CZECH UNIVERSITY OF
LIFE SCIENCES PRAGUE

Faculty of Environmental Sciences

Department of Applied Ecology

Diploma Thesis

Study of an Industrial Site converted into a protected Ornithological Site open to the public in France

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CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

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FINAL THESIS ASSIGNMENT

Kristina Tanghe

Engineering Ecology
Nature Conservation

Thesis title

Study of an industrial site converted into a protected ornithological site open to the public in France

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Objectives of thesis

Studying this protected Ornithological Natura 2000 site, the aim is to find out how the industrial past uses influenced the functioning of the ponds and their current state. The results will allow us to highlight the particularities of this site and define different ways of possible management.

Methodology

1. To describe the historical development of the area concerned.
2. To describe the current situation of the area : environment functioning and present species.
3. To find out how to manage the site, two ways : preserve the current state or try to remove as much as possible traces of past uses.

The proposed extent of the thesis
60 pages

Keywords
Birds, ponds, protected area, industry, water quality

Recommended information sources

1. Kalantary, R.R., Barzegar, G., Jorfi, S., 2022. Monitoring of pesticides in surface water, pesticides removal efficiency in drinking water treatment plant and potential health risk to consumers using Monte Carlo simulation in Behbahan City, Iran. Chemosphere 286, 131667.

2. Piccolo, A., De Martino, A., Scognamiglio, F., Ricci, R., Spaccini, R., 2021. Efficient simultaneous removal of heavy metals and polychlorobiphenyl from a polluted industrial site by washing the soil with natural humic surfactants. Environmental Science and Pollution Research 28, 25748-25757.

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Expected date of the defence
2021/2022 SS - FES

The final thesis supervisor
Prof. Ing. Jan Vymazal, CSc

Supervising department
Department of Applied Ecology

I hereby declare that I have independently elaborated the diploma thesis with the topic :

"Study of a past Industrial Site converted into a protected Ornithological Site in France" *and that I cited all the used information sources, also listed in the References part.*

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In Prague, 30.03.2022 :

Aknowledgments

I would like to thank my supervisor Jan Vymazal for all the guidance provided during the realization of the research, as well as Mr. Sochacki Adam for all the help concerning the standard water analysis. Also i would like to thank Remy Bequart, Manager of he North department guards, for sharing his knowledges, documents and for helping to collect the water samples in the site.

Abstract

Agricultural pollution is the result of the use and overuse of a variety of pesticides. It is an increasing problematic because it can impact ecosystems and biota at different severity degrees. Many studies have already proven the environmental negative effects of pesticides. Taken into account that agricultural pollution is a global problem and the cause of biodiversity loss and threat, this research attempts to find how organic pollution can influence an ecosystem and its evolution. Moreover, the aim is to highlight the particularities of a site originally created for industrial uses and then converted into an Ornithological protected Natura 2000 area. Literature reviews, document researches, observations and water analysis including standard water parameters, elements and pesticide residues have been made.

244 species of birds were identified with few species nesting which are of european or national significance. The standard water parameter, chemical elements and pesticide analysis led to the acquisition of better knowledge about the water composition. If the concentrations found are low, these analyzes are coherent to other results regarding environmental conditions and its functioning. The “Cinq Tailles" site is different from its past industrial use, presents various environmental particularities which are beneficial to many species. So it is important to preserve it at this stage instead of trying to remove traces of past uses.

Table of contents

Index of figures

Index of tables

Glossary

PCB = polychlorobiphenyl

HM = heavy metals

DDT = dichlorodiphenyl trichloroethane

HCH = hexachlorocyclohexane

POP = persistant organic pollutant

EDCs = endocrine disrupting compounds

EDPs = endocrine disrupting pesticides

MP = micro-plastic

MS = masse spectrometry

GC = gas-chromatography

HA = humic acid

WTPs = water treatment plants

1. Introduction

Industrial pollution has been a global environmental issue of increasing concern in the past decades. The constant growth of human population leads to fertile field demand ever higher. Soil is impoverish and polluted by chemical compound residues which are used to increase production profitability. After application on the yield, residues will be present in the air, soil and adjacent water bodies but also infiltrate food. Negative impacts can affect every organisms using these resources.

Nowadays, if many natural sites and species have been and are still threatened by agricultural pollution, there is also a quantity of area which are from industrial sites. Like in the North of France which is a highly industrialized region, especially regarding sugar production and where Beghin-Say factory built basins for washing sugar beets after harvest. Some of them have been redeemed and converted into natural areas. This was the case of the studied site : The Ornithological site of “Cinq Tailles”, today protected and classified as Natural Sensitive Area and Natura 2000.

This research attempts to highlight and understand the environmental particularities of this protected site.

2. Preview, historic of the site

Sugarbeet (*Beta vulgaris*) is a bisannual plant harvested for its white roots to produce sugar (saccharose). There are two phases of development : vegetative and reproductive. During the vegetative phase the foliage grows and the roots accumulates energetic reserves in the form of sugar. It will be harvested in autumn season for the sugar production. During the reproductive phase, stems will grow and the inflorescences develop with appearance of hermaphrodite flowers with crossed fecondation in June. After blooming and anemophyl pollinisation the seeds will be produced, followed by the fruits maturation in August.

Today, more than 1600 varieties exist, it is one of the most important ameliorated species. It is used for different types of sugar production, beets sirup, alcohol and ethanol-fuel. The main under-products are molasses and beets-pulp that contains 50% of sugar and are used to feed animals.

Unfortunately the intensive agriculture of sugar-beets needs a big quantity of pesticides which are known as toxic for the environment, particularly for insects (e.g. neonicotinioids for bees).

This plant is produced in France since 1875. It is the first global producer of sugarbeet with around 39.579 tonnes in 2018. The culture is mainly located in north and east parts of the country (Document d’objectif natura 2000, 2015).

During the 70s, the village of Thumeries, in the north of France, was home to Beghin-Say factory, today TEREOS group. They built the first decantation basin to wash the sugarbeets. Quickly filled by the muds, they had to build another one in 1987. Finally they abandoned the sugar production in 1990 to focus on conditioning, leaving 4 basins :

- 2 settling ponds
- 1 artificial pond to treat the wastewater (dry now)
- 1 aeration basin to treat organic material

These abandoned basins aroused the interest of many naturalists and ornithologists. Also the association “Nature et Vie” (nature and life) collected some data which were send to the headquarters of the North Department which was looking for new fields to preserve and arrange for the public.

After evaluated the ecological potential, they acquired it in June 2001 as ENS (Natural Sensitive Space), started the arrangment work in November 2004 and opened it to the public in June 2005. The site has been classified Natura 2000 in 2006 : Natura 2000 site “Les Cinq Tailles - FR3112002” (Fig. 1).

Today, this area is composed of around 75 hectares of forest and 30 hectares of wetlands including ponds and reed beds.

Figure 1 : view of the South basin of the “Cinq Tailles” (taken in August during the Ornithological inventory), photo : author

3. Thesis objectives

3. 1. Hypothesis

a. Water is polluted by organic residues. Which can be caused by the decomposition of chemical residues (such as pesticides, widely used for sugarbeets agriculture).

b. There is a lot of algae. This leads to an overused of minerals and nutrients and results to an increasing amount of nitrates (from bacterial decomposition), a loss of normal oxygen production that can lead to oxygen depletion.

c. During the summer when the water is warmer it could lead to an O2 release. Added to the characteristics of the water this can lead to an unfavorable, unstable environment, e.g. for fish.

3. 2. Aims

To evaluate and highlight the environmental particularities of the “Cinq Tailles” site, the objective is to analyze and understand how the past uses of these ponds influenced its environmental evolution including water quality and biodiversity, focusing on birds. Find out the functioning of the current area of concerned and how we can manage it. In the case of there is pesticide residues, find if there is any possiblity to remove or decrease the amount.

Then, study the results and discuss about advantages and disadvantages of these particularities and conclude.

Specific aims

- To make standard water parameter analysis of water samples from each basin.
- To make water analysis focusing on selected 29 elements using ICP-OES apparatus Agilent 730, Agilent Technologies, USA.
- To analyze if there are residues from pesticides in the water.
- To observe the current state of the area of concerned including an ornithological inventory and analyze the historic of other ornithological inventories.
- To read, understand and compare the results with available literature.

4. Literature review

4. 1. Pollution

Most of the time pollution is defined as resulting of human activities, that will indirectly or directly impact water, air or soil of matter or energy which has a negative effect on living organisms (Russel, 1974). In comparison, in the US legal system, pollution is defined as the wrongful contamination of the atmosphere, water or soil to the material injury of the right of an individual.

