The impact of human activity on the rivers water quality of our town, Vervins (Picardie, France)

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Abstract

First of all, it is relevant to say that human activity can have a quite important impact on the rivers water quality, even more particularly as far as the low-yielding rivers water is concerned. In order to estimate this effect, we will not only focus on the biodiversity of macro-invertebrates but also on the diversity of some micro-organisms called diatoms. These observations will be presented along with various physicochemical measurements (i.e. temperature, PH readings, dissolved dioxygen, current speed, turbidity, conductivity and so on…).
These scientific facts as well as the water sampling will be carried out on both upstream and downstream rivers in our town. A third river which is known for the exceptional quality of its water will also be studied as a basis for comparison.
We can assume that the biodiversity in the downstream part of the town will be lower.
Where appropriate and on the basis of these studies, the identification of the species which disappear – or, on the contrary, whose population abnormally grows – together with physicochemical measurements should enable us to determine the potential source of pollution.
This process ultimately aims at making our citizens aware of the impact of their activities and helping them understand the importance of preserving a significant biodiversity.

Keywords
biodiversity; macro-invertebrates; diatoms, water quality

1.Introduction

1.1.Vervins Location and characteristics

Vervins is a small rural town located in Northern France, near the Belgian line. Vervins has 2507 inhabitants with a density of 242 inhabitants/km². Its area is 10,35 km² and is altitude is between 120 and 208 meters. There are some industries and farms around the studied rivers, with a hospital and a water treatment plant.

Figure 1: Vervins location and aerial view

1.2.Watercourses studied

We led a research on two local watercourses, the Simone and the Chertemps. There are two small rivers, their debit is less than 1m^3/s. The Simone joins the CHERTEMPS just on Vervins' downstream. Its length is 4.5 km from the source to the confluence. The Chertemps is a little bit more important in size and debit. Its length is about 9km from the source to the confluence. The two watercourses are part of the Seine's watershed area.

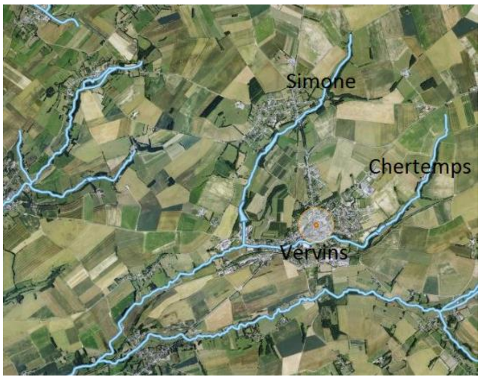

Figure 2: Vervins hydrography

Figure 3 : Vervins' place on the Seine's watershed area

2.Content

2.1.Purpose of the investigation

The goals to reach are the following:

- Estimate a medium town's impact on the water quality in the crossing rivers.
- Construct hypotheses about the causes of the changes between the uphill and the downhill slope of a river (the Chertemps, in our case)
- Inform the local community about the consequences of human activities on the water quality.

2.2.Method

We did our samples on 4 sites, each including 5 appointements. However, we use an approximate GNBI; the studied rivers are undersized regarding to this calculation's standards.

To complete our results, we observed diatoms, which are watery micro-organisms. It is possible to work out a biotic index with diatoms (DBI) but the equipment needed was too expensive so we didn't use it.
These single-cell algas' sampling is achievable on all watercourse types, excepting salt water.

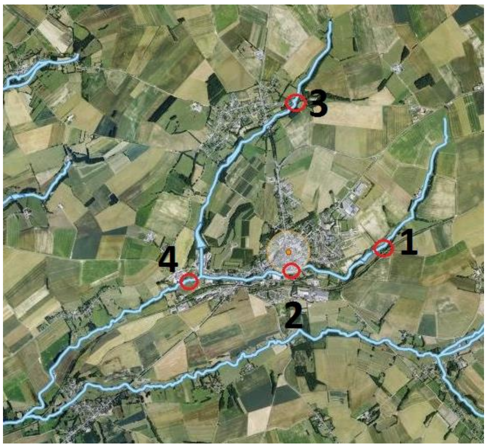

Figure 4: Our four sampling sites around the town


Figure 5: first sampling site aerial view

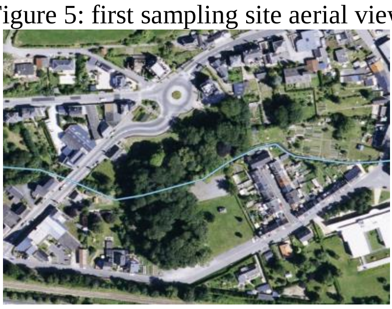
Figure 6: second sampling site aerial view

