OPEN-CAST RESTORATION OF A HYDROSYSTEM AND DEVELOPMENT OF PONDS AND WETLAND IN AN AGRICULTURAL SURFACE BY REMOVAL OF A DRAINAGE NETWORK AND BY SOIL MODELLING

EXAMPLE OF REPLACEMENT OF HABITATS TO IMPROVE BIODIVERSITY

BERNARD LACHAT, bioengineer

BIOTEC Biologie appliquée SA, route de Courroux 17, CH - 2824 Vicques

(tél. +41 32 435 66 66, FAX +41 32 435 56 46 , e-mail : biotec@biotec.ch)

The initial state of the site consisted of a fertilised meadow and a marshy pasture. Views before works (for comparison, see illustration on bottom left). Whole the plot of land is situated on a soft inclined slope.

COMMUNE OF CORNOL

FREGIECOURT

The land use of surfaces seem to have drained the ground gradually, also reducing floristic diversity and reproduction of amphibians.

The site of 'Pré Raisin' was retained because it had the following characteristics :
- situation in alignment with existing wood, allowing to create an ecological continuum;
- high potential of ecological diversification: rather wet ground, semi-extensive agricultural use;
- not very deep grounds, with rock exposures and presence of clay, being of minor interest for agriculture;
- disturbances relatively low, in spite of the presence of a shooting range close by (in use maximum 2 days a month, only during the day).

These various parameters allowed to forecast :
- a good attractivity of the environment for game, especially for dispersal (wild boar, roe-deer, stag), thanks to the permanent food resources, and the cover at any season;
- the development of a rich biodiversity in a farmland zone : the potential taxonomic groups on the site are the vegetation of running or stagnant waters, of marshy surfaces, of wet and dry meadows, the invertebrate fauna, birds and amphibians.

Since the small ditches and the ponds, natural infiltrations in direction of downstream are thus possible. The water absorption and imbibition in the ground are possible throughout water courses. Thus, without particular direct action on the settlement, this one changes according to the percentage of moisture.

The habitats obtained are illustrated with the next colors :

LEGEND

- Zone A : wet extensive meadow
- Zone Ba (north / bottom), Zone Bb (east / flat land), Zone Bc (west / slope): extensive meadow with flowers
- Zone C : orchard and extensive meadow
- Zone D : reeds meadow
- Zone Ea: new surface seeding with wet meadow plants
- Zone Eb (dry), Zone Ec (semi-wet): extensive meadow with flowers
- Zone F : reeds meadow
- new surface seeding with wild flowers
- little ponds
- ponds
- Hedge
- Copses
- Groves (*Alnus glutinosa)*
- Ditch
- Weir
- Old variety of high-stem fruit tree
- Lonesome tree
- Forest border
- Drainage
- Fence
- Access

Alignment of the little ponds supplied with the overflow of pond 1.
These ponds are not very deep (max. 50 cm) in order to offer optimal conditions for the development of the insect larvae and the growth of particular plants.

Downstream from the pond 2, they are two preferential courses (resulting from two overflows at the same level on the dam), which were designed with not very deep ponds.
For pond 1, the clay excavated was laid out into a little dam, downstream of the outfalls of pond 2, in order to create a 0.80 m depth additional pond. These two ponds do not have a system of emptying. With this intention, if necessary, a siphoning can be planned.

The central point is the creation of a deep vast pond (pond 2) which collects water of the first series of ditches, the rivulets and the water percolations in the soils.

The interest of this pond is the permanent presence of water during the year. The surface of the water level is of 1'500 m² and the maximum depth of 2 m.

In order to guarantee the stability of the dam on the inclined and wet ground, this one was built with tight materials of the 1st quality (pure clay) (figure 7) resulting from the digging of the tunnels of the motorway.

It was strongly compacted and drained with a solid base at the bottom. A narrow excavation of the central part was made. This one was filled with lean concrete to avoid the work of sap of the muskrats (Ondatra zibethicus).

Several large pits, upstream and downstream from pond 1, were dug (max 1 m) along the rivulet. The course thus create fill of water, restore the moisture of the sail and function as a ditch. Running water is then recovered in another basin and so on.This system has the advantage of creating permanent water points in summer, even if the water flow decreases.

Water runs in a small not deep rivulet where the lentic and lotic facies alternate. Often, one or two logs out of wooden clogged with clay and arranged transversely to the flow (weir) forces water to overflow and wet the lands. The flow is variable according to precipitations'. On average 1 l/s runs out. However, in summer, the flow can be null.

The purpose was to reactivate, a "hydrosystem" starting from underground drains in the top of the plot, in order to create a vast wetlands on more than 4 ha in order to favour several groups of plants and threatened and/or protected animals (red lists).
Water is collecting at a point where the principal drain was put open-cast.

