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Water quality

DIATOMS IN THE STOMACH CONTENT OF BARBEL (*Barbus meridionalis*) FROM SHKUMBINI RIVER (CENTRAL ALBANIA)

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Abstract. More than 95 species of diatoms were found in the digestive apparatus of barbel (*Barbus meridionalis*) from different parts of the Shkumbini river. *Pennatae* diatoms, mostly of *benthic* origin, were dominant. Hence, more than 115 diatoms were known for Shkumbini. Trophic index calculated for diatoms shows that the water quality changes from *mesotrophic* to *polytrophic*, that means the human impact exists more or less evidently along the river. The upper part upstream Elbasani is mainly *mesotrophic*; the values of trophic (saprobic) index increase evidently in Paperi and Peqini, from *eupolytrophic* to *polytrophic*, showing a high presence of organic matter, mainly phosphor. Lowest trophic values were found during winter period, while the summer seems to be the most critical season.

Keywords: Albanian microalgae, diatoms, Shkumbini river, water quality, trophic state.

AIMS AND BACKGROUND

Due to morphologic features Albania is very rich in rivers, which have a torrential and erosive regime (in the eastern part of the country). Generally, they form a large and undulated bed in the western coastal plane. Knowledge of their biological food webs may help for a better use and conservation, understanding their problems and applying effective restoration activities. In another presentation here, the authors have given some general indications on the Shkumbini river, an ecological approach considering the fishes and physico-chemical parameters. An assessment of microalgae, mainly diatoms in digestive apparatus of barbel (*Barbus meridionalis*) was carried out, aiming further knowledge of river biota and its trophic state, in a cooperation by the authors[1,2]. It takes parts, also, in efforts made to know the Albanian microflora, where the relative importance and interest increased during the last decade. It was a first approach from the Albanian side, after the data reported from the Hungarian researcher Uherkovich[3], during his expedition in autumn 1960.

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EXPERIMENTAL

During March 1988–September 1993, barbel fishes were collected during 11 expeditions, belonging to four stations along the Shkumbini river: Proptishti (3 expeditions), Labinot-Fushe (5), Paperi (near Cerriku, 2) and Peqini (1) (Fig. 1). Digestive apparatus was conserved in 70% alcohol. Cleaning of diatom frustules was done boiling the material (for 20 min), first with conc. HCl and then, after washing, boiling again with conc. H_2SO_4, adding during last procedure some crystals of KNO_3, as described by Krammer and Lange-Bertalot[4]. Microscopic slides were prepared using Naphrax (index 1.69) and observed in a Leitz-Diaplan Leica optic microscope, using an 63X objective. Determinations were made using mainly the Krammer and Lange-Bertalot[4] keys. To get a reliable confidence (95%), more than 400 valves were counted. Trophic index for the diatoms was calculated using the Zelinka and Marvan formula[5]:

$$TI_{\text{dia}} = \frac{\sum_{i=1}^{n} TW_i G_i H_i}{\sum_{i=1}^{n} G_i H_i}$$

where TI_{dia} is trophic index for diatoms; TW_i – trophic (saprobic) value of i species (1-3); G_i – indicative weight of i species (1-5); H_i – relative frequency of i species (%); n – total number of species.

The respective values of TW_i and G_i, as well as trophic classes were taken after Rott et al.[6]