There are two different types of pollution sources :

- natural, which will be caused by natural events,
- anthropogenic, such as urbanization, industry, agriculture, livestock farming, domestic activities, waste and waste treatments…

When the amount of pollution is signficant in an environment, it can lead to a high incidence of malignant diseases among the population and reduce social welfare so also impact the sustainable economic development in the long-term (Xu et al, 2022).

4. 2. Water pollution

According to the Council of Europe, "*a water course is considered as polluted when the water in it is altered in composition or condition, directly or indirectly, as a result of the activities of man, so that is less suitable for any or all of the purposes for which it would be suitable in its natural state*" (Russel, 1974).

Indeed, water is one of the most abundant natural resources on earth, being 75% of its surface (Ayanshola et al, 2021) but if there is around 1 386 millions km³ of water on the planet, there is only 0,007% of it that is drinkable so 9000 km³ (Fischesser and Dupuis-Tate, 2017). Drinking water is essential for humans and many organisms. This is why we must preserve its quantity and quality. However, it is more and more threatened by human activities, whether it is intentional or not. The increasing pollution from agriculture including cultivation, aquaculture and livestock farming, with industry and domestic pollution contributes to the deterioration of water quality (Xu et al, 2022).

Main sources of water pollution are nitrates and phosphates contained in pesticides, also called organic pollution. Adding to that, human and veterinary medicines, paint, household products, heavy metals, acids, as well as hydrocarbons used in the industry are polluting water sources. For example the european norms for nitrates, which fixed the rate at 44 mg/l, is exceeded in 30% of the samples carried out in France (Fischesser and Dupuis-Tate, 2017).

4. 2. 1. Sources of water pollution

- Urbanization : organics, suspended solids, nitrogen, phosphorus, microbial pollution.
- Industry : chemical and toxic contaminants,
- Agriculture : pesticides, herbicides, virus, organic matter, including endocrine disruptors.
- Oil pollution : incidents, degassing..
- Waste and waste treatments.

4. 2. 2. Pesticides water pollution

Water pollution by pesticides is a global issue. Pesticides are often present in surface water and can be accumulated in organisms. Indeed, pollutants (e.g. from farming) enter rivers through the carrying effect of precipitation and this will be much higher during the busy agricultural season. Moreover, we also have to take into account that there is often a cumulative effect, such as livestock farming and cultivation. They will both increase the number of lag periods increases (Xu et al, 2022).

This can be a problem for public health and damaging for nature. In developed countries there are strict rules in waste management but it is different in less developed countries. The presence of pesticides and heavy metals in water is an important environmental indicator.

According to the study of Sabo et al. (2021), in some developed countries such as Netherlands and Spain, pesticides are present in water but not in fish and animals. Which means that the presence of pesticides is occasional without permanent negative impact for fauna. Indeed, heavy metals are very toxic environmental pollutants and there is possibility of bioaccumulation. As (arsenic), Cd (cadmium), Pb (lead), and Hg (mercury) are considered most toxic to humans and animals, fish and environment. It will cause ecosystem destabilization by the bioaccumulation in organisms and toxic effect on biota. It stays in living organisms for a long time and are almost indestructible.

In comparison, in South Africa, organochlorine residues were find in fat samples of crocodiles. This is an indicator of permanent presence of pesticides with negative effect on the ecosystem. Indeed, here pollutants come from agricultural and pest control activities which are introduced to the concerned wetland park via groundwater and fluvial processes (Buah-Kwofie et al, 2018).

Since the last decades, the industrialization and urbanization generated a large amount of industrial wastewater and domestic sewage (Xu et al, 2022). Organic pollution caused by discharges of wastewater and wastewater treatment plants, industrial influence and agricultural runoff, may lead to rapid deoxygenation of river water, a high concentration of ammonia and the disappearance of fish and aquatic invertebrates. The situation can be aggravated by water heating during recent years which is inversely proportional to the solubility of oxygen in water (Sabo et al, 2021).

4. 2. 3. Sudden pollution incidents

Sudden water pollution incidents are often random and damaging. Caused by natural or human factors, it leads pollutants to get into the water environment. Instantly or in a short time, they will negatively impact the water quality. According to the study of Xu et al, (2021), nearly 30000 environmental sudden pollution incidents occured in China since 1993, with more than 1000 major and extraordinary (which 53% are water pollution incidents). Their number has increased from 2006, main causes are illegal pollutant discharges, production safety accidents and traffic accidents.

4. 2. 4. Water treatments

The identification of the main source(s) and its impact on the water quality is important to improve the water quality management (Xu et al, 2022). The choice of treatment processes is defined by water quality standards such as turbidity which is the measure of water clarity and transparency (Ayanshola et al, 2021). There are different purification methods. Nowadays, the repairing of sewage bodies using microbial landscape aquatic plants is catching more attention (Hu and Li, 2021).

First of all, natural environment, whether aquatic of terrestrial, has purifying mechanism which is called auto-purifying capacity. Micro-organisms e.g. bacteria, will use metabolic energy from organic molecules decomposition and release carbon dioxyde with soluble mineral salts that are the main food substrates of chlorophyllous plants. In this treatment, aerobic bacteria are the most efficient but they need a high amount of oxygen. However, O^2 is poorly soluble in water and can quickly decrease if the environment is not brewed or if the water is warm or also if the photosynthesis of organisms is not enoughly efficient to recharge it (Fischesser and Dupuis-Tate, 2017).

Human were inspired by natural processes to purify the water. We use plants to remove organic matter and nutrients from wastewaters, but this is not efficient to remove other contaminants such as pharmaceuticals, illicit drugs, heavy metals. Also, a high percentage of pollutants such as micropastics is settle on the bottom of waste water traitment plant tanks, accumulating in the recycled sludge. This is a potential problem for terrestrial and aquatic environment as it will be used in agriculture fertilizer worldwilde. 50% of the total sludge production comes from Europe and America (depending to the treatments used) (Magni et al, 2019).

Example of wastewater treatment station (in Italy) :

- pre-, primary, secondary and tertiary treatments, articulated in screening,
- grit and grease removal stages,
- biological treatment,
- sedimentation (with recycled activated sludge),
- sand filter treatment
- disinfection

Here MPs residuals were removed from wastewater probably mainly during grease, sedimentation and sand filtering processes (Magni et al, 2019).

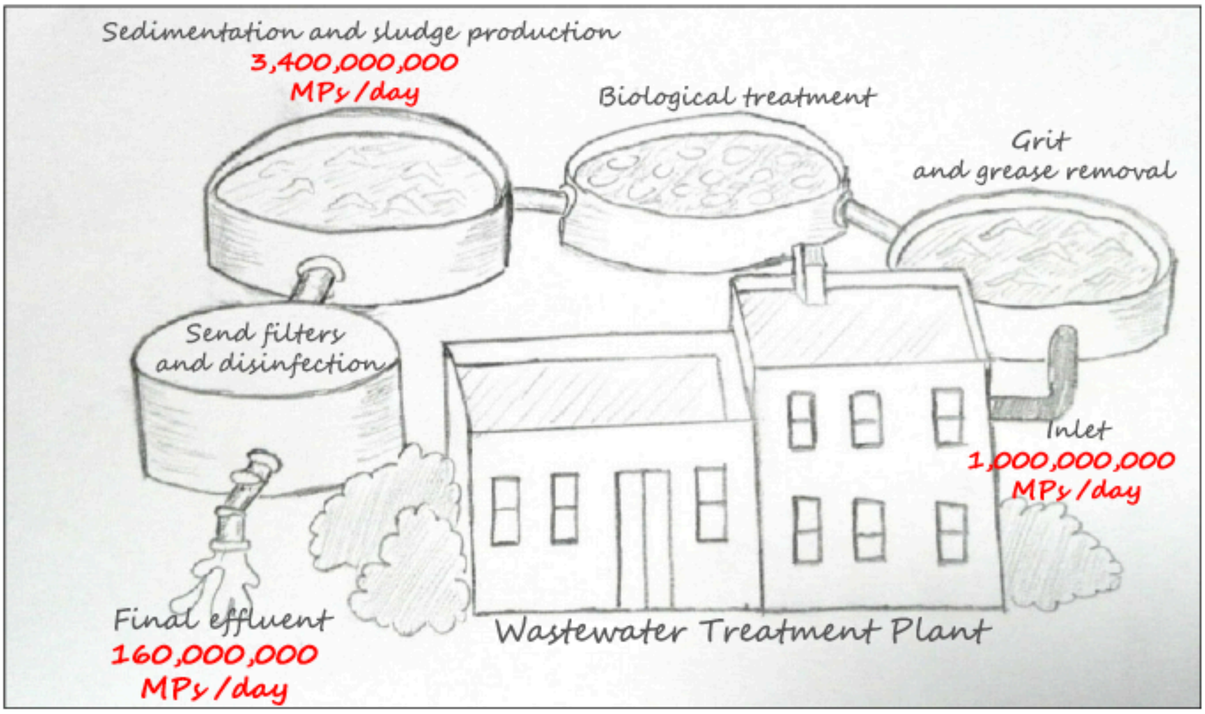


Figure 2 : Schema of the wastewater treatment station (Magni et al, 2019)

4. 3. Industrial sites

Since the beginning, human always sought to improve his techniques. But it's from the first industrial revolution, 18/19e centuries, that we can really talk about industry with a constant evolution of mecanisation. Using natural resources to satisfy human needs whether vital, recreational or useful in everyday life, we finally realized during the 20e century that it can negatively impact our environment.

