RESEARCHES UPON THE EPILITHIC DIATOMS FLORA FROM CERNA VALLEY

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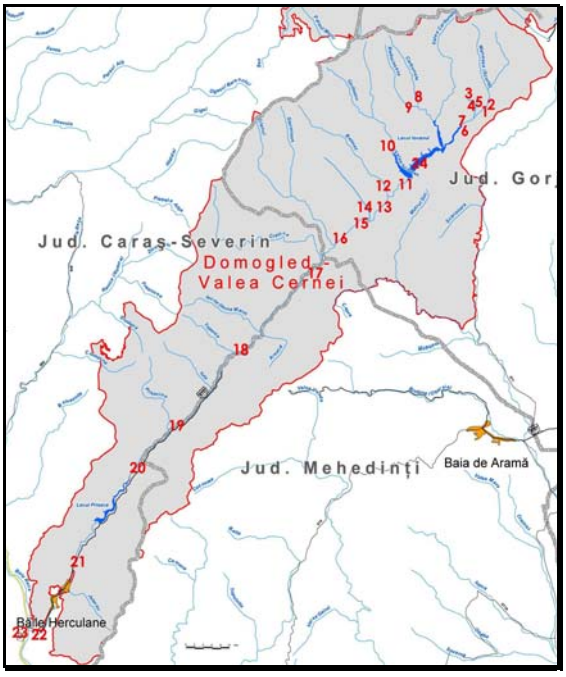
Summary: In this paper the diversity of epilithic diatoms flora in Cerna River is presented, from upstream to the junction with Bela Reca River (downstream of Herculane city). The identified species came from samples witch were brushed from the surface of different kinds of rocks. Then the samples were preserved and processed with specific techniques. The identification and the taxonomic classify were in accord with specialty literature.

Keywords: algae, diatoms, epilithic, Cerna River

STUDY AREA

The Cerna River, located in the south- western part of our country, oriented to north-est - south-west, along the mountains called Vâlcan, Mehedinţi, Godeanu and the Cerna Mountains in south. The river flows through several counties like: Caraş–Severin, Mehedinţi and Gorj. The Cerna River has 60 km. It drains a little basin of approximately 555 km², with an almost linear and lop – sided axis. The most important tributaries are located at the right side of the river and are supplied by rain, snow, phreatic waters and underground waters from the depth.

The strongest water flow usually appears in summer and the lowest appear during the dry and frosty season [BADEA, 1981]. Along the Cerna River two dammings were made : "The Cerna dam", downstream from the confluence with the Iovanu tributary, 15 km from the springs – the surface has 290 hectares and a volume of 120 milions m³, and also "The Seven Springs dam" from approximately 7 km upstream the Herculane Bay, having 13 km [OARCEA, 1999].



MATERIAL AND METHODS

The epilithic diatom samples were made in 24 – 25.05.2002, from 24 stations (**Fig. 1**) by the usual brushing process from the rocks, fully covered with water in certain areas where the water flow had some speed. Important epilithic samples were taken. Samples were also made which belong to another domain of the benthos, for further comparison from the Cerna River and some of its tributaries.

The samples were later kept in formol 4%. The containers were labeled and protected against an accidental opening. The process was made in order to remove the organic component of the diatom cell and to obtain some frustules, as clean as possible, with visible striae, suitable for microscopic observation. A combined method has been used for this, namely the treatment with strong mineral acid (HNO_3) first, and than the cremation (during 4 – 6 hours).

The mounting of the slides has been made in colophony, than finished and labeled.