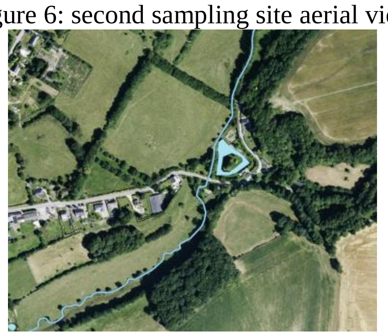
Figure 7 : third sampling site aerial view


Figure 8 : fourth sampling site

2.3.Sampling and physicochemical protocol

In laboratory (before sampling)
- Hardware preparation (different sensors measuring conductivity, oxygen, turbidity, pH, temperature, current speed, depth, light, GPS location).
-Suber net, brushes, sampling tubes,90% ethanol.

On site
- Spot a sampling site and differenciate 5 distinct posts.
- Measure the physicochemical parameters with the sensors.
- Place the Surber net in order to take a macroinvertebrates sampling.
- Take some rocks in the net demarcation.
- Rub these rocks with brushes to pick up the diatoms.
- Lift the net.
- Drain it in a basin or in a jar.
- Put the content in a sampling tube with 90% ethanol.
- Label (date, hours, GPS coordinates…)
- Repeat for each post.

In laboratory (after sampling)
Macro-invertebrate preparation
- Pour the sampling tube content in the sieve
- Wash out several times with clear water.
- Pick up the different species with a flat clip, put them in a Petri box.
- Identify each species with a magnifying glass, count and classify them, calculate the GNBI with the reference table (see annex n°3)
- Repeat for each sampling tube.

Diatoms preparation
→ Pick up 2 mL from the sample to put in a test tube.
→ Add 8 mL of hydrogen peroxyde to destroy the organic matter. Let it settle in for 12 hours at room temperature.
→ Complete 2 or 3 decantation cycles with distill water to purify the sample. You can either use decantation, which lasts about 10 hours, or a 1500 turns/minute centrifuge during 3 minutes. We choose the method with centrifugation Take the sample back and put a drop of solution on a slide.
→ With a heating, let the solution vanish until the liquid has disappeared.
→ Put one o three resin drops on the slide (with an index of refraction superior to 1.7). Let the resin boil slowly on the heating and then place the slide on a plan surface. Apply a chip immediately and carry out a soft pressure on it until you hear the valve crisp on the glass.
The preparation is ready when the resin is solid and the slide cold.

3.Results

3.1.Sampling site 1: Chertemps' uphill, on April the 11th, 2016 (around 11 A.M.)

Table 1 : Physicochemical parameters sampling site 1

Post	Conditions	Light Lux	Coordinates (Lat./Long.)	Temperature °C	Dissolved Oxygen mg/l	C urrent speed m/s	Depth m	pH	Turbidity UTN
1	Clay and thin to medium sediments	70	49.833664/ 3.926773	11.3	10.5	0.39	29	7.2	1.4
2		211	49.834045/ 3.926743	11.2	9.9	0.01	13		
3		170	49.834457/ 3.927155	10.9	10.4	0.15	12		
4		192	49.834213/ 3.926743	11.1	9	0.38	15		
5		218	49.834381/ 3.926971	11.3	10.4	0.22	13		

Table 2 : G.N.B.I. sampling site 1

Post	Species	Quantity	Taxon groups	Grade
1	EPHEMEROPTERA : Heptageniidae COLEOPTERA : Hydrophilidae Empty scabbards	37 1 2	Taxon 5 Taxon 5	15/20
2	Leeches (anelides, hirudinea) Molluscs COLEOPTERA : Hydrophilidae	1 1 1	Taxon 1 Taxon 2 Taxon 5	5/20
3	EPHEMEROPTERA : Heptageniidae Leech TRICHOPTERA : Beraeidae Flatworms	12 1 2 2	Taxon 5 Taxon 1 Taxon 7 Taxon	7/20
4	Empty scabbards Molluscs Achetes EPHEMEROPTERA : Baetidae DIPTERA : Chironomidae	3 3 2 8 3	 Taxon 2 Taxon1 Taxon 2 Taxon 1	4/20
5	Molluscs Achetes Leech DIPTERA : Chironomidae EPHEMEROPTERA : Baetidae	1 3 1 1 1	Taxon 2 Taxon 1 Taxon 1 Taxon 1 Taxon 2	2/20