Indeed, for example in France, the first law of environmental protection was voted in 1906, aiming to protect the waterfall of Lison against the industrial grabbing. Recently, the pollution problem of industrial wastelands has been highlighted by studies and researches. The aim is to restore, protect, update or use the factory buildings and their equipments.

4. 3. 1. Industrial heritage : site preservation

Concerning the building itself, the first trace of industrial site study appeared in the research work of “Iron Bridge Gorge”, in Shropshire (England) (Qing and Junfeng, 2021). Since this time, many countries made researches and works on industrial heritage. Finally, the International Committee for the Conservation of Industrial Heritage, held in tagil, Russia, in July 2003, adopted the programmatic document of *Nizhny Tagil Charter for the Industrial Heritage*, endowing the industrial heritage (Qing and Junfeng, 2021). Some abandoned industrial sites have been converted into cultural or creative parks, museums, art areas… allowing people to visit them and to be aware of the environmental pollution problem left by industrial urban areas. It is important to uphold the sustainable development concept and take into account the inheritance of industrial civilization, maintain the ecological balance between the site and the surrounding environment.

4. 3. 2. Ecological restoration of past industrial sites

Today there are many industrial sites which are abandoned because it is too expensive to restorate them aiming to make usable or standardized sites. It is an important problematic since many years. For example in Washington, the budget to clean up between 130.000 and 425.000 sites were estimated around 650 billion dollars (Batsch and Munson, 1994).

Regarding the restoration process, first of all, to make an effective decision-making in ecological restoration it is essential to estimate ecological and environmental damages (Hou et al. 2021). Then according to the results of detailed environmental assessments we can implement active, progressive and passive interventions to improve and renovate the post-reclamation mining ecosystem and ensure sustainable planning in underground mining area (Hou et al. 2021).

4. 3. 3. Industrial sites : pollution

The malfunctioning of industrial activities will lead to the contamination of soils and waters by toxic and persistent pollutants (e.g. PCB and heavy metals). Which are dangerous for all the organisms that will be directly or indirectly in contact with. Heavy metals are inorganic pollutants and can cause a phytotoxicity, limit microbial activity and affect soil functions when accumulated in a big amount in soil. PCB is one of the most hazardous pollutants and highly hydrophobic contaminants. It is absorbed in soils, hardly bio-accessible and very poorly bio-degradable (Piccolo et al, 2021).

4. 4. Pesticide pollution

Agriculture is the main source of food for humans and domestic animals. As the population is constantly increasing, it is important to ensure the production of food and then, increase crop yields and their efficiency. This includes to treat yields against pests and weeds, mainly by using pesticides and herbicides.

However, despite their advantages on production improvments, the use and overuse of these chemical products are considered as dangerous for the environment and for all organisms that are directly or indirectly exposed to. They are even present in drinking water, e.g. in the study of El-Nahhal and El-Nahhal (2021) they found 113 pesticide residues (including pesticides, herbicides and fungicides) in drinking water samples from 31 countries.

Indeed, agricultural pesticides represent a significant class of endocrine-disrupting chemicals (EDGs) (Tavaleri and Galoppo, 2020). Nowadays, the environmental pollution is a global problem for which many researches and projects were conducted. The aim is to limit the use of pesticides and reduce the pollution. Some solutions are already applied such as genetically modified pest-resistant crop varieties and the use of nanomaterials as pesticides.

4. 4. 1. Pesticide classification

Pesticides are a substance which differs in their chemical, physical and identical properties from one to other. That is why they are classified based on these properties (Kaur et al. 2019). The term pesticide is a general word to describe groups of insecticides, fungicides, herbicides, garden chemicals, household disinfectants and rodenticides (Hassan and El Nemr, 2020).

There are different types of pesticide classifications, it can be based on chemical structure, physical properties, solubility, but also on the toxicity and health effects.

The most common classification method is based on their chemical composition which gives the clue about efficacy, chemical and physical properties. These information are essential to determine the application mode, precautions and application rates (Kaur et al. 2019). Pesticides are divided into groups, here are some important pesticide families :

- Organochlorines
- Organophosphorus
- Carbamates
- Pyrethrin and pyrethroids
- Chloroacetanilides
- Triazines
- Morpholines
- Ureas
- Triazinones
- Aryloxyalkanoic acids

Classification based on chemical structure :

Pesticides	Organochlorines	DDT
		HCH
		Cyclodiene
		Toxaphene
		Mirex & Chlordecone
	Organophosphorus	Malathion
		Parathion
		Fenthion
		Dichlorvos
		Fenitrothion
	Carbamates	Thiobencarb
		Propoxur
		Molinate
		Disulfiram
		Pyridostigmine
	Pyrethrins and Pyrethroids	Cypermethrin
		Permethrin
		Bifenthrin
		Deltamethrin
	Chloroacetanilides	Alachlor
		Metolachlor
		Acetochlor
	Triazines	Atrazine
		Propazine
		Simazine

	Morpholines	Amorolfine
		Fenpropimorph
		Tridemorph
	Ureas	Norea
		Cycluron
		Linuron
	Triazinones	Metamitron
		Metribuzin
	Aryloxy alkanoic acids	2,4 D
		Dicamba
		Bentazon

Table 1 : Pesticides classification (Kaur et al. 2019), (Gideon et al. 2021), (Parekh et al. 1994)

There is another class of pesticides called biopesticides which is also divided in three groups : biochemical pesticides, microbial pesticides and plant incorporated protectants. They are naturally occuring or derived materials from living organisms (e.g. from fungi, plants, bacteria..) (Hassan and El Nemr, 2020).

4. 4. 2. Pesticide effects

Exposure to pesticides occurs through dermal contact and inhalation (Pedroso et al, 2021). Toxic substances cause acute, sub-chronic and chronic effects on living organisms. It can be mutagenic, histopathological, enzyme inducing and, or inhibiting, carcinogenic and teratogenic (Kolankaya, 2007).

EDPs, endocrine disrupting pesticides are the largest group of EDCs, endocrine-disrupting compounds, compared to other chemical groups. Among 800 pesticides used in the world, around 650 can disrupt endrocrine system (Girard et al, 2020). After application on the yield, pesticide residues will be present in the air, soil and adjacent water bodies, it will infiltrate food, in which they will be active in low concentration.

Today, negative effects of EDPs are pretty well known, they can affect the reproductive perfomances of human and wildlife species (Pandey et al, 2017), such as reduce fertility, viability of offspring, impaired hormone secretion, modification of reproductive organ histoarchitecture. But also affect the development, behavior and immune system.

Some taxa are more sensitive to chemical perturbations like amphibians, leading to a big decline of populations. Indeed, the reproductive season, during the spring and early summer coincides with the seasonal application of pesticides. The negative effect of the use of EDCs on wildlife can be also significant regarding species that are already endengered (Tavaleri and Galoppo, 2020).

Focusing on human, many researches have been made to define pesticide responsabilities of diseases such as breast cancer (Girard et al, 2020), testicular cell tumors (Swartz et al, 2022), multiple myeloma, non-Hodgkin's Lymphoma, bladder and prostate cancer, leukemia… (Pedroso et al, 2021).

Most of the time they could either demonstrate that toxic effect of pesticides could lead to it but not define exact mechanisms or identify a relationship between disease risk and exposure to pesticides.

4. 4. 3. Pesticide analysis

Their detection requires precise instrumental analytical techniques with multistep sample preparation including cleaning and preconcentration of the resulting extract. The most efficient method for pesticide residues analysis is chromatography combined with MS detection. With this method we are able to detect pesticides in $ng.L^{-1}$.

Preparation : extraction and enrichment

There are various different techniques such as : extraction disk ; supercritical fluid extraction, solid phase extraction ; micro liquid-liquid extraction ; extraction using hollow fibber membranes. Generally, the two most common preconcentration methods used for pesticide analysis are liquid-liquid extraction and solid-phase extraction (Pablos-Espada et al, 2006).