Figure 1. The location of the samples **1** - epilithic, Cernişoara upstream from the confluence with the Cerna spring; **2** - episamnic, Cernişoara upstream from the confluence with the Cerna spring; **3** - epilithic, Cerna spring (upstream); **4** - epiphytic, Cerna spring (downstream); **5** - epilithic, Cerna spring (downstream); **6** - epilithic, downstream from the confluence with Cerna spring and Cernişoara, the left shore; **7** - epilithic, downstream from the confluence with Cerna spring and Cernişoara, the right shore; **8** - epilithic, Cărbunele; **9** - epilithic, Rădoteasa; **10** - epilithic, Iovanu; **11** - epilithic, Cerna, downstream the Iovanu dam; **12** - epilithic, Balmoş, upstream from the confluence with Cerna; **13** - epilithic, Cerna, downstream from the confluence with Balmoş river and upstream the Corcoaiei Keys; 14 - epilithic, from Naiba; **15** - epilithic, Cerna, upstream the Cerna-sat; **16** - epilithic, Cerna, downstream the Cerna-sat; **17** - epilithic, Cerna, upstream from the confluence with the Mihalca river; **18** - epilithic, Cerna, upstream from the confluence with the Topenia river; **19** - epilithic, Cerna, upstream from the confluence with the Prisăcina river; **20** - epilithic, Cerna, upstream the Prisăcina lake; **21** - epilithic, Cerna, upstream the Herculane Bay; **22** - epilithic, Cerna, downstream the Herculane Bay and upstream from the confluence with the Bela-Reca river; **23** - epilithic, the Beca-Reca river, Herculane Bay downstream and upstream from the confluence with Cerna; **24** - plankton, Iovanu lake. (http://www.domogled-cerna.ro/imgages/harta.jpg)

In order to determine the taxonomy, the slides were studied with the help of a trinocular CETTI or BIOROM microscope (100x). The determination of different taxons has been made using a catalogue for determining breeds, species, varieties and certain sites dedicated to diatoms. The floristic table has been organized according to the presented system, from the thesis called *The Diatoms* [ROUND, 2000]. The photos were made with the help of an equipment containing a Nikon Coolpix 4500 digital camera, a Super Micro Lens microphotography objective and a DigiSnap 2000 releasing device, allowing the focus, growth and start through a cable.

Further processing was made to determine the specific abundance, the genes and also the synthetic appreciation of the saprobe preferences. After the determination of the taxonomy, the following floristic list has been made:

Stephanodiscaceae Glezer & Makarova
Cyclotella bodanica Grunow var. *affinis* (Grunow) Cleve-Euler
Cyclotella menenghiniana Kützing
Cyclotella planctonica Brunnthaler
Cyclotella pseudostelligera Hustedt
Melosiraceae Kützing
Melosira lineata Agardh
Melosira varians Agardh
Fragilariaceae Greville
Asterionella formosa Hassall
Diatoma ehrenbergii Kützing
Diatoma hyemalis (Roth) Heiberg
Diatoma mesodon (Ehrenberg) Kützing
Diatoma moniliformis Kützing
Diatoma vulgare Bory de St.-Vincent
Diatoma vulgaris Bory de St.-Vincent, var. *capitulata* Grunow
Hannaea arcus (Cleve) Foged (*Fragilaria arcus* Cleve)
Meridion vernale Agardh (*Meridion circulare* (Greville) Agardh)
Meridion vernale Agardh *var. constrictum* (Ralphs) van Heurck
Fragilaria capucina Desmazières var. *vaucheriae* (Kützing) Lange-Bertalot
Fragilaria crotonensis Kitton
Fragilaria pinnata Ehrenberg
Fragilaria ulna (Nitzsch) Lange-Bertalot (*Synedra ulna* Ehrenberg)
Staurosira construens (Ehrenberg) Williams & Round (*Fragilaria construens* (Ehrenberg) Grunow)
Tabellariaceae Kützing
Tabellaria flocculosa (Roth) Kützing
Mastogloiaceae Mereschkowsky
Aneumastus stroesei (Østrup) Mann & Stickle (*Navicula tuscula* var. *stroesei* Østrup) (**FIG. 2**)
Aneumastus tusculus (Ehrenberg) Mann & Stickle (*Navicula tuscula* Ehrenberg)
Rhoicospheniaceae Chen & Zhu
Rhoicosphaenia abbreviata (Agardh) Lange-Bertalot
Cymbellaceae Greville
Cymbella affinis Kützing
Cymbella amphicephala Naegelli
Cymbella aspera (Ehrenberg) Cleve
Cymbella caespitosa (Kützing) Brun
Cymbella cuspidata Kützing
Cymbella cistula (Ehrenberg) Kirchner
Cymbella compacta Østrup
Cymbella excisa Kützing
Cymbella gracilis (Ehrenberg) Kützing
Cymbella helvetica Kützing
Cymbella laevis Naegeli (*Cymbella gracilis* var. *laevis* (Naegeli) Rabenhorst)
Cymbella mesiana Cholnoky
Cymbella minuta Hilse
Cymbella naviculiformis Auerswald
Cymbella prostrata (Berkeleley) Cleve
Cymbella silesiaca Bleisch
Cymbella sinuata Gregory (*Reimeria sinuata* (Gregory) Kociolek & Stoermer
Cymbella tumida (Brébisson) van Heurck
Cymbella tumidula Grunow
Cymbella turgidula Grunow
Cymbopleura anglica Lagerstedt (*Cymbella anglica* Lagerstedt) (**FIG. 3**)
Cymbopleura frequens Lange-Bertalot (*Cymbella amphicephala* sensu Hustedt)
Gomphonemataceae Kützing
Gomphonema acuminatum Ehrenberg
Gomphonema angustatum (Kützing) Rabenhorst
Gomphonema gracile Ehrenberg
Gomphonema helveticum Brun
Gomphonema minutum (Agardh) Agardh
Gomphonema olivaceum (Hornemann) Brébisson
Gomphonema parvulum (Kützing) Kützing
Gomphonema truncatum Ehrenberg
Dydimosphaenia geminata M. Schmidt (**FIG. 4**)
Achnantaceae Kützing
Achnanthes lanceolata (Brébisson) Grunow var. *frequentissima* Lange-Bertalot
Achnanthes lanceolata (Brébisson) Grunow ssp. *lanceolata* (Brébisson) Grunow var. *lanceolata*
Achnanthes impexiformis Lange-Bertalot
Achnanthes minutissima Kützing
Achnanthes petersenii Hustedt
Achnanthes thermalis (Rabenhorst) Schönfeldt
Cocconeidaceae Kützing
Cocconeis disculus (Schumann) Cleve
Cocconeis neodiminuta Krammer
Cocconeis pediculus Ehrenberg
Cocconeis placentula Ehrenberg
Cocconeis placentula Ehrenberg var. *lineata* (Ehrenberg) van Heurck
Cocconeis scutellum Ehrenberg
Cocconeis scutellum Ehrenberg var. *parva* (Grunow) Cleve
Amphipleuraceae Grunow
Amphipleura pellucida (Kützing) Kützing
Frustulia amphipleuroides (Grunow) Cleve (*Frustulia rhomboides* (Ehrenberg) De Toni)
Frustulia saxonica Rabenhorst (**FIG. 5**)
Frustulia vulgaris (Thwaites) De Toni
Pinnulariaceae D. G. Mann
Pinnularia viridis (Nitzsch) Ehrenberg