Table 3 :diatoms observed

Diatoms	Water quality indicated
Nitzshia capitellata Planothidium delicatulum Luticola mutica Bacillaria paradoxa	Bad Bad Mediocre Mediocre

3.2.Sampling site 2 : Vervins' downtown, on March the 13th, 2016 (around 01 P.M.)

Table 4 : Physicochemical parameters sampling site 2

Post	Conditions	Light Lux	Coordinates (Lat./Long.)	Temperature °C	Dissolved Oxygen mg/l	Current speed m/s	Depth m	pH	Turbidity UTN
1	Gravel	455	49.828583/ 3.981302	12.4	8.9	0.56	12	7.6	4.2
2		580	49.828613/ 3.881332		8.9	0.39	16		
3	Garbage	590	49.828568/ 3.881058		9	0.61	30		
4	Clay alluvium	550	49.828598/ 3.881027	12.5	9.1	0.88	25		
5	Thin alluvium (bank)	560	49.828613/ 3.880966	13.7	9.1	0.01	13		

Table 5 : G.N.B.I. sampling site 2

post	Species	Quantity	Taxon groups	Grade
1	Achetes Molluscs Leeches EPHEMEROPTERA : *Baetidae*	25 2 13 1	1 2 1 2	8/20
2	EPHEMEROPTERA : *Baetidae* Leeches Achete	1 3 1	2 1 1	2/20
3	EPHEMEROPTERA : *Baetidae* Leech	1 1	2 1	2/20
4	TRICHOPTERA : *Rhyacophilidae*	1	4	4/20
5	Achetes Molluscs	3 3	1 2	2/20

3.3.Result sampling site 3 : the Simone, on April the 11th, 2016 (around 01 P.M.)

Table 6 : Physicochemical parameters sampling site 3

Post	Conditions	Light Lux	Coordinates (Lat./Long.)	Temperature °C	Dissolved Oxygen mg/l	Current speed m/s	Depth cm	pH	Turbidity UTN
1	Gravel	262	49.853928/ 3.908798	11.7	9.3	049	15	7	5
2		280	49.853943/ 3.908798	11.3		0.45	10		
3		260	49.853928/ 3.908752			0.50	28		
4	Clay alluvium	422	49.853943/ 3.908722			0.01	8		
5	Gravel	320	49.853958/ 3.908707			0.4	14		

Table 7 : G.N.B.I. sampling site 3

post	Species	Quantity	Taxon groups	Grade
1	AMPHIPODA : *Gammaridae* EPHEMEROPTERA : *Ephemeridae* EPHEMEROPTERA : *Potamanthidae* Leeches EPHEMEROPTERA :*Heptageniidae* TRICHOPTERA : *Brachycontridae* scabbards TRICHOPTERA : *Rhyacophilidae*	21 3 1 2 1 3 4	Taxon 2 Taxon 6 Taxon 5 Taxon 1 Taxon 5 Taxon 8 Taxon 4	8/20
2	AMPHIPODA :*Gammaridae* TRICHOPTERA : *Sericostomatidae* TRICHOPTERA : *Goeridae* EPHEMEROPTERA : *Heptageniidae* DIPTERA : *Chironomidae* Leeches	+50 5 3 3 3 2	Taxon 2 Taxon 6 Taxon 7 Taxon 5 Taxon 1 Taxon 1	15/20
3	AMPHIPODA :*Gammaridae* TRICHOPTERA :*Glossomatidae* *A*chetes	11 2 8	Taxon 2 Taxon 7 Taxon 1	7/20
4	AMPHIPODA :*Gammaridae* Molluscs EPHEMEROPTERA :*Heptageniidae* TRICHOPTERA :*Glossomatidae* Achetes Leech	5 2 3 2 3 1	Taxon 2 Taxon 2 Taxon 5 Taxon 7 Taxon 1 Taxon 1	7/20
5	AMPHIPODA :*Gammaridae* Leeches TRICHOPTERA :*Glossomatidae* Empty scabbard TRICHOPTERA :*Rhyacophilidae*	+50 2 2 1 1	Taxon 2 Taxon 1 Taxon 7 Taxon 4	15/20

Table 8 : diatoms observed sampling site 3

Diatoms	Water quality indicated
Cymatopleura elliptica Navicula lanceolata (viridula ou frustulia vulgaris) Cocconeis Navicula schroeteri (radiosa) Navicula schroeteri Navicula striolata Cocconeis placentula	Good Medium/Good Medium Good Good Medium

3.4.Sampling site 4 : Chertemps' downhill slope, on April the 11th, 2016 (around 03 P.M.)