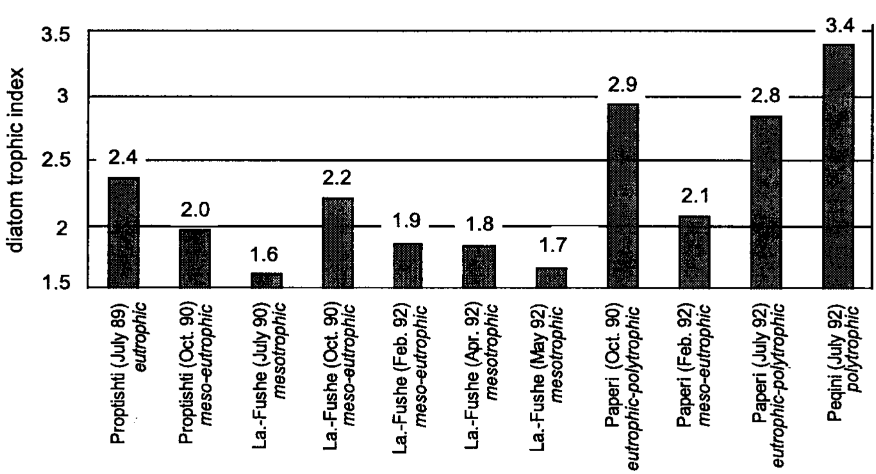

Fig. 1. Values of diatom trophic index in examined samples

RESULTS AND DISCUSSION

Microscopic examinations showed that barbel may be considered a very good sampler. More than 95 species of diatoms were found, whereas *Pennatae*, mostly of benthic origin, were dominant. Number of the species in each sample varies from 9 (Peqini) to 41 (Paperi, 1992), without evident differences between different habitats along the river flow. The most common species found abundant almost in all samples was *Diatoma moniliformis*, until 84.5%, with high peaks in Paperi (February 1992) and Proptishti (October 1990). Other abundant species were *Achnanthes minutissima* (26.8% in La.-Fushe, July 1990), *Fragilaria capucina* (45.4% in La.-Fushe, July 1990), *F. ulna* (93.2% in Peqini, July 1992), *Cymbella affinis* (8.2% La.-Fushe, July 1990), *Diatoma vulgaris* (21.3%, La.-Fushe, February 1992), *Gomphonema tergestinum* (33.5% in La.-Fushe, April 1992), *Nitzshia dissipata* (17.5%, Paperi, October 1990), *N. palea* (24.9%, Peqini, July 1992), *Cocconeis pediculus* (19.4%, Proptishti, July 1989), *Gomphonema olivaceum* (20.2%, La.-Fushe, May 1992), *G. minutum* (9.8%, Peqini, July 1992), etc. In Plate 1, there are presented 21 microphotographs, belonging of 18 most common diatom species.

Uherkovich[3], in three net samples of potamoplankton (collected in October 1960), respectively, in Upper Part, Bushtrica and Rrogozhina (lower part), reported 104 species, 57 of them diatoms. The rest were mainly blue-green algae (28 species). Together with them, the checklist of diatoms known for Shkumbini reaches at ca. 115, reported here in Table 1. Differently with Uherkovich data, we have not found very dense *Fragilaria biceps* and *Diatoma vulgaris* in the upper part, which seems to be replaced by *F. moniliformis, F. capucina* and/or *Cocconeis pediculus*. Instead, *F. ulna* and *F. biceps* were comparatively dense in lower part (Peqini and Rrogozhina), as it was also *N. palea*.

Diatom index gives the saprobic value, indicating the contribution to eutrophication of habitats made by organic pollution. It is linked mainly with the preference to phosphor, depending on the relative numbers of dominant *taxa* in the sample[6,7]. In Fig. 1, there are given the respective values, which vary from 1.6 (*mesotrophic*) to 3.4 (*polytrophic*). There were observed evident high trophic values for the lower plain part (Paperi and Peqini), showing a heavy organic pollution, probably caused by Elbasani town and its industrial activities. Lowest values were found for Labinot-Fushe and Proptishti. The low value observed in Paperi shows also the dilution of organic matter, influenced probably by rainy period during winter. In the other presentation of Cake et al.[2], there is discussed the strong impact from human activity in Elbasani plain. Suspended matter and nitrates increased and oxygen level decreased, exceeding evidently limits of fish growth. There was also a very strong pollution with toxic substances, like cyanides, phenols, etc. The total phosphor was not measured regularly, but if compared with values given by Rott et al.[6], its concentration upstream Elbasani (Proptishti to La.-Fushe) may oscillate during the year from 30-100 μg/l, while