Pinnularia borealis Ehrenberg
Caloneis shumanniana (Grunow) Cleve
Caloneis silicula (Ehrenberg) Cleve
Diploneidaceae D. G. Mann
Diploneis elliptica (Kützing) Cleve
Diploneis ovalis (Hilse) Cleve
Naviculaceae Kützing
Navicula accomoda Hustedt
Navicula angustata W. Smith
Navicula brockmanii Hustedt
Navicula capitatoradiata Germain
Navicula cari Ehrenberg
Navicula cataracta-rheni Lange-Bertalot
Navicula cincta (Ehrenberg) Ralfs
Navicula clementis Grunow
Navicula cryptocephala Kützing
Navicula cryptotenella Lange-Bertalot
Navicula decussis Østrup (*Geissleria decussis* (Hustedt) Lange-Bertalot *et* Metzeltin)
Navicula digitatoradiata (Gregory) Ralfs
Navicula erifuga Lange-Bertalot
Navicula elginensis (Gregory) Ralfs
Navicula gregaria Donkin
Navicula halophila (Grunow) Cleve
Navicula lapidosa Krasske
Navicula kotschyi Grunow
Navicula lanceolata (Agardh) Ehrenberg
Navicula libonensis Schoeman
Navicula menisculus Schumann
Navicula diluviana Krasske
Navicula phyllepta Kützing
Navicula pupula Kützing
Navicula radiosa Kützing
Navicula reichardtiana Lange-Bertalot
Navicula rhynchocephala Kützing
Navicula rotunda Hustedt
Navicula sublucidula Hustedt
Navicula subrhynchocephala Hustedt
Navicula tripunctata (O. F. Müller) Bory
Navicula trivialis Lange-Bertalot
Navicula tuscula (Ehrenberg) Grunow
Navicula veneta Kützing
Navicula viridula (Kützing) Ehrenberg var. *viridula*
Pleurosigmataceae Mereschkowsky
Gyrosigma acuminatum (Kützing) Rabenhorst
Gyrosigma attenuatum (Kützing) Rabenhorst
Gyrosigma scalproides (Rabenhorst) Cleve
Gyrosigma nodiferum (Grunow) Reimer
Stauroneidaceae
Craticula submolesta (Hustedt) Lange-Bertalot (*Navicula submolesta* Hustedt)
Stauroneis obtusa Langerstedt
Catenulaceae Mereschkowsky
Amphora aequalis Krammer
Amphora ovalis (Kützing) Kützing (**FIG. 6**)
Amphora pediculus (Kützing) Grunow
Amphora subcapitata (Kisselev) Hustedt
Amphora veneta Kützing
Bacillariaceae Ehrenberg
Denticula kuetzingii Grunow
Denticula tenuis Kützing
Denticula thermalis Kützing
Nitzschia brevissima Grunow
Nitzschia capitellata Hustedt
Nitzschia clausii Hantzsch
Nitzschia dissipata (Kützing) Grunow
Nitzschia linearis (Agardh) W. Smith
Nitzschia palea (Kützing) W. Smith
Nitzschia perminuta (Grunow) M. Peragallo
Nitzschia sigmoidea (Nitzsch) W. Smith
Nitzschia sinuata (Thwaites) Grunow var. *tabellaria* (Grunow) Grunow (**FIG. 7**)
Nitzschia subtilis Grunow
Rhopalodiaceae (Karsten) Topachevs'kyi & Oksiyuk
Epithemia argus (Ehrenberg) Kützing
Epithemia adnata (Kützing) Brébisson
Rhopalodia gibba (Ehrenberg) O. Müller
Surirellaceae Kützing
Cymatopleura solea (Brébisson) W. Smith
Surirella angusta Kützing
Surirella brebissonii Kützing
Surirella minuta Brébisson
Surirella ovalis Brébisson