Table 9 : Physicochemical parameters sampling site 4

Post	Conditions	Temperature °C	Dissolved Oxygen mg/l	Current speed m/s	Depth m	pH	Turbidity UTN
1	Bright and unobstructed place	7.9	11.14	0.49	12	7.3	2
2		7.3	11.58	0.27	16		
3		7.9	11	0.01	30		
4		7.6	11.57	0.6	25		
5		7.8	11.4	0.31	13		

Table 10 :G.N.B.I.sampling site 4

Post	Species	Quantity	Taxon groups	Grade
1	Achetes EPHEMEROPTERA : Heptageniidae Molluscs	15 3 2	1 5 2	5/20
2	Achetes Mollusc EPHEMEROPTERA : Heptageniidae	25 1 3	1 2 5	8/20
3	Sericostomatidae (Empty scabbards) Achetes	3 10	6 1	4/20
4	Brachycentridae (scabbard) Lepidostomatidae (scabbard) Achetes Molluscs	1 1 8 6	8 6 1 2	3/20
5	EPHEMEROPTERA : Heptageniidae Achetes Molluscs	4 17 3	5 1 2	6/20

Table 11 :Diatoms observed samplig site 4

Diatoms	Water quality indicated
Craticula accomoda Navicula molestiformis 9 Navicula veneta 21 Navicula minuscula 8 Planothidium delicatulum Nitzschia communis Bacillana paradoxa Surirella brebissonil / Surirella ovalis Navicula tripunctata	Bad Bad Bad Bad Bad Bad Mediocre Mediocre

4.Observations

4.1.Observations sampling site 1

The physicochemical features we found are globally normal. The riverbed’s composition is clayey. Temperature and pH are medium.
Though, we can notice some workable parameters:
→ The dissolved oxygen concentration is under the norm, which is 10,9 mg/L for a water between 10 and 15° Celsius
→ The turbidity is low.
→ The river’s facies is that of a flat current: a shallow watercourse, mostly narrow, with an approximate debit of 50 L/s (debit= v in m/s * river section in m²) and a depth under 40 cm.
→ According to our results, the picked up GNBI, 6.6/20, is bad.
→ The diatoms study, thanks to which we observe a poor quality, confirms this assessment.

4.2.Observations sampling site 2

Temperature and oxygen concentration are average regarding to the sampling period.
But some other parameters are noteworthy:
→ The turbidity is low.
→ The estimated GNBI is 5.2/20 (bad).
→ The observed macroinvertebrates are mostly achetes, molluscs and empty scabbards.
→ We haven’t been able to sample diatoms and to use the results.

→ The quality deterioration indicated by the GNBI isn't due to thick particles.
→ The sampling was carried out a month before the three others. We cannot compare its physicochemical features to other sites'.

4.3.Observations sampling site 3

The soils are slimy and there is gravel in the riverbed.
→ The dissolved oxygen concentration is under the norm, which is 10,9 mg/L for a water between 10 and 15° Celsius.
→ The estimated GNBI is 10.4/20. It's average.
→ The diatoms observation has a "middling" result which confirms the GNBI.

4.4.Observation sampling site 4

The site is correctly exposed to light. There is garbage in the riverbed. A lot of parameters are to note here:

→ Turbidity is low.

→ Temperature rose of about a degree.

→ The dissolved oxygen concentration lowered.

→ The pH increased (alcalizing).

→ The estimated GNIB is 3.6/20. It's very bad.

→ The bad results of the diatoms observation confirms this rating.