Analytical methods :

Chromatographic methods are widely used for analytical separation, identification and quantification of many pesticides. Gas-chromatography (GC) using long capillary columns and with sensitive detectors, such as Electronic Capture Detector which is one of the most used method to determine pesticide presence (Pablos-Espada et al, 2006).

Coupling GC with Mass Spectrometry increases the selectivity and certainty of identification, avoid false positives in pesticide multi-residue determinations in water. Sensitivity and selectivity can be improved using Tandem Mass Spectrometry (MS/MS) (Pablos-Espada et al, 2006).

Results : quantitation in gas-chromatographic pesticide residues analysis techniques, 2 methods :

- ES method, area of the peak in the sample extract is compared to the peak of one or more standard solutions.

- IS method, a compound named the internal standard, which cannot be detected in samples, is added to both samples and the standard solutions at the same concentration. The ratios of standard / IS are compared (Anagnostopoulos et al, 2007).

4. 4. 4. Pesticide degradation

There are different processes of degradation : mineralization (it turns pesticides into smaller compounds like NH_3, H_2O, CO_2), photolysis, hydrolysis. Also there are two main biological mechanisms of pesticide degradation, which are both changing the compound's toxicity and can lead to undesirable effects (Hassan and El Nemr, 2020).

Photolysis : solar distillation : water is evaporated and condensation will give pure water. With a photocatalyst, the photon of energy greater than its band gap will irradiate the catalyst, it will generate an electron and hole, e.g. TiO_2 -> $e^- + h^+$ (solar irradiation) (Gandhi et al, 2021).

Microbiological reaction in water and soil : many microbial strains are able to use pesticides as a source of carbon, nitrogen and other elements such as phosphorus. They will degrade the chemical compound using extra and intracelullar enzymes that allow them to use the pesticide residues as carbon source and their conversion into simpler product or complete mineralization (Conde-Avila et al, 2020).

Biocatalysts : it can be synthesized, their advantages are : high reactivity, selectivity in the nucleophilic attack of P atom and recyclability over various cycles (Ferreira et al, 2022).

4. 4. 5. Pesticide removal

The excessive application of micropollutants such as pesticides to control pests and weeds leads to contaminating water bodies. To remove them we can use water treatment plants, but the efficiency of the removal depends of the primary pesticide concentration and will not be enough for drinking water anyway (Kalantary et al, 2022). Focusing on pesticide removal from polluted water there are different methods using chemical knowledge.

Microextraction :

The droplet liquid-liquid microextraction will extract pesticides using their hydrophobic nature. 50% of pesticides are removed in the coagulation-flocculation process, accumulated into the sludge which is discharged into the environment without any treatment (Rezaei et al, 2022).

So the pesticides will be released into the soil or return to the surface water via runoffs. That is why it's really important to develop suitable management strategies for the disposal of the produced sludge (see water treatment).

Natural organic sufractants :

HA (humic acid) from lignite is a natural organic surfactants that can be used to wash heavy metals (HM) and polychlorobiphenyls (PCB). According to the study of Piccolo et al., only one soil washing with HA removed 68 and

75% of PCB congeners for 1:1 and 10:1 solution/soil ratios respectively. When the same HA washing removed a cumulative average of 47% of total heavy metals, with a maximum of 57 and 67% for Hg and Cu. So washing a highly polluted soil with HA solution is effective and fast. Moreover, it removes HM and persistant organic pollutants. Using humic biosurfactants is also sustainable and eco-friendly technology because it will preserve the soil biodiversity, promote natural attenuation of unextracted POP and accelerate further soil reclamation techniques (e.g. bio- or phytoremediation).

The case of drinking water :

Define the appropriate method to remove pesticide residues from drinking water requires full knowledge of pesticide physico-chemical properties like their solubilities, chemical structure, ionic status of molecules, and Kow (El-Nahhal and El-Nahhal, 2021). Kow is a partition coefficient, the ratio of a chemical concentration in the octanol phase to its concentration in the aquaous phase of a two-phases octanol/water system.

<u>Removal by physical processes</u> : absorption method

This will use physical properties of pesticides : hydrophobicity, water solubility, molecular weight, evaporation and sensitivity to photodegradation.

The absorption method uses the hydrophobic character of the compound. To process, organic absorbing materials are needed, such as activated carbon, activated charcoal, nano-organic materials, organoclays and bioabsorbents e.g. plant residues.

Compounds	Pesticides removed
Organoclays	chloroacetamide herbicides
Porous materials	simazine
Activated carbon	carbaryl, methomyl and carbofuran
Granular activated carbon and carbon nanotubes	atrazine, simazine, diuron
Carbon slurry	endosulfan and methoxychlor
Activated carbon	methoxychlor, methyl parathion, atrazine
Colloidal biochar	atrazine, λ-cyhalothrin
Bioabsorbents	atrazine, alachlor, endosulfan sulfate and trifluralin
Plant materials	alachlor, atrazine, simazine, and triflularin, aldrin, chlorpyrifos, chlorfenvinphos, dieldrin, α-endosulfan, endrin, hexachlorobenzene, β-HCH, γHCH, carbaryl and fenuron

Table 2 : compounds properties for removing pesticides (El-Nahhal and El-Nahhal, 2021)

Pesticide ions or molecules from water will adhere to the surfaces of solid materials. It will create layer(s), mono or bi-layers depending of the physico-chemical properties of the pesticides and solid materials.

5. Methodology

5. 1. Area of study

5. 1. 1. Location

The site of “Les Cinq Tailles” (Fig. 3) is located in the north of France, 30 km from the city of Lille, on the territory of Thumeries and La Neuvilles cities. The site is also part of Phalempin forest massif and regional green-blue frame, which is located on an important bird migration axis.

5. 1. 2. Definition of the area of study

The protected area of “Les Cinq Tailles” - FR3112002 belongs to the North Department of France. The biggest part of 105 ha has been acquired on 6 June 2001, then the two basins in the North-East were acquired in 2007. The total size of the site is 123 ha (Document d’objectif natura 2000, 2015).

Figure 3 : map of the ”Cinq Tailles" site, aerial view from google map

5. 2. Observation

5. 2. 1. Water

Water standard observations have been made for each basin focusing on general state and water turbidity. We have to notify that observations were realized at the end of the winter, on 4rd March 2022, when water is more clear. External temperature was 15 degrees celsius.

5. 2. 2. Birds

Many inventories are made every year by the guards, ornithological associations and bird enthusiasts. The inventory presented in the thesis was made the 25th August 2021 in the morning, focusing on wetlands area. This includes observed birds on the water, banks, islets and flying over the site.

5. 3. Analysis

6 water samples were taken, 2 per basin :

- North basin : North 1, North 2
- East basin : East 1, East 2
- South basin : South 1, South 2

5. 3. 1. Standard water parameter analysis

TOC, TC, IC, TN, F^-, Cl^-, NO_2, Br-, NO_3^-, PO_4^{3-}, SO_4^{2-}, pH and conductivity.

The samples were filtered using 0.22 µm polyethersulfone syringe filters Rotilabo (Carl Roth). The analysis of anions (bromides, nitrites, nitrates, sulfates and phosphates) was performed using ionic chromatograph 883 Basic IC Plus Metrohm with a column Metrosep A Supp 5, 15 cm x 4 mm I.D., 5 µm particles (Metrohm 6.1006.520). The mobile phase was composed of 3.2

mM sodium carbonate and 1.0 mM sodium bicarbonate. The flow rate was 0.7 mL/min and the injection volume was 20 μL.

The analysis of dissolved carbon (DC), dissolved organic carbon (DOC), dissolved inorganic carbon (DIC) and total nitrogen (TN) was carrie out using FormacsHT analyser (Skalar). The analysis of ammonium nitrogen (N-NH4) was performed photometrically using indophenol blue method (ISO 7150-1:1984) and measuring the absorbance by the Carvy 60 UV-Vis spectrometer (Argilent).

pH was measured using WTW pH-meter 3630 IDS with an electrode IDS pH Electrode SenTixⓇ 940. Conductivity was measured using WTW inoLab Cond 7110 Conductivity Benchtop Meter.