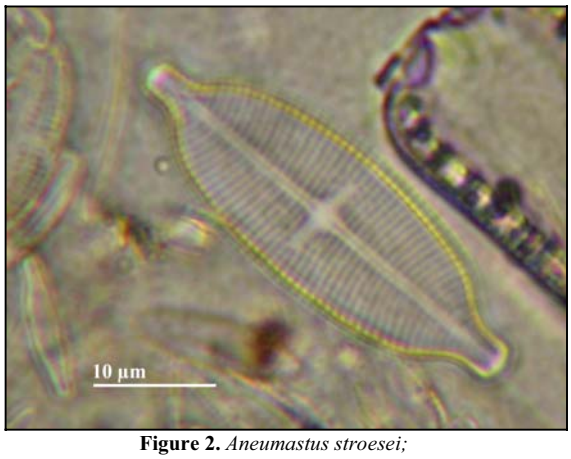


Figure 2. *Aneumastus stroesei;*

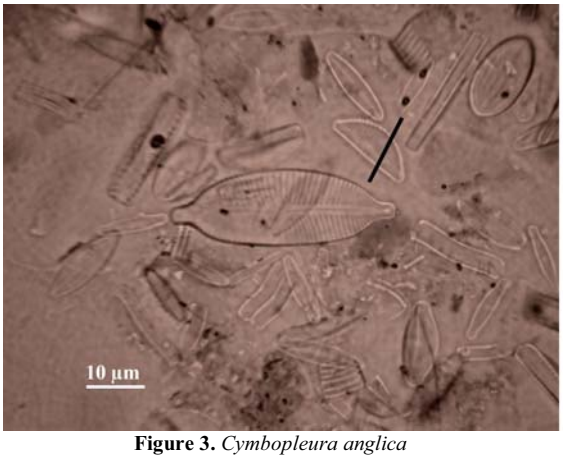


Figure 3. *Cymbopleura anglica*

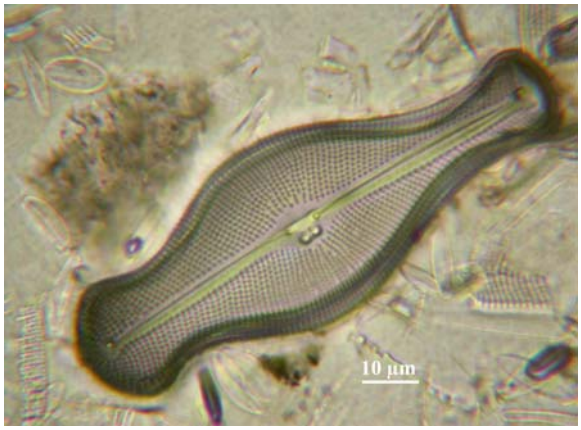


Figure 4. *Dydimosphaenia geminata*

Figure 5. *Frustulia saxonica*

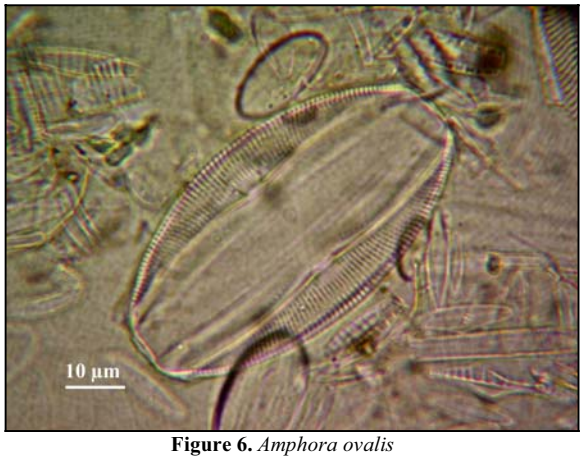


Figure 6. *Amphora ovalis*

Figure 7. *Nitzschia sinuata* var. *tabellaria*

RESULTS AND DISCUSSIONS

The list of the identified taxons contains 137 species and 9 varieties, grouped in 32 genera, 20 families, 12 orders, 4 subclasses and 3 classes. The most important family is Naviculaceae, with the *Navicula* genus, containing 35 species. The less important families are Tabellariaceae and Rhoicospheniaceae with a single genus (*Tabellaria* and *Rhoicosphenia*) and one species.

Other important families are the Fragilariaceae (5 genera and 14 species), the Cymbellaceae (2 genera and 22 species) and the Bacillariaceae (2 genera and 13 species). The ecological study presents the identified taxons, in several aspects, described at the general characteristics, based on specialized literature. Therefore, in all the chorological respects, a number of 99 taxons (67,8%) are recorded as cosmopolitan, meanwhile 6 taxons (0, 41%) are the rarest.

Concerning the environment characteristics, a number of 17 taxons (11,6%) can be found only in rivers, 8 taxons (0,54%) prefer the spring, meanwhile 24 taxons (16%) can be found in still waters (lakes, ponds); the aerophyl taxons are very few (6 - 0,4%). A number of 30 taxons are recorded to prefer brackish or fresh-brackish water, very few (3 taxons - 0,2%) can be found in typical salt waters. The thermophil taxons have the same percentage (0,2%), prefering the thermomineral waters.