Work execution : **1996**

Cost : **CH Fr. 86'000.-- / € 57'000.00**

Annual maintenance cost :
CH Fr. 1'000.-- / € 700.00

The purpose being to reactivate the soil moisture to constitute at the same time a natural environment being used as corridor and as a site of reproduction for fauna, it was significant to be able to raise the water level.

Landscape patches develop various habitats and ecotones like :

rivulets;
ponds;
ditches;
untreated wet meadow;
marshy pasture;
grassiomel;
hedges;
thickets;
forest border;
orchard.

LEGEND

- Zone A : wet extensive meadow
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Butterflies

30 species of butterflies were counted. General of them are rare or endangered. The majority of butterflies observed are ubiquist species (*Vanessa cardui, Pieris sp.*), mesophilous meadow species (*Coenonympha pamphilus, Manida jurtina, Polycommatus icarus, Colias hyale*).

Two species are very interesting :

Brenthis ino, rare in the country, and *Lycaena dispar* endangered in Switzerland.

Dragonflies

28 species of dragonflies were observed in 2002.

This relatively high quantity is explained particularly by the variety of various water habitats : running water, ditches, large pond, …

Because they are directly related to water levels the different vegetation types form a series of distinct zones and produce riche ecotones.

Marshes which fringes areas of open water and semi-aquatic vegetation create various landscape patches.

Fens and marshes provide suitable habitats for frogs and grass snake.

Insects and other invertebrates occur in profusion. Some species are totally dependant on the continuity of very specialised conditions such as permanent water, particular plants for their food, …

Species	pond 1	pond 2	littles ponds	ditches
Aeshna cyanea	+	+	+	
Aeshna grandis	+			
Aeshna mixta		+		
Anax imperator	+	+		
Calopteryx s. splendens	+		+	
Calopteryx v. virgo	+			
Chalcolestes viridis	+	+	+	
Coenagrion puella	+	+	+	+
Cordulegaster boltonii				+
Cordulia aenea	+	+		
Crocothemis erythraea		+		
Enallagma cyathigerum	+	+	+	
Epitheca bimaculata	+			
Gomphus pulchellus	+		+	
Ischnura elegans	+	+	+	
Ischnura pumilio			+	+
Libellula depressa	+	+	+	+
Libellula quadrimaculata	+	+	+	
Orthetrum albistylum	+			
Orthetrum brunneum	+		+	
Orthetrum cancellatum	+	+	+	
Orthetrum coerulescens			+	
Platycnemis pennipes	+	+	+	
Pyrrhosoma nymphula	+	+	+	+
Somatochlora metallica		+		
Sympecma fusca		+	+	
Sympetrum sanguineum			+	
Sympetrum striolatum	+	+	+	

Many of the plants and animals which live in wetland habitats are specially adapted for semi-aquatic conditions and so are entirely dependent on fens and marshes for their survival. Most of wildlife depends on wetland for food and shelter. Because of the different types of habitat it offers, the created wetland zona supports a richest variety of wildlife.

Management of the area has been divided in vegetation parts due to the ground water level and run off variations.

The distribution of plants and animals in the wet area is affected largely by the type of soil (moisture or no) and by the farming methods used. Wet meadows consist predominantly of sedges together with flowers dependent on moist soil. A regime of reed cutting and short time grazing has been established in order to retain the characteristic plants and animals of the area.

Grassland and wet meadows are managed traditionally and are rich in flowers and grasses which in turn provide food for butterflies and other insects.

Conservation of fens and marshes requires also careful control of water levels.

The source of water needs to be carefully respected to ensure that it is not heavily polluted with plants nutrients.