5.Data interpretation

From site to site, along the Chertemps, the GNBI results dicrease since the uphill to the downhill slope.
According to Tuffery and Verneaux's biotic index method, some species' population tumbles when there is pollution (see annex n°5).
The diatoms observation imparts the same degradation.
Water heat is a sign of organic pollution.
Between the sampling sites are pollution sources.
Turbidity is always low so this pollution doesn't come from thick elements.
About the whole lot of samplings, excepting Vervins' downtown, the water pollution can be due to phosphate and nitrate ions present in the phytosanitary products used in farms; this type of pollution doesn't act on turbidity.
The Simone and Chertemps' uphill results are average though the sampling took place near the source.
Both sites are near a farm. These results may be caused by phytosanitary rejects.
We can see a loss of quality from the Chertemps' uphill to Vervins' downtown.
However, there are no farms or industries between these points. The pollution intervening here would be domestic.

6.Conclusion

We could note that, according to a watercourse's location, this one could suffer from the consequences of our urban activities. Industries, farms and even people breed pollution, for instance organic pollution (sewage, garbage...).
The four sites we studied are incurring biological damages. We found increasingly bad results from Vervins' uphill to the downhill slope. we can infer that our way of life, even in a small city, has harmful effects on water biodiversity.

The studied rivers are undersized, and it makes them more sensitive to pollution effects. Indeed, the bad GNBI observed in the Simone and in the Chertemps' uphill is really inusual near the source. This fact should open a way to further investigations, like a chemical analysis of the watercourses, so we could understand the causes of these results.

We did such a little part of all the work science could do on this subject, and our project can be carried on more deeply, from year to year, by the others pupils of our Institution. Our mission will be to train the future students so the researches can continue, and our results will become more and more accurate.

7.References

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8.Annexes

8.1.The macro invertebrates

Taxon group 1

Figure 1: *Chironomidae*

Figure 2*: Achete*

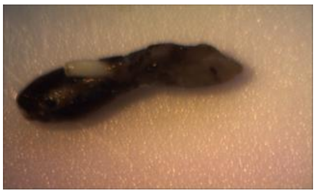

Figure 3: Flatworm

Figure 4: Leech

Taxon group 2

Figure 5: *Gammaridae*

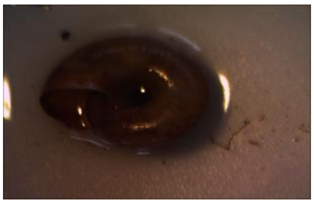

Figure 6: Mollusc

Taxon group 4

Figure 7: *Rhyacophilidae*

Taxon group 5

Figure 8: *Heptageniidae*

Figure 9: *Potamanthidae*

Figure 10: *Hydropitilidae*

Taxon group 6

Figure 11: *Ephemeridae*

Taxon group 7

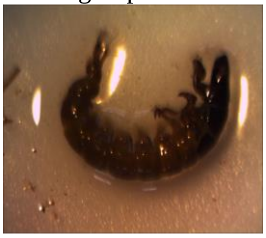

Figure 12: *Beraeidae*

Figure 13: *Goeridae*

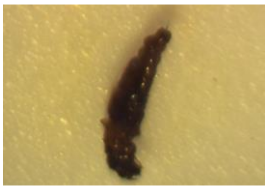

Figure 14: *Glossomatidae*

8.2.Some Diatoms (MOx500)