5. 3. 2. Water sample analysis focusing on 29 elements

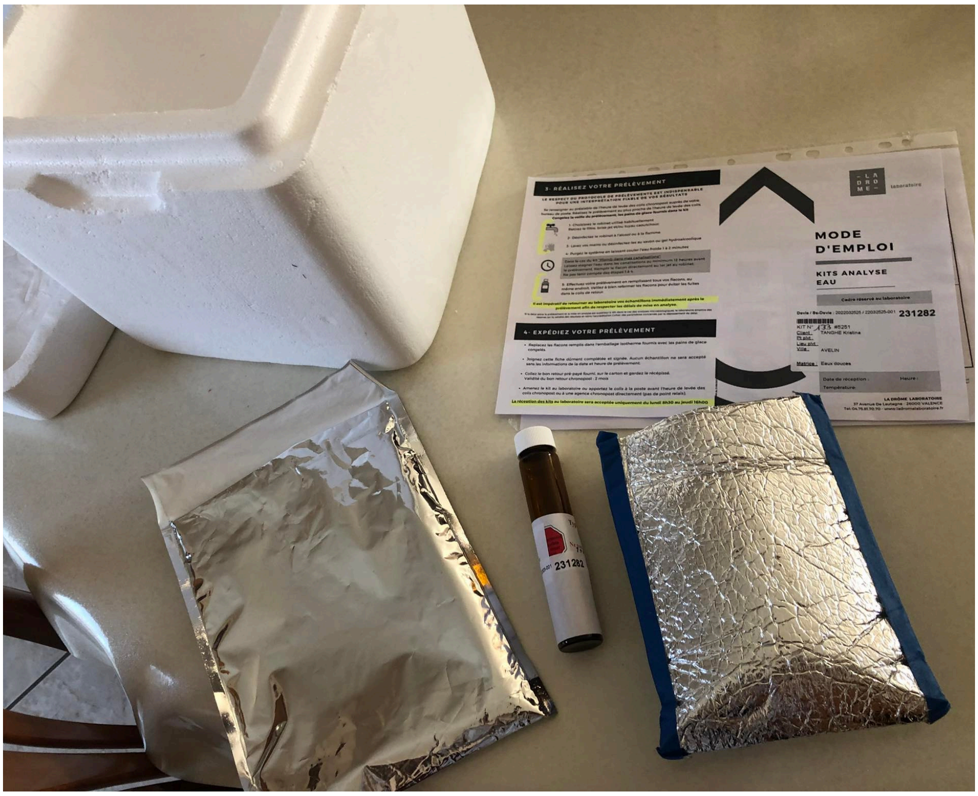
Aluminium (Al), Arsenic (As), Barrium (Ba), Berrium (Be), Calcium (Ca), Cadmium (Cd), Cobalt (Co), Chrome (Cr), Copper (Cu), Iron (Fe), Potassium (K), Lithium (Li), Magnesium (Mg), Manganese (Mn), Molybdenum (Mo), Sodium (Na), Nickel (Ni), Phosphate (P), Lead (Pb), Sulfur (S), Antimony (Sb), Selenium (Se), Silicon (Si), Strontium (Sr), Titanium (Ti), Thallium (Tl), Vanadium (V), Zinc (Zn).

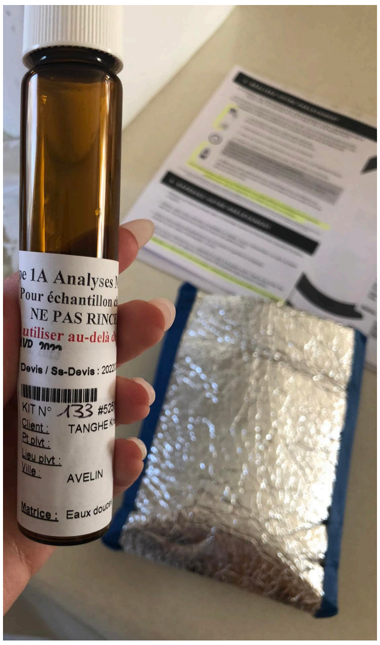
The concentration of selected elements was measured using ICP-OES apparatus Agilent 730, Agilent Technologies, USA.

5. 3. 3. Pesticide analysis : private laboratory

As pesticide analysis require very specific material and techniques, a private laboratory was chosen. "La Drome Laboratoire” is located in Valence, France and proposed a pesticide analysis kit based on a predefined list of 50 pesticides. They sent one sample bottle containing thiosulfate, isothermal envelope, ice block and manual with instructions to follow for taking the water sample and send it back (Fig. 4 and 5).

One sample was taken, in a stabilized glass flacon containing water from the South basin and thiosulfate.





Figures 4 and 5 : sample material for pesticide analysis, photo : author

Analysis method :

For pesticide residue analysis the laboratory used Multidetection in gas-chromatography (EDC, Masse spectrometry MS and MS/MS) and multidetection in liquid-chromatography (DAD, fluorescence, Masse spectrometry MS/MS).

<u>In this kit, pesticide residues researched are</u> :

2,4-D (acid 2,4-dichlorophenoxyacetic), Alachlore ESA, Alachlor OXA, Atrazine, Atrazine deisopropyl (DIA), Atrazine desethyl (DEA), Atrazine desethyl desisopropyl (DEDIA), Bentazone, Chloridazone desphenyl, Chloridazone methyl desphenyl, Chlortoluron, Cyanazine, DCPMU [1-(3,4-Dichlorophenyl)-3-Methyl Urea], DCPU [1-(3,4-DichloroPhenyl) Urea], Diflubenzuron, Dimetachlore OXA, Dinosebe, Dinoterbe, Diuron, Ethidimuron, Flufenacet, Flufenacet ESA, Fluroxypyr, Hexazinone, Hydroxyatrazine, Hydroxysimazine, Hydroxyterbuthylazine, Imidaclopride, IPPU [1-(4-IsopropylPhenyl) Urea], Isoproturon, Linuron, MCPA (2,4-MCPA), Mecoprop (MCPP), Metaldehyde, Metazachlor, Metazachlor ESA, Metazachlor OXA, Metolachlor (R+S), Metolachlor ESA, Metolachlor NOA, Metolachlor OXA, Monolinuron, N,N-dimethylsulfamide, Propyzamide, Quinmerac, Simazine, Terbumeton, Terbumeton Desethyl, Terbutylazine, Terbutylazine Desethyl.

Sample has been taken on 4th March 2022 and conserved below 5°C, the laboratory received it on 7th March 2022, the temperature at the reception was 5°C.

They provided the detailed results within 10 days via email.

5. 3. 4. Past analysis from Pasteur Institute (FR, 2006)

In 2006, Pasteur Institute of Lille made water and mud analysis, aiming to study the resistance of the H5N1 virus in the water.

For water, they took samples from the surface of South basin and analyzed :

- Physico-chemistry : pH, total suspended matter, total organic carbon, UV mesurement at 254 nm, DCO (COD) and DBO5 (BOD5).
- Anions : orthophosphates PO4.
- Cations : ammonium.

For the mud they took samples from evacuation and analyzed :

- Physico-chemistry : dry matter, pH of present water, organic matter, total organic carbon, Kjeldahl nitrogen (TKN), C/N rapport, total phosphorus P2O5.
- Cations : ammonium, calcium CaO, magnesium MgO, potassium K2O.

6. Results

6.1. Observations

- Basin 1 (North) : low turbidity, from shallow to deep water.

- Basin 2 (South) : low turbidity, from shallow to deep water (maximum of 4.5 meter deep). Presence of many stems from algae. (Fig. 6)

- Basin 3 (East) : low turbidity and shallow (Fig. 7 and 8).

Figure 6 : picture of the South basin, photo : author

Figures 7 and 8 : pictures of the East basin, photo : author

Every year during the summer, we can observe that algaes occupy approximately 50% of basins (Document d'objectif natura 2000, 2015) (Fig. 9).

Figure 9 : picture of the South basin during the summer, photo : Remy Bequart

Ornithological inventory :

Species (latin name)	English names	French names	General repartition
Fulica atra	Coots	Foulques macroule	Palearctic, Oceanie, south of asia
Tachybaptus ruficollis ruficoliis	Little grebe	Grèbe castagneux	Europe till Oural, north-west africa
Aythya fuligula	Tufted duck	Fuligule morillon	Europe, Western Asia
Delichon urbicum	Common house martin	Hirondelle de fenêtre	Eurasia, North-west Africa
Riparia riparia	Sand martin	Hirondelle de rivage	Europe , North America, Northern Asia
Hirundo rustica	Barn shallow	Hirondelle rustique	North America, Eurasia, North Africa
Podiceps nigricollis	Black-necked grebe	Grèbe a cou noir	Europe, Asia, Africa, America
Anas platyrhynchos	Mallard	Canard colvert	Europe, America, Oceania
Mareca strepera	Gadwall	Canard chipeau	Eurasia, Nothern America
Gallinua chloropus	Common moorhen	Gallinule Poule d'eau	Eurasia, Africa, Southern Asia
Aythya ferina	Common pochard	Fuligule milouin	Eurasia, Japan, Southern China, India
Tringa totanus	Common redshank	Chevalier	Europe, Africa
Larus argentatus	Herring gull	Goéland argenté	Northern Europe, Nothern America and Asia