Floristic list and sociology

Pré Raisin			Zone A	Zone Ba, bottom	Zone Bb, flat land	Zone Bc, slope	Zone C orchard	Zone Ea, littles	Zone Ec, soil	Zone D et zone F	Littles ponds	Ponds 1 and 2
Types			Wet extensive meadow	Extensive meadow + flowers	Extensive meadow + flowers	Extensive meadow + flowers	Extensive meadow + flowers	Extensive meadow (seeding)	Extensive meadow (seeding)	Reeds meadow		
Coverage			100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Species	PRO-TECTION	STATUT	A D	A D	A D	A D	A D	A D	A D	A D	A D	A D
Achillea millefolium		LC	+	+ 2	+	+	+ 2	+	+	+		
Achillea ptarmica		VU										3
Agrostis stolonifera		LC	+ 1									
Ajuga reptans		LC				+ 2	1 2	+	+		1	
Alchemilla xanthochlora		LC			+ 1							
Alopecurus pratensis		LC				+ 2	1 2	+	+ 1			
Angelica sylvestris		LC										
Anthoxanthum odoratum		LC	2 2	+ 1	+ 2	2 2	1 2	+	+ 1			
Anthriscus sylvestris		LC	1 2					+				
Aquilegia vulgaris	REG	LC										
Arrhenatherum elatius		LC	1 2	2 3	2 2	2 2	2 2	+	2 2			
Bellis perennis		LC	+ 2					+	+		1	
Brachypodium sylvaticum		LC							+			
Briza media		LC							+			
Bromus erectus		LC				r 1			+			
Bromus hordeaceus		LC	1 1		1 2	1 2	2 2		+			
Calystegia sepium		LC		1 2						2 2	1	
Capsella bursa-pastoris		LC					+ 1					
Cardamine hirsuta		LC										
Cardamine pratensis		LC	+ 2		r 1	+ 2	+ 1					
Carduus crispus		LC										
Carex acutiformis		LC		2 4								
Carex distans		VU										
Carex flacca		LC									1	
Carex hirta		LC	+ 1		2 2		1 2	+	+ 1	1 2	1	
Carex paniculata		LC										
Carex spicata		LC	+ 1	3 3	1 2		1 2	+	1 2			
Carex viridula		NT									1	
Centaurea jacea		LC			r 1			+	+			
Centaurea scabiosa	REG	LC										
Cerastium brachypetalum		VU	2 1		+ 1	1 1	2 1					
Cerastium glutinosum		VU	1 1									
Chaerophyllum hirsutum		LC									1	
Cirsium arvense		LC	+ 1	+ 1	+ 1		2 1	+	+ 2	1 1		
Cirsium oleraceum		LC										
Cirsium vulgare		LC		1 1		+ 1		+	+		1	
Colchicum autonnale		LC					+ 1					
Crepis biennis		LC	1 1			1 1	+ 1					
Cynosurus cristatus		LC	1 1			+ 1	1 2					
Dactylis glomerata		LC	2 1	1 2	1 2	+ 1	2 2	+	+ 1	1 1		
Deschampsia caespitosa		LC					2 2			1 1		
Dipsacus fullonum		LC				+ 2						
Epilobium hirsutum		LC		1 1							1	
Epilobium parviflorum		LC		2 1					+	1 1		
Equisetum arvense		LC		2 1								
Eupatorium cannabinum		LC										
Euphorbia sp.		LC							r	1 1		
Festuca arundinacea		LC							+	1 1		
Festuca pratensis		LC	1 1	1 2	1 2	+ 1	2 2	+	+			
Festuca rubra		LC	+ 2	3 3	2 2	1 2	2 2	+	+ 2	3 3		
Filipendula ulmaria		LC		1 2					+	2 1		
Galeopsis tetrahit		LC		1 1		+ 1	+ 1		+	2 1		
Galium album mollugo		LC	2 2	2 4	+ 2	2 3	1 2	+	+	3 3		
Galium aparine		LC		1 1	+ 1	+ 1				1 2		
Geranium dissectum		LC	+ 1		+ 1	+ 1	r 1					
Geranium robertianum		LC					r 1					
Geum urbanum		LC			+ 1							
Glechoma hederacea		LC							+			
Glyceria notata		LC									1	
Helichrichon pubescens		LC							+			
Heracleum sphondylium		LC	2 1	+ 1		+ 1	2 1	+	+			
Holcus lanatus		LC	3 3	3 3	2 2	1 2	2 2	+	+ 2			
Hypericum maculatum		LC					r 1		+			
Hypericum tetraptenum		LC									1	
Hypochaeris radicata		LC							r 1			
Juncus articulatus		LC										
Juncus effusus		LC					r 2				1	
Juncus inflexus		LC									1	
Knautia arvensis		LC							+			
Lamium maculatum		LC					1 4					
Lamium purpureum		LC					r 1					
Lapsana communis		LC							+			
Lathyrus pratensis		LC	1 3	+ 2		1 2	2 2	+	+ 2	1 1		
Lemna minor		LC										
Leontodon hispidus		LC					r 1					
Leucanthemum vulgare		LC				+ 1			+			
Linaria vulgaris		LC				1 3	1 2		+			
Lolium perenne		LC	2 1			+ 2	1 3					
Lotus corniculatus		LC	r 1			+ 2	1 3					
Luzula multiflora		LC							r 1			
Lysimachia nummularia		LC				+ 1						
Lysimachia vulgaris		LC										
Lythrum salicaria		LC		1 1								
Medicago lupulina		LC	1 2			2 2	1 2					
Mentha aquatica		LC		1 2								
Mentha longifolia		LC		1 4			1 2		2 4	1 1		
Myosotis arvensis		LC										
Myosotis scorpioides		LC				+ 1						
Ononis repens		LC					r 1					
Origanum vulgare		LC							+			
Orobanche alba	REG	NT										
Phleum pratense		LC	1 2				2 2					
Pimpinella major		LC	r 1				1 1					
Plantago lanceolata		LC	2 3	1 2			2 2					
Poa pratensis		LC	1 1	2 1	+ 2	1 1	2 2					
Poa trivialis		LC	2 1	2 2	+ 2	1 1	2 2					
Polygonum hydropiper		LC					+ 1					
Potentilla anserina		LC		2 3		1 2	2 2					
Potentilla reptans		LC	+ 2	1 1		1 2	1 2	+	+	1 1		
Primula elatior	REG	LC										
Prunella vens	REG	LC	r 1					+	+			
Ranunculus repens		LC				1 1	+ 1	+	+			
Ranunculus acris		LC	2 1	+ 1	1 2	2 2	1 2	+	+			
Ranunculus ficaria		LC				2 3	2 2					
Ranunculus repens		LC					+ 1					
Rhinanthus alectorolophus		LC										
Rubus idaeus		LC										
Rubus sp.		LC		1 2								
Rumex acetosa		LC	2 1	1 1	+ 2	2 3	2 2	+	+			
Rumex crispus		LC	r 1				+ 1					
Rumex obtusifolius		LC	+ 1				+ 1					
Salvia pratensis		LC										
Sambucus ebulus		LC										
Sanguisorba minor		LC				+ 1						
Scirpus sylvaticus		LC										
Scrophularia nodosa		LC		1 1			+ 1					
Senecio jacobea		LC		1 1								
Silene dioica		LC										
Silene flos-cuculi		LC	+ 2				1 2	+	+			
Soldago gigantea	NI	(LC)										
Sonchus asper		LC	r 1									
Sparganium erectum	REG	NT										
Stachys sylvatica		LC										
Myosotis aquaticum		LC					+ 1					
Stellaria graminea		LC										
Stellaria media		LC										
Taraxacum officinale		LC	1 1									
Tragopogon pratensis		VU										
Trifolium pratense		LC	2 1									
Trifolium repens		LC	1 1									
Trisetum flavescens		LC	2 1									
Typha latifolia	REG	LC										
Urtica dioica		LC										
Valeriana officinalis		LC										
Veronica anvensis		LC	2 1									
Veronica beccabunga		LC										
Veronica chamaedrys		LC										
Veronica hederifolia		LC										
Vicia cracca		LC										
Vicia sepium		LC	r 1									
Diversity			34	32	14	35	49	44	34	32	19	19

