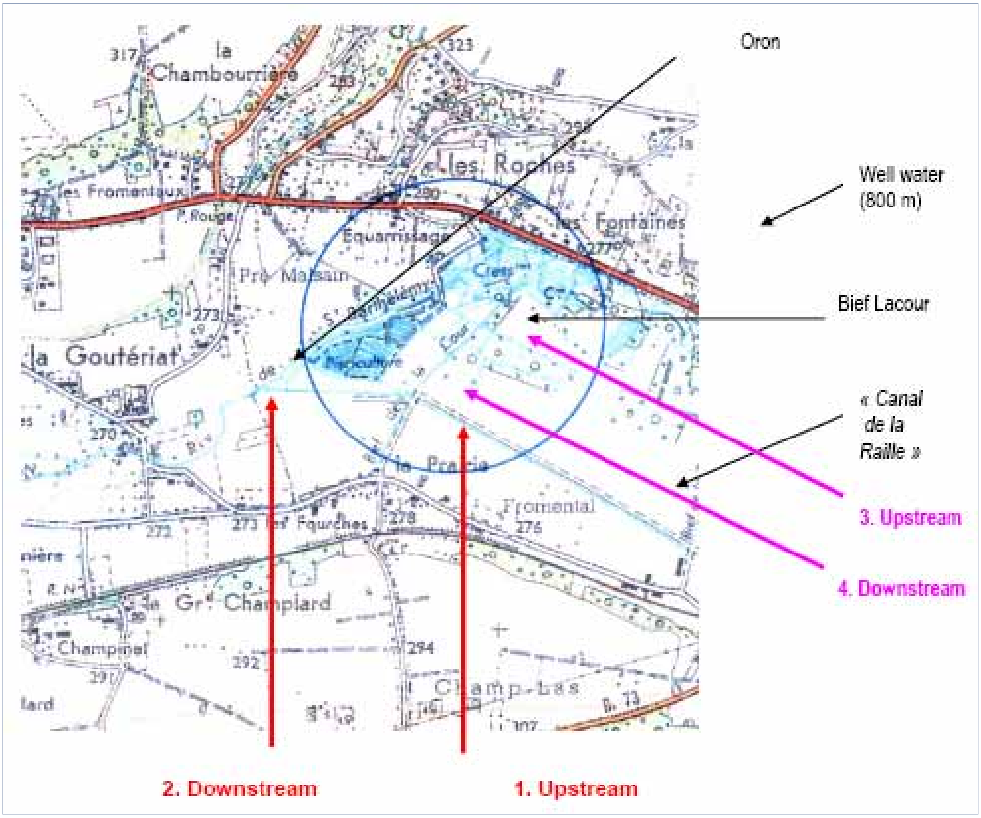

Figure 2: Murgat farm situation and IBGN sampling points

The “reserved flow rate” (water flow that the farmer has to release into the river without using it in the farm) is also released in the “Bief Lacour” when the watercourse level is low.

6. Results

July 2006

In July 2006, two IBGN were assessed upstream and two downstream of the place where the farm effluent discharges:

1) in the Oron and the Canal de la Raille :

upstream IBGN : **10**/20 with IG= 5 and TV= 6.
downstream IBGN : **11**/20 with IG= 5 and TV= 7.

Both indicate a fair water quality. This low Index can be explained by the water origin (well water) which is biologically poor; furthermore, the samples were taken in summer when most insects are in their flying phase and others are in their larval phase, making determination difficult. At this area, the 1985 -86 study showed an Index of **12**/20 upstream and **11**/20 downstream.

2) in the “Bief-Lacour”:

upstream IBGN : **11**/20 with IG= 7 and TV= 5.
downstream IBGN : **8**/20 with IG= 3 and TV= 6.

Downstream of the outlet of the farm, the water quality falls within the poor category and the biological diversity decreases.

April 2007

In April 2007, two Indices were determined upstream and downstream of the main discharge point of the farm (in the Oron and the Canal de la Raille). There was no discharge into the “Bief Lacour” at this period.

upstream IBGN n°1: **15**/20 with IG= 7 and TV= 9.
downstream IBGN n°1 : **14**/20 with IG= 7 and TV= 8.

upstream IBGN n°2 : **15**/20 with IG= 8 and TV= 8.
downstream IBGN n°2 : **14**/20 with IG= 6 and TV= 7.

The water quality and the substrate quality of habitats are ‘Good’ downstream the outlet of the farm, with a biological quality than upstream (fewer insects and more detritus-consuming animals).

7. Conclusion

Since the whole effluent treatment system was set up in 2006, the biological quality of the recipient ecosystem has improved, with a current ‘good’ biological quality.

The effluent treatment system had a positive impact on biological communities with more rare and pollution-sensitive species found in the 2007 samples.
In spite of the short duration of the AquaETreat project, the treatment of effluent at Murgat farm had a measurable and positive effect on the recipient ecosystem.

Annex 1: The role of algal photosynthesis in transforming fish farm wastes into usable resources

Name of the stream :			
Name of the sampling site :			**Date** :
Hydrology :	• Low water	• Average waters	• Others
Water temperature (°C)	**Turbidity (cm)** (Secchi)	**pH**	**Conductivity** (µS)

Surface water speed V (cm/s)		V>150	150-75	75-25	25-5	V<5
Supporting habitat:						
Bryophytes	9					
Submerged seed-plants	8					
Coarse organic elements (litter, twigs, roots)	7					
Large mineral sediments (stones, pebbles) (>25 mm)	6					
Coarse aggregates (25 mm – 2.5 mm)	5					
Emergent marginal seed-plants	4					
Organic fine sediments, "mud" (<0.1 mm)	3					
Sand and silt grains (<2.5 mm)	2					
Natural and artificial areas (rocks, slabs, soil, walls) (blocks >250 mm)	1					
Algae or bare marl and clay	0					

Example of completed cell:

4	(3)	25 cm

4 = sample number (from 1 - 8)

(3) = cover abundance of the sampled substrate:

(1) incidental (2) scarce (<10%) (3) abundant (10 - 50%) (4) very abundant

25 cm = water depth at the sampling location.