Larus melanocephalus	Mediterranean gull	Mouette mélanocephale	Europe
Accipiter nisus	Hawk	Epervier d'Europe	Europe, Nother Africa, India, Asia
Branta canadensis	Canada goose	Bernache du canada	Northern America, Europe
Falco tinnunculus	Common kestrel	Faucon crècerelle	Europe, Nothern Africa, Asia
Gallinago gallinago	Snipes	Bécassine	Asia, Europe
Vanellus vanellus	Northern lapwing	Vanneaux huppé	Asia, Europe
Tringa ochropus	Green sandpiper	Chevalier culblanc	Europe, Southern Africa, Asia
Buteo buteo	Common buzzard	Buse variable	Central Europe, West-Asia, North-East Africa

Table 3 : Ornithological inventory

6. 2. Analysis

6. 2. 1. Standard water paramater analysis

	TOC	TC	IC	TN	F-	Cl-
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
east1	22,01693	52,9132	30,89628	1,761254	0,458	57,199
east2	21,87248	52,83591	30,96342	1,628035	0,454	56,997
south1	19,81851	45,98482	26,16631	1,613169	0,445	48,676
south2	19,82707	46,01116	26,18409	1,522523	0,443	48,616
north1	21,94621	52,08805	30,14184	1,443749	0,511	99,777
north2	22,40183	53,17896	30,77714	1,528666	0,513	99,833

NO2-	Br-	NO3-	PO43-	SO42-	pH	conductivity
mg/L	mg/L	mg/L	mg/L	mg/L		µS/cm
0	0	0,319	0,486	142,119	8,08	806
0	0	0,094	0,462	141,834	8,09	785
0,018	0	0,132	0	20,216	8,22	475
0	0	0	0	19,753	8,25	458
0	0	0,069	0,542	265,516	8,04	1312
0	0	0,148	0,568	265,744	7,94	1097

Table 4 : Standard water sample analysis

6. 2. 2. Element analysis

Al	As	B	Ba	Be	Ca	Cd	Co	Cr	Cu	Fe	K	Li	Mg
mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
0,001	0,007	0,055	0,029	0,000	49,285	0,000	0,000	0,000	0,014	0,000	47,837	0,008	20,602
0,001	0,020	0,061	0,030	0,000	48,555	0,000	0,000	0,000	0,026	0,008	46,503	0,009	20,393
0,001	0,021	0,027	0,000	0,000	31,216	0,000	0,000	0,000	0,016	0,001	26,105	0,000	10,441
0,001	0,000	0,023	0,000	0,000	31,068	0,000	0,000	0,000	0,027	0,015	25,655	0,001	10,300
0,001	0,000	0,062	0,000	0,000	116,615	0,000	0,000	0,000	0,010	0,019	111,255	0,010	24,041
0,001	0,015	0,068	0,000	0,000	124,268	0,000	0,000	0,000	0,028	0,093	115,334	0,008	25,214

Mn	Mo	Na	Ni	P	Pb	S	Sb	Se	Si	Sr	Ti	Tl	V	Zn
mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
0,079	0,000	52,276	0,000	0,135	0,000	53,282	0,003	0,000	0,181	0,471	0,000	0,004	0,000	0,000
0,000	0,010	48,971	0,000	0,128	0,001	52,113	0,003	0,000	0,181	0,462	0,000	0,009	0,000	0,005
0,000	0,000	25,502	0,000	0,114	0,000	7,382	0,004	0,000	0,419	0,186	0,000	0,002	0,000	0,000
0,000	0,000	25,419	0,000	0,067	0,001	7,237	0,000	0,000	0,537	0,180	0,000	0,000	0,000	0,000
0,006	0,000	42,054	0,000	0,188	0,000	119,902	0,009	0,000	1,159	0,482	0,000	0,000	0,000	0,000
0,008	0,000	55,658	0,001	0,472	0,000	133,765	0,003	0,000	1,470	0,495	0,000	0,000	0,000	0,000

Table 5 : Element analysis

6. 2. 3. Pesticide analysis

The tables show : Sandre code which stands for the national administrative service of water data and referentials ; Parameters (substances) ; Family/sub-family ; Method ; Concentration in µg/L.

Substances found :

Code Sandre	Paramètres	Famille/ Sous Famille	Méthode	Concentration (1)
1832	Hydroxyatrazine (Hydroxyatrazine (2 Hydroxy))	Herbicides Triazines (Métabolite)	CMO_MT73	0.024 µg/L
1414	Propyzamide	Herbicides Amines, Amides	CMO_MT73	0.008 µg/L

Table 6 : Results of substances found in the sample

<u>Two substances were identified</u> :

- Hydroxyatrazines (hydroxyatrazine (2 Hydroxyl)) from herbicide triazines family, at the concentration 0.024 µg/L.
- Propyzamide from herbicide amines, amides family, at the concentration of 0.08 µg/L.

The second table shows the detailed results based on 50 substances researched. Sandre code, parameter, CAS number (the unique numerical identifer assigned to every chemical substance), method, technique, result, unit (µg/L), LQ (quantification limit).

We can observe :

- For Hydroxyatriazines the concentration found in the sample is 0.024 µg/L and the quantification limit is 0.005 µg/L.
- For Propyzamides the concentration found in the sample is 0.008 µg/L and the quantification limit is 0.005 µg/L. Other substances analyzed are all below the LQ.

6. 2. 4. Pasteur Institute analysis

In the study from Pasteur Institue of Lille, the values observed are :

Samples	BOD_5 (mg/L)	COD (mg/L)	BOD_5/COD ratio (α)
1.a.	1,0	24	0,042
1.b	1,0	28	0,036
2.a	2,0	33	0,061
2.b	2,0	23	0,087

Table 7 : BOD, COD results from Pasteur Institute analysis

7. Discussion

The researches and results of this study indicate that past uses of the site led to some of his actual specificities. It started with only one decantation basin for washing sugarbeets to finally become a protected natural site classified Natura 2000. It is home to various species of birds, insects, amphibians, mammals, invertebrates, reptiles and plants.

This includes 244 birds species. Focusing on wetland areas we can especially observe black-necked grebe (*Podiceps nigricollis*) who nests on the site since 1991 (Document d'objectif natura 2000, 2015). Breeding populations on the site are of national importance which played an important role during acquisition processes and establishment of protection mesures by the North Department of France. We can also mention some species which are considered as threatened in Europe, such as the Meditarranean gull (*Larus melanocephalus*) who mainly nests on islets of the site and the Spotted crake (*Porzana porzana*).

In the studied site, organic residues would have been accumulated in the mud, decomposed by microorganisms and released in the form of carbon dioxyde with mineral salts. As it is the main food substrates of chlorophyllous plants, it can explain the presence of the high amount of algae during high season. Moreover aerobic bacterial activity needs a large amount of oxygen to degrade these compounds and dioxygen is poorly soluble in water so there is eutrophication process. Also, this could be amplified by the global warming, these last years temperatures increased and the solubility of oxygen decreases with increasing temperatures.

This makes a favorable environment for algae proliferation that uses solar energy to convert $CO2$ into $O2$. Algae are essential food source to molluscs and other invertebrates such as insects, which are an important source of food to many birds. So the past uses probably had and still have an important responsability in the current water state and composition which is rich of organic matter.

Concerning the simple observations, water turbidity is low for the three basins, excluding suspended solid suspension pollution (Skoronski et al, 2018). In the South basin we can also observe many stems which are probably algea remains.

The studies from Pasteur Institue of Lille (Table 7), ratio BOD_5/COD were calculated. α, the degree of biochemical degradation has a value comprised between 0 and 1. More the value is close to 1, more the quantity of biochemically degradable substances is high (Morin-Crini et al, 2017). Here the values obtained are below 0.1. So according to these results, as the BOD_5/COD ratio is low the water contains low concentration of biologically decomposable organics. However, the BOD_5 concentrations are so low that they resemble to drinking water concentrations.

Regarding water standard analysis (Table 4), the concentration of total organic carbon (TOC) is comprised between 19.82 mg/L and 22.4 mg/L. According to EPA (U.S. Environmental Protection Agency) the limit natural concentration for treated/drinking water is 2 mg/L. Here the values found are high and the water is considered as 'bad quality', values about 17 are classified as 'untreated/polluted water' (Chen, 2019).

The median value of total nitrogen (TN) : 1.57 mg/L, according to the EPA (U.S. Environmental Protection Agency) the nitrate standard value for drinking water is 10 mg/L.

The maximum fluoride value : 0.51 mg/L is a normal value freshwater lakes and streams (Beitz, 2010).