According to the pH requirements, a number of 3 taxons (0,2%) are acidophilus, 5 (0,34%) are circumneutral and a higher number 15 (1,03%) are alcalinophilus. Only one from the species (0, 07%) is recorded as indifferent (euroiionic). As an indicative value of the degrees from the water trophicity, the best represented categories of taxons are the ones who prefer the oligotrophyc waters (24 taxons - 16%); the following ones are the eutrophyc indicative taxons (16 taxons - 10,95%). The mezotrophyc (8 taxons - 0,54%) and distrophyc (3 taxons - 0,2%) categories are reduced.

The most important assessment is made on the saprobic environment, where different taxons can be found. This assessment took into consideration those species which are defined in the specialized literature, as part of the saprobic categories from the waters they populate. It should be mentioned that these characterizations do not contain all the defined taxons. Some of the taxons are not defined from this point of view. Other taxons have a eurybiont character and can be found in waters with different degrees of saprobity.

From all the 146 identified taxons, 102 taxons belong to one or more saprobic categories. Therefore, 6 taxons belong to the xenosaprobic category. The most important categories (36 taxons) are indicative taxons for β – mesosaprobic waters, meaning healthy" waters with prevalent aerobian decomposal, where the main production is not damaged. There is an intermediate level β-α mesosaprobic, considered critical and is well represented (24 taxons). The oligosaprobic character is also important (20 taxons), meaning waters where all

free nutrients are fully metabolic and recycled in the native metabolic cycles.

Analyzing the better represented categories, we concluded that almost 83% from the identified taxons can be found in clean or almost clean waters. The saprobic category which includes "dirty" waters (α–β mesosaprobic and α mesosaprobic), where anaerobian decomposal can be found and the inhibition of the trophic phase begins, is represented by 8 taxons. The polisaprobic category, in the case of waste waters, is also represented by 8 taxons **(Fig. 8).**

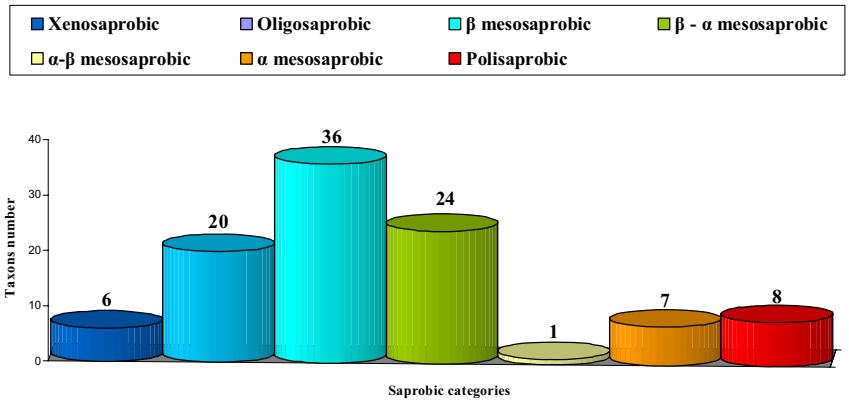


Figure 8.- Distribution of taxons in saprobic categories

CONCLUSIONS

From a taxonomical point of view, the best represented family is Naviculaceae, with the Navicula genus (35 species); the following families are also important: the Cymbellaceae (2 genera with 22 species), Fragilariaceae (5 genera and 14 species) and the Bacillariaceae (2 genera with 13 species). The less represented families are: Tabellariaceae and Rhoicospheniaceae, with a single genus and one kind of species.

Among the identified taxons, the cosmopolitans are predominantly, also the ones widespread in still waters, which prefer brackish or fresh-brackish water and also the alcalinophilus ones. As regarding the trophicity, the best represented category is called the oligotrophic category. From the identified flora, 102 taxons belong to one or more categories of saprobes: 6 taxons represent xenosaprobic waters, 20 taxons represent oligosaprobic waters, 36 taxons represent β mesosaprobic waters, 24 for the β–α mesosaprobic, 1 for the α–β mesosaprobic, 7 taxons represent mesosaprobic waters and 8 polisaprobic ones. Therefore, almost 83% from the identified taxons represent clean or almost clean waters.

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