Plate 1: × 1500

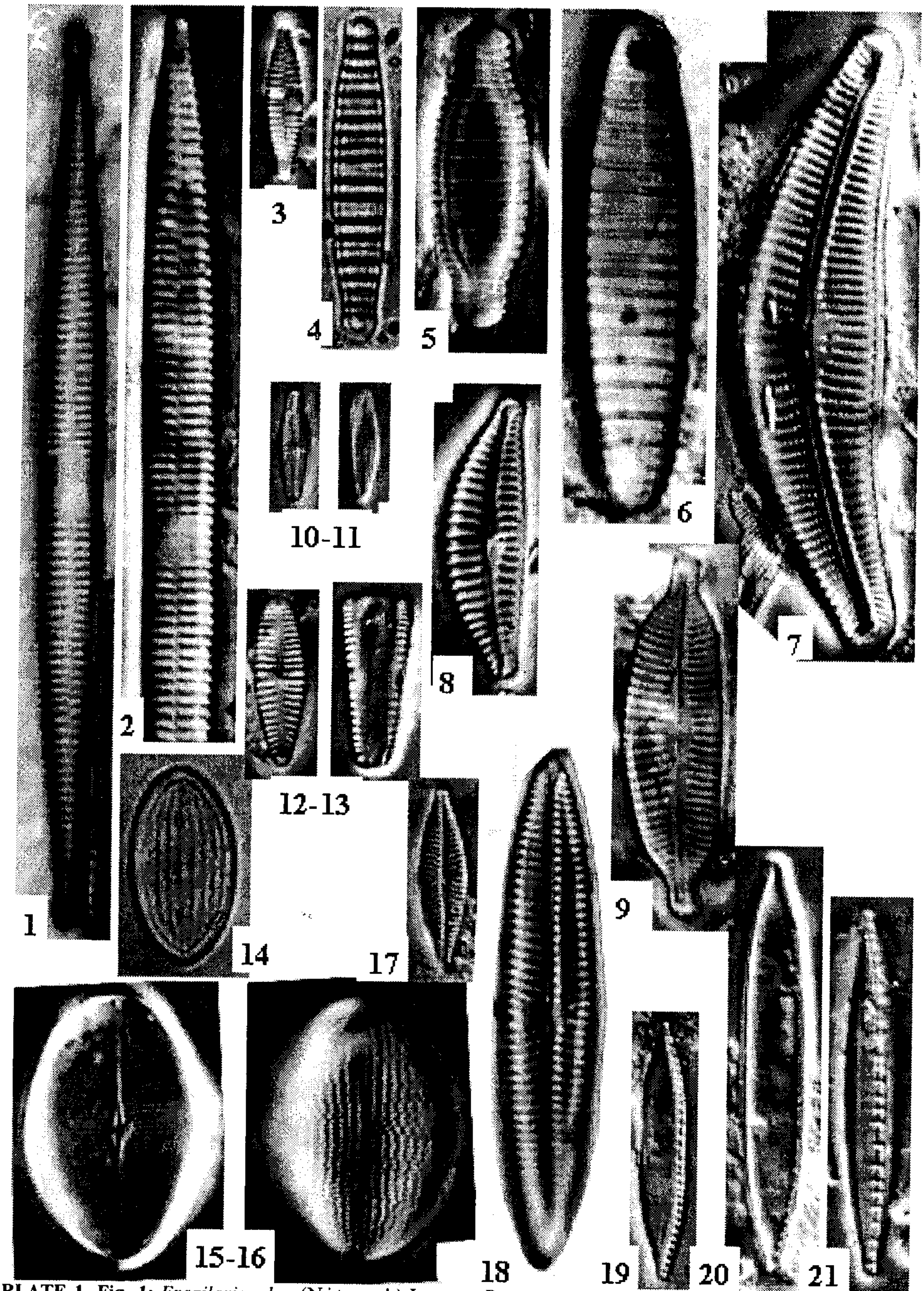

PLATE 1. Fig. 1: *Fragilaria ulna* (Nitzsch) Lange-B. var. *acus*; **Fig. 2**: *F. ulna* (Nitzsch) Lange-B. var. *ulna*; **Fig. 3**: *F. capucina* var. *perminuta* (Grun.) Lange-B.; **Fig. 4**: *Diatoma moniliformis* Kuetz.; **Fig. 5**: *D. vulgaris* Bory morph. *capitulata*; **Fig. 6**: *D. vulgaris* Bory var. *vulgaris*; **Fig. 7**: *Cymbella cistula* (Ehr.) Kirch.; **Fig. 8**: *C. affinis* Kuetz.; **Fig. 9**: *C. amphicephala* (Naeg.) Kuetz.; **Fig. 10-11**: *Achnanthes minutissima* Kuetz var. *minutissima*; **Fig. 12-13**: *Gomphonema minutum* Ag.; **Fig. 14**: *Cocconeis placentula* var. *lineata* (Ehr.)Van Heurck; **Fig. 15-16**: *C. pediculus* Ehr.; **Fig. 17**: *Navicula reichardtiana* Lange-B.; **Fig. 18**: *N. tripunctata* (Mueller) Bory; **Fig. 19**: *Nitzschia capitellata* Hust.; **Fig. 20**: *N. palea* (Kuetz.) W. Sm. var. *palea*; **Fig. 21**: *N. dissipata* (Kuetz.) Grun.