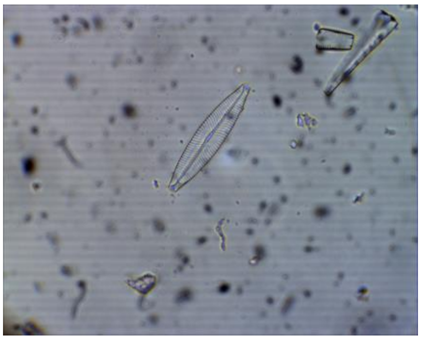

Figure 15 : *Navicula Erifuga*

Figure 16 : *Navicula Tripunctata*

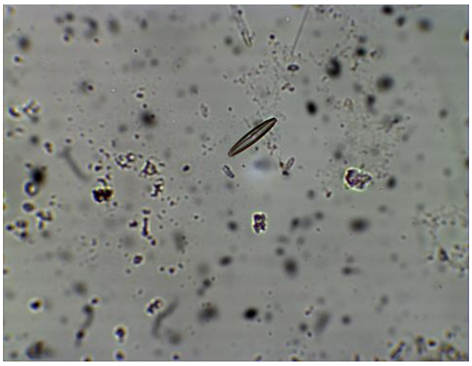

Figure 17: *Navicula minuscula*

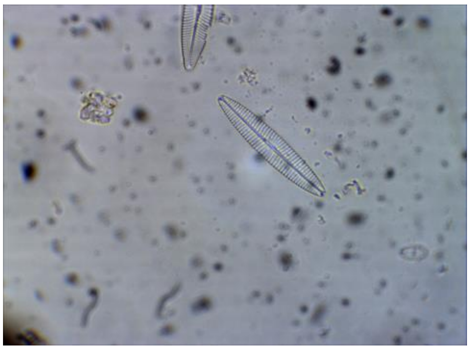

Figure 18: *Navicula veneta*

Figure 19: *Navicula molestiformus*

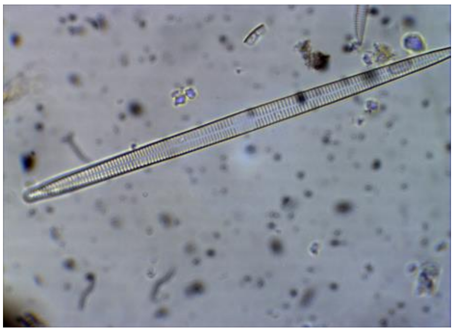

Figure 20: *Fragilaria ulna*

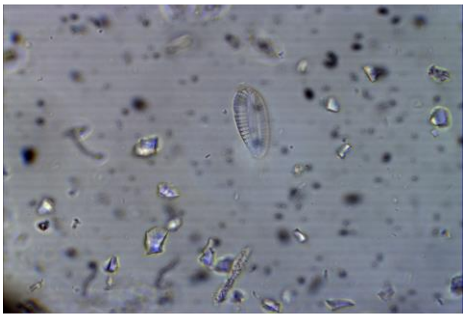

Figure 21: *Surinella brebissonil*

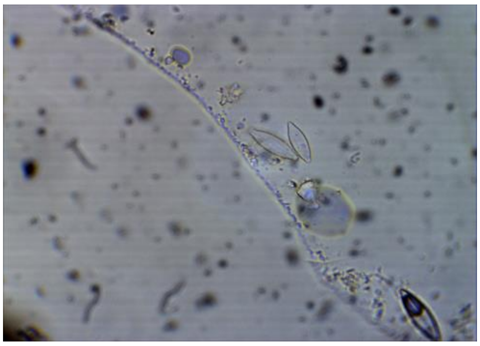

Figure 22: *Craticula accomoda*

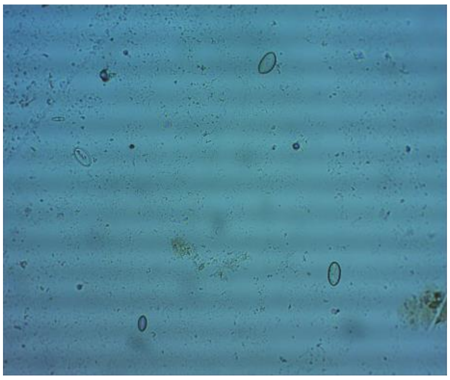

Figure 23: *Cocconeis placentula*

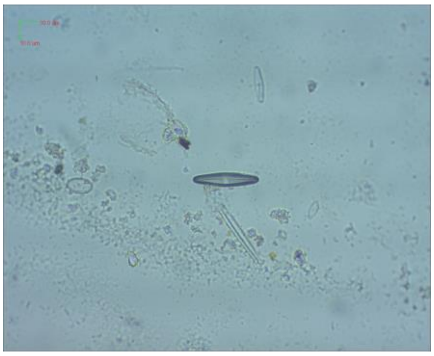

Figure 24: *Navicula lanceolate*

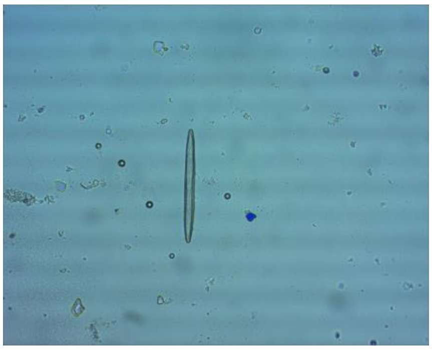

Figure 25: *Bacillaria paradoxa*

9.Acknowledgements

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