Annex 2 : List of the 138 taxa used for the IBGN, List of fauna

INSECTS **PLECOPTERA** **Capniidae(8)** **Chloroperlidae(9)** **Leuctridae(7)** **Nemouridae(6)** **Perlidae(9)** **Perlodidae(9)** **Taeniopterygidae(9)** **TRICHOPTERA** **Beraeidae(7)** **Brachycentridae(8)** Ecnomidae **Glossosomatidae(7)** **Goeridae(7)** Helicopsychidae **Hydropsychidae(3)** **Hydroptilidae(5)** **Lepidostomatidae(6)** **Leptoceridae(4)** **Limnephilidae(3)** Molannidae **Ondotoceridae(8)** **Philopotamidae(8)** Phryganeidae **Polycentropodidae(4)** **Psychomyidae(4)** **Rhyacophilidae(4)** **Sericostomatidae(6)** Thremmatidae **EPHEMEROPTERA** **Baetidae(2)** **Caenidae(2)** **Ephemerellidae(3)** **Ephemeridae(6)** **Heptageniidae(5)** **Leptophlebiidae(7)** Oligoneuriidae **Polymitarcidae(5)** **Potamanthidae(5)**	Prosopistomatidae Siphlonuridae **HETEROPTERA** **Aphelocheiridae(3)** Corixidae Gerridae Hebridae Hydrometridae Naucoridae Nepidae Notonectidae Mesoveliidae Pleidae Veliidae **COLEOPTERA** Curculionidae Donaciidae Dryopidae Dystiscidae Eubriidae **Elmidae(2)** Gyrinidae Haliplidae Helodidae Helophoridae Hydraenidae Hydrochidae Hydrophilidae Hydroscaphidae Hygrobiidae Limnebiidae Spercheidae **DIPTERA** Anthomyzidae Athericidae Blephariceridae Ceratopogonidae Chaoboridae **Chironomidae(1)** Culicidae	Dixidae Dolichopodidae Empididae Ephydridae Limoniidae Psychodidae Ptychopteridae Rhagionidae Scatophagidae Sciomyzidae Simuliidae Stratiomyidae Syrphidae Tabanidae Thaumaleidae Tipulidae **ODONATA** Aeschnidae Calopterygidae Coenagrionidae Cordulegasteridae Corduliidae Gomphidae Lestidae Libellulidae Platycnemididae **MEGALOPTERA** Sialidae **PLANIPENNIA** Osmylidae Sysyridae **HYMENOPTERA** **LEPIDOPTERA** Pyralidae **SHELLFISH** **BRANCHIOPODA** **AMPHIPODA** **Gammaridae(2)** **ISOPODA** **Asellidae(1)**	**DECAPODS** Astacidae Atyidae Grapsidae Cambaridae **MOLLUSCS**(2) **BIVALVIA** Corbiculidae Dreissenidae Sphaeriidae Unionidae **GASTROPODS** Ancylidae Bithynidae Bythinellidae Hydrobiidae Lymnaeidae Neritidae Physidae Planorbiidae Valvatidae Viviparidae **WORMS** **ACHAETA(1)** Erpobdellidae Glossiphonidae Hirudinidae Piscicolidae **TRICLADIDA** Dendrocoelidae Dugesiidae Planariidae **OLIGOCHAETA(1)** **NEMATHELMINTHES** **HYDRACARI** **HYDROZOA** **PORIFERA** **BRYOZOA** **NEMERTEA**

green	blue	cyan	violet	mauve	pink	orange	grey	red
IG9	IG8	IG7	IG6	IG5	IG4	IG3	IG2	IG1

Annex 3:

Variety class (TV)		14	13	12	11	10	9	8	7	6	5	4	3	2	1
Indicators taxa	St **IG**	> 50	49 45	44 41	40 37	36 33	32 29	28 25	24 21	20 17	16 13	12 10	9 7	6 4	3 1
Chloroperlidae Perlidae Perlodidae Taeniopterygidae	**9**	20	20	20	19	18	17	16	15	14	13	12	11	10	9
Capniidae Brachycentridae Odontocéridae Philopotamidae	**8**	20	20	19	18	17	16	15	14	13	12	11	10	9	8
Leuctridae Glossosomatidae Beraeidae Goeridae Leptophlébiidae	**7**	20	19	18	17	16	15	14	13	12	11	10	9	8	7
Nemouridae Lepidostomatidae Sericostomatidae Ephemeridae	**6**	19	18	17	16	15	14	13	12	10	9	8	7	6	5
Hydroptilidae Heptageniidae Polymitarcidae Potamanthidae	**5**	18	17	16	15	14	13	12	11	10	9	8	7	6	5
Leptoceridae Polycentropodidae Psychomyidae Rhyacophilidae	**4**	17	16	15	14	13	12	11	10	9	8	7	6	5	4
Limnephilidae (1) Ephemerellidae (1) Hydropsychidae Aphelocheiridae	**3**	16	15	14	13	12	11	10	9	8	7	6	5	4	3
Baetidae (1) Caenidae(1) Elmidae (1) Gammaridae (1) Molluscs	**2**	15	14	13	12	11	10	9	8	7	6	5	4	3	2
Chironomidae (1) Asellidae (1) Achets Oligochets (1)	**1**	14	13	12	11	10	9	8	7	6	5	4	3	2	1

(1) Taxa represented by at least 10 individuals. Others by at least 3 individuals