Chloride median value : 48.65 mg/L is also acceptable for lake waters (Dugan et al, 2017). Nitrite values (from 0 to 0.32 mg/L) are even below the maximum acceptable value of 1.0 mg/L defined for drinking water in US (Health Department of Vermont, 2021).

About element analysis (Table 5), it showed an average of 0.184 mg/L in phosphorus concentrations. According to the OECD, the values higher than 0.1 mg/L are considered as hypertrophic.

For heavy metals, values are equals to zero or lower than 0.01 mg/L for aluminium (Al), thallium (Tl), lead (Pb) and cadmium (Cd). Higher values were found for Arsenic (As) with a maximum of 0.021 mg/L but it is more than acceptable (e.g. freshwater and algae contain about 1-250 mg/L of arsenic) (Lenntech website).

For pesticide analysis (Table 6) of the sample from the South basin, which should present the higher amount of pesticide residues according to its past use, all substances analyzed were below the quantification limit (LQ) except for hydroxyatriazines (Hydroxyatrazine (2 Hydroxy)) and propyzamides. About hydroxyatrazine, the concentration found is 0.024 µg/L and the quantification limit is 0.005 µg/L and for Propyzamides the concentration found in the sample is 0.008 µg/L (quantification limit at 0.005 µg/L). These analyzes show the presence of pesticide residues but concentrations are still very low.

8. Conclusion

Based on observations, researches and results obtained we can make these conclusions :

- The Ornithological Site of “Cinq Tailles” presents interesting and atypical characteristics related to its industrial past use.

- There is no significant current water pollution.

- Organic pollution negatively affects our environment, but can also lead to the establishment of an exceptional area and be beneficial to many species of birds but also algae and invertebrates.

- It is better to preserve this site at this state instead of trying to remove past pollution traces.

9. Recommendations

Further researches :

- Analyze pesticide residues in all basins.
- Do more researches to define all potential species whose organic residues can be or could have been beneficial.
- Analyze mud samples from each basin.

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Document d’objectif Natura 2000, Zone de protection spécial : “Les Cinq Tailes” FR3112002 ; THUMERIES - LA NEUVILLE (59), 2015.

Appendices

Analysis from Pasteur Institute

BULLETIN D'ANALYSE
Dép :
Commune : THUMERIES.

DIVERS EAU DOUCE
EAU
No : 1
PARC ORNITHOLOGIQUE
Bon cde :
Vos Ref : EAU DE SURFACE
Prélevé par le demandeur
le 06/02/2009 à
Reçu le 10/02/2009 (L) à 09H30
Début des essais le 10/02/2009

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Bulletin d'analyse concernant l'échantillon 906262
Edition n° 1 **Page** 1 / 1

USM-MADAME NATHALIE DEBOOSERE
INSTITUT PASTEUR DE LILLE
COMPTE 4900
LILLE
59000 LILLE

L = mesure du laboratoire de Lille
G = mesure du laboratoire de Gravelines
* = mesure sous accréditation

	Paramètre	*Méthode*	*Résultat*	*Unité*	*Réf. qualité / valeurs guides*	*limites qualité / val. impératives*
PHYSICO-CHIMIE						
	pH a temp.echant.	NF T 90-008	* L 8.05	u.pH		
	Matieres en suspension totales	NF EN 872	* L 3	mg/l		
	Carbone organique total	NF EN 1484	* L 10.9	mg/l C		
	Mesure UV a 254 nm	Spectrophotometrie	L 0.037	u.abs		
	DCO	NF T 90-101	* L 24	mg/l		
	DBO5	NF EN 1899-1	* L 1.0	mg/l		
ANIONS						
	Orthophosphates PO4	NF EN ISO 15681-2	* L <0.10	mg/l PO4		
CATIONS						
	Ammonium	NF EN ISO 11732	* L <0.05	mg/l NH4		

A Lille, le 18/02/2009

Le Chef de Laboratoire,

A Delvoye E. Pierlot J.S. Pharamond E. Oudart A. Puchois A. Vanhille P. Thomas A. Le Minor E. Picque E. Ready

L'accréditation du COFRAC atteste de la compétence des laboratoires pour les seuls essais couverts par l'accréditation, qui sont identifiés par le symbole *.
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Laboratoire de référence agréé pour l'analyse des eaux

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Bulletin d'analyse concernant l'échantillon 907127
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59000 LILLE

L = mesure du laboratoire de Lille
G = mesure du laboratoire de Gravelines
* = mesure sous accréditation

Paramètre	*Méthode*	*Résultat*	*Unité*	*Réf. qualité / valeurs guides*	*limites qualité / val. impératives*
PHYSICO-CHIMIE					
pH a temp.echant.	NF T 90-008	* L 8.00	u.pH		
Matieres en suspension totales	NF EN 872	* L 2	mg/l		
Carbone organique total	NF EN 1484	* L 11.0	mg/l C		
Mesure UV a 254 nm	Spectrophotometrie	L 0.034	u.abs		
DCO	NF T 90-101	* L 28	mg/l		
DBO5	NF EN 1899-1	* L 1.0	mg/l		
ANIONS					
Orthophosphates PO4	NF EN ISO 15681-2	* L <0.10	mg/l PO4		
CATIONS					
Ammonium	NF EN ISO 11732	* L <0.05	mg/l NH4		

A Lille, le 19/02/2009

Le Chef de Laboratoire,

A Delvoye E. Pierlot J.S. Pharamond E. Oudart A. Puchois A. Vanhille P. Thomas A. Le Minor E. Picque E. Ready

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Bulletin d'analyse concernant l'échantillon 905139
Edition n° 1 **Page 1 / 1**

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G = mesure du laboratoire de Gravelines
* = mesure sous accréditation

Paramètre	*Méthode*	*Résultat*	*Unité*	*Réf. qualité / valeurs guides*	*limites qualité / val. impératives*
PHYSICO-CHIMIE					
pH a temp.echant.	NF T 90-008	* L 7.95	u.pH		
Matieres en suspension totales	NF EN 872	* L 7	mg/l		
Carbone organique total	NF EN 1484	* L 11.0	mg/l C		
Mesure UV a 254 nm	Spectrophotometrie	L 0.19	u.abs		
DCO	NF T 90-101	* L 33	mg/l		
DBO5	NF EN 1899-1	* L 2.0	mg/l		
ANIONS					
Orthophosphates PO4	NF EN ISO 15681-2	* L <0.10	mg/l PO4		
CATIONS					
Ammonium	NF EN ISO 11732	* L 0.12	mg/l NH4		

A Lille, le 12/02/2009

Le Chef de Laboratoire,

A Delvoye E. Pierlot J.S. Pharamond E. Oudart A. Puchois A. Vanhille P. Thomas A. Le Minor E. Picque E. Ready

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Reçu le 26/01/2009 (L) à 12H00
Début des essais le 26/01/2009

Mirador
prélevé le 19/01/09

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Institut Pasteur de Lille

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Bulletin d'analyse concernant l'échantillon 903287
Edition n° 1 Page 1 / 1

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COMPTE 1019
LILLE
59000 LILLE

L = mesure du laboratoire de Lille
G = mesure du laboratoire de Gravelines
* = mesure sous accréditation

Paramètre	*Méthode*	*Résultat*	*Unité*	*Réf. qualité / valeurs guides*	*limites qualité / val. impératives*
PHYSICO-CHIMIE					
pH a temp.echant.	NF T 90-008	*L 8.00	u.pH		
Matieres en suspension totales	NF EN 872	*L 4	mg/l		
Carbone organique total	NF EN 1484	*L 10.0	mg/l C		
Mesure UV a 254 nm	Spectrophotometrie	L 0.21	u.abs		
DCO	NF T 90-101	*L 23	mg/l		
DBO5	NF EN 1899-1	*L 2.0	mg/l		
ANIONS					
Orthophosphates PO4	NF EN ISO 15681-2	*L <0.10	mg/l PO4		
CATIONS					
Ammonium	NF EN ISO 11732	*L 0.09	mg/l NH4		

A Lille, le 04/02/2009

Le Chef de Laboratoire,

A Delvoye E. Pierlot J.S. Pharamond E. Oudart A. Puchois A. Vanhille P. Thomas A. Le Minor E. Picque E. Ready

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Pesticide analysis

- L A
D R O
M E -
laboratoire

Environnement - sécurité alimentaire - agriculture

Client demandeur N° : 44045
Fax :
Vos ref :

Client payeur N° : 44045
TANGHE Kristina
59710 AVELIN

Madame Kristina TANGHE
57 rue de Lille
59710 AVELIN

Rapport d'essai n° 22-04664-001	N° de prélèvement **231282**

Marché | **Commande** #5251
Lieu de prélèvement Site ornithologique des cinq tailles - Bassin sud
Commune THUMERIES
Nature Eau douce
Prélevé le 04/03/2022 **à** 15:00 **par** LE CLIENT
Reçu le 07/03/2022 **à** 09:05 **Température à reception :** 5 °C
Edité le 17/03/2022

Dossier n° **22-04664** Echantillon n° **22-04664-001** Devis n° **2022032525** Sous-Devis n° **22032525-001**

Libellé de l'échantillon : - KIT N°133

Commentaire : Eau conforme à la législation en vigueur pour les paramètres analysés.