INFORMATIONS about PROTECTION

Local protection (cantonale)	REG
Protection in Switzerland	CH
European alien	E
Non-european alien	N
Invasive alien	N/EI
World red list	W
To be protected (Bern Convention)	BC

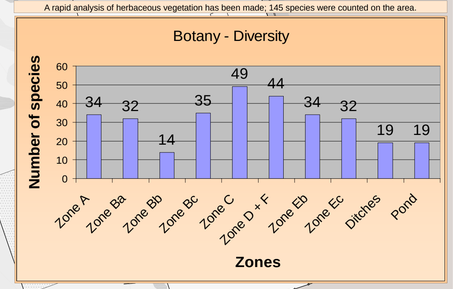
STATUS

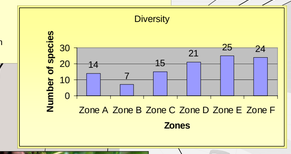
Extinct	EX	Red list	
Extinct in Switzerland	RE	Red list	
Critically endangered	CR	Red list	
Endangered	EN	Red list	
Vulnerable	VU	Red list	
Near threatened	NT		
Least concern	LC		
Data deficient	DD		

A = abundance / D = dominance-aggregation

r	:	One or only few rare elements;
+	:	elements not abundant, coverage < 1 %;
1	:	elements relatively abundant, coverage < 5 % / isolated
2	:	elements very abundant, coverage between 5 and 25 % / confined groups
3	:	coverage between 25 and 50 %, any abundance / wide groups
4	:	coverage between 50 and 75 %, any abundance /little colonies
5	:	coverage between 75 and 100 %, any abundance / very close communities

A rapid analysis of herbaceous vegetation has been made; 145 species were counted on the area.





Studying biodiversity is very well; creating wetlands and ponds is better and urgent with regard to security from floods and biodiversity management.

The results achieve here are very interesting and encourage for such projects.

Generally, unfortunately, promoters want to pay well the works as mitigation for their projects but they will pay nothing else. Also, it is very difficult to find money for serious monitoring. For us it was the only unsatisfaction.

Special thanks to
Team BIOTEC,
biologists : **Emmanuel Wermeille** (butterflies)
and **Christian Monnerat** (dragonflies),
Service Ponts & Chaussées, Jura