Synthèse des résultats d'analyses

Mise en route des analyses
Date d'analyse: HPLCMS Directe Shidmazu 16/03/2022

Substances trouvées :

Code Sandre	Paramètres	Famille/ Sous Famille	Méthode	Concentration (1)	CMA ou limite Q.	NQE ou Ref. Qualité
1832	Hydroxyatrazine (Hydroxyatrazine (2 Hydroxy))	Herbicides Triazines (Métabolite)	CMO_MT73	0.024 µg/L		
1414	Propyzamide	Herbicides Amines, Amides	CMO_MT73	0.008 µg/L		

(1) Si mention "Présence" : La valeur est comprise entre la Ld (limite de détection) et la Lq (limite de quantification). En général Ld = Lq/3

Méthodes :

Méthode	Description
CMO_MT73	Méthode interne: Injection directe de l'échantillon décanté et Dosage par Chromatographie Liquide (Spectrométrie de masse en tandem)

Par délégation de la Présidente,
Signé électroniquement par Philippe REY, Adjoint au chef de service - Service Environnement, signataire autorisé.

LABORATOIRE DÉPARTEMENTAL D'ANALYSES
37 AVENUE LAUTAGNE - BP 118, 26904 VALENCE CEDEX 9 - TÉL : 04 75 81 70 70 - FAX : 04 75 81 70 71
laboratoire@ladrome.fr - www.ladromelaboratoire.fr - SIRET 222 6000 17 003 62 - CODE APE 7120B

Code Sandre	Paramètre	N° CAS	Méthode	Technique	Résultat	Unité	LQ
6800	Alachlore ESA	142363-53-9	CMO_MT73	HPLCMSMS	<0.02	µg/L	0.02
6855	Alachlore OXA	171262-17-2	CMO_MT73	HPLCMSMS	<0.05	µg/L	0.05
1107	Atrazine	1912-24-9	CMO_MT73	HPLCMSMS	<0.005	µg/L	0.005
1109	Atrazine Deisopropyl (DIA)	1007-28-9	CMO_MT73	HPLCMSMS	<0.005	µg/L	0.005
1108	Atrazine Desethyl (DEA)	6190-65-4	CMO_MT73	HPLCMSMS	<0.005	µg/L	0.005
1113	Bentazone	25057-89-0	CMO_MT73	HPLCMSMS	<0.005	µg/L	0.005
6378	Chloridazone desphényl	6339-19-1	CMO_MT73	HPLCMSMS	<0.01	µg/L	0.01
6379	Chloridazone méthyl desphényl	17254-80-7	CMO_MT73	HPLCMSMS	<0.01	µg/L	0.01
1136	Chlortoluron	15545-48-9	CMO_MT73	HPLCMSMS	<0.005	µg/L	0.005
1137	Cyanazine	21725-46-2	CMO_MT73	HPLCMSMS	<0.005	µg/L	0.005
1830	Desethyl Deisopropylatrazine (DEDIA)	3397-62-4	CMO_MT73	HPLCMSMS	<0.02	µg/L	0.02
1488	Diflubenzuron	35367-38-5	CMO_MT73	HPLCMSMS	<0.005	µg/L	0.005
6380	Dimetachlor OXA	1086384-49-7	CMO_MT73	HPLCMSMS	<0.020	µg/L	0.020
1491	Dinosebe	88-85-7	CMO_MT73	HPLCMSMS	<0.005	µg/L	0.005
1176	Dinoterbe	1420-07-1	CMO_MT73	HPLCMSMS	<0.020	µg/L	0.020
1177	Diuron	330-54-1	CMO_MT73	HPLCMSMS	<0.010	µg/L	0.010
1763	Ethidimuron	33043-49-3	CMO_MT73	HPLCMSMS	<0.005	µg/L	0.005
6864	Flufenacet ESA	947601-87-8	CMO_MT73	HPLCMSMS	<0.020	µg/L	0.02
1940	Flufenacet (Thiafluamide)	142459-58-3	CMO_MT73	HPLCMSMS	<0.005	µg/L	0.005
1765	Fluroxypyr	69377-81-7	CMO_MT73	HPLCMSMS	<0.005	µg/L	0.005
1673	Hexazinone	51235-04-2	CMO_MT73	HPLCMSMS	<0.005	µg/L	0.005
1832	Hydroxyatrazine (Hydroxyatrazine (2 Hydroxy))	2163-68-0	CMO_MT73	HPLCMSMS	0.024	µg/L	0.005
1954	Hydroxyterbuthylazine	66753-07-9	CMO_MT73	HPLCMSMS	<0.005	µg/L	0.005
1877	Imidaclopride	138261-41-3	CMO_MT73	HPLCMSMS	<0.005	µg/L	0.005
1208	Isoproturon	34123-59-6	CMO_MT73	HPLCMSMS	<0.005	µg/L	0.005
1209	Linuron	330-55-2	CMO_MT73	HPLCMSMS	<0.005	µg/L	0.005
1214	Mecoprop (MCPP)	93-65-2	CMO_MT73	HPLCMSMS	<0.020	µg/L	0.020
1796	Metaldehyde	108-62-3	CMO_MT73	HPLCMSMS	<0.05	µg/L	0.05
1670	Metazachlore	67129-08-2	CMO_MT73	HPLCMSMS	<0.005	µg/L	0.005
6895	Metazachlore ESA	172960-62-2	CMO_MT73	HPLCMSMS	<0.02	µg/L	0.02
6894	Metazachlore OXA	1231244-60-2	CMO_MT73	HPLCMSMS	<0.02	µg/L	0.02
6854	Metolachlore ESA	171118-09-5	CMO_MT73	HPLCMSMS	<0.020	µg/L	0.02
7729	Métolachlore NOA	1418095-19-8	CMO_MT73	HPLCMSMS	<0.02	µg/L	0.02
6853	Metolachlore OXA	152019-73-3	CMO_MT73	HPLCMSMS	<0.020	µg/L	0.02
1221	Metolachlore (R+S)	51218-45-2	CMO_MT73	HPLCMSMS	<0.005	µg/L	0.005
1227	Monolinuron	1746-81-2	CMO_MT73	HPLCMSMS	<0.005	µg/L	0.005
6384	N,N-Dimethylsulfamide	3984-14-3	CMO_MT73	HPLCMSMS	<0.01	µg/L	0.01
1414	Propyzamide	23950-58-5	CMO_MT73	HPLCMSMS	0.008	µg/L	0.005
2087	Quinmerac	90717-03-6	CMO_MT73	HPLCMSMS	<0.005	µg/L	0.005
1263	Simazine	122-34-9	CMO_MT73	HPLCMSMS	<0.005	µg/L	0.005

Code Sandre	Paramètre	N° CAS	Méthode	Technique	Résultat	Unité	LQ
1831	Simazine Hydroxy	2599-11-3	CMO_MT73	HPLCMSMS	<0.01	µg/L	0.01
1266	Terbumeton	33693-04-8	CMO_MT73	HPLCMSMS	<0.005	µg/L	0.005
2051	Terbumeton Desethyl	30125-64-5	CMO_MT73	HPLCMSMS	<0.005	µg/L	0.005
1268	Terbutylazine	5915-41-3	CMO_MT73	HPLCMSMS	<0.010	µg/L	0.010
2045	Terbutylazine Desethyl	30125-63-4	CMO_MT73	HPLCMSMS	<0.005	µg/L	0.005
1930	1-(3,4-DichloroPhenyl)Uree (DCPU)	2327-02-8	CMO_MT73	HPLCMSMS	<0.010	µg/L	0.010
1929	1-(3,4-Dichlorophenyl)-3-MethylUree (DCPMU)	3567-62-2	CMO_MT73	HPLCMSMS	<0.005	µg/L	0.005
2847	1-(4-IsopropylPhenyl)Uree (IPPU)	56046-17-4	CMO_MT73	HPLCMSMS	<0.005	µg/L	0.005
1141	2,4-D	94-75-7	CMO_MT73	HPLCMSMS	<0.005	µg/L	0.005
1212	2,4-MCPA	94-74-6	CMO_MT73	HPLCMSMS	<0.010	µg/L	0.010