Table 1. Checklist of diatoms found in the Shkumbini river

Centrales	*Fragilaria ulna* var. *oxyrhynchus* (Kuetz) Van Heurck
Cyclotella meneghiniana Kuetz.	*Frustulia vulgaris* (Thwaites) De Toni
Ellerbeckia arenaria (Moore) Crawford	*Gomphonema clavatum* Ehr. agg.
Melosira varians Ag.	*Gomphonema angustum* Ag.
Stephanodiscus hantzschii Grun.	*Gomphonema constrictum* Ehr.
Pennales	*Gomphonema minutum* (Ag.) Ag. agg.
Achnanthes exigua (Grun.) Cl.	*Gomphonema olivaceum* var. *calcareum* Cl.
Achnanthes minutissima Kuetz. agg.	*Gomphonema olivaceum* (Horn.) Bréb. var. *olivaceum*
Amphipleura pellucida Kuetz.	*Gomphonema parvulum* Kuetz. agg.
Amphora montana Krasske	*Gomphonema pumilum* (*cf.* var. *elegans* Reich. & Lange-B.)
Amphora ovalis Kuetz.	*Gomphonema tergestinum* Fricke
Amphora pediculus (Kuetz.) Grun.	*Gyrosigma scalproides* (Rab.) Cl.
Caloneis amphisbaena (Bory) Cl.	*Gyrosigma spenceri* (Quekett) Griwth
Caloneis silicula (Ehr.) Cl.	*Hantzschia amphioxys* (Ehr.) Grun.
Cocconeis neothumensis Krammer Van Heurck	*Meridion circulare* var. *constrictum* (Ralfs)
Cocconeis pediculus Ehr.	*Navicula capitatoradiata* Germain
Cocconeis placentula Ehr. agg.	*Navicula cari* Ehr.
Cocconeis placentula var. *lineata* (Ehr.) Van Heurck	*Navicula cataractarheni* Lange-B.
Cocconeis scutellum Ehr.	*Navicula cryptotenella* Lange-B.
Cymatopleura elliptica (Bréb.) W. Sm.	*Navicula cryptotenelloides* Lange-B.
Cymatopleura solea (Bréb.) W. Sm.	*Navicula cryptocephala* Kützing
Cymbella affinis Kuetz.	*Navicula lanceolata* (Ag.) Kütz.
Cymbella amphicephala (Naeg.) Kuetz.	*Navicula oligotraphenta* Lange-B. and Hofmann
Cymbella aspera (Ehr.) Cl.	*Navicula radiosa* Kuetz.
Cymbella austriaca Grun.	*Navicula reichardtiana* Lange-B.
Cymbella caespitosa Kuetz.	*Navicula seibigii* Lange-B.
Cymbella cistula (Ehr.) Kirch. agg.	*Navicula schroeteri* Meister
Cymbella cymbiformis Ag.	*Navicula tripunctata* (O. F. Mueller) Bory
Cymbella helvetica Kuetz.	*Navicula veneta* Kuetz.
Cymbella lanceolata (Ehr.) Van Heurck	*Navicula viridula* var. *rostellata* (Kuetz.) Cl.
Cymbella microcephala Grun.	*Navicula viridula* (Kuetz.) Cl. var. *viridula*
Cymbella naviculiformis (Auersw.) Cl.	*Neidium affine* var. *amphirynchus* (Ehr.) Cl.
Cymbella prostrata (Berk.) Cl.	*Neidium dubium* (Ehr.) Cl.
Cymbella pusilla Grun.	*Neidium dubium* var. *constrictum* Hust.
Cymbella silesiaca Bleisch	*Nitzschia acicularis* W. Sm.
Cymbella sinuata Greg.	*Navicula minuscula* Grun.
Cymbella turgidula (Grun.) Schmidt	*Nitzschia alpina* (Hust.) Lange-B.

to be continued

Cymbella ventricosa A g.	*Nitzschia amphibia* G r u n. fo. amphibia
Denticula kuetzingii G r u n.	*Nitzschia capitellata* H u s t.
Diatoma anceps (E h r.) G r u n.	*Nitzschia constricta* (K u e t z.)R a l f s
Diatoma ehrenbergii K u e t z.	*Nitzschia dissipata* (K u e t z.) G r u n.
Diatoma mesodon (E h r.) K u e t z.	*Nitzschia hungarica* G r u n.
Diatoma moniliformis K u e t z.	*Nitzschia hantzschiana* R a b.
Diatoma vulgaris B o r y morph. *capitata*	*Nitzschia intermedia* H a n t z s c h
Diatoma vulgaris B o r y morph. *capitulata*	*Nitzschia lacuum* L a n g e-B.
Diatoma vulgaris B o r y morph. *linearis* G r u n.	*Nitzschia linearis* (A g.) W. S m. var. *linearis*
Diatoma vulgaris B o r y morph. *ovalis*	*Nitzschia palea* (K u e t z.) W. S m. var. *palea*
Diatoma vulgaris B o r y morph. *producta*	*Nitzschia pumila* H u s t.
Diatoma vulgaris B o r y var. *vulgaris*	*Nitzschia sigmoidea* (E h r.) W. S m.
Epithemia sorex K u e t z.	*Nitzschia inconspicua* L a n g e-B.
Eunotia arcus E h r.	*Nitzschia heufleriana* G r u n.
Fragilaria affinis (K u e t z.) L a n g e-B.	*Pleurosigma acuminatum* (K u e t z.) G r u n.
Fragilaria arcus (E h r.) Cl.	*Rhoicosphaenia abbreviata* (A g.) L a n g e-B.
Fragilaria biceps (K u e t z.) H u s t.	*Rhopalodia gibba* (Ehr.) M u e l l e r
Fragilaria capucina D e s m. agg.	*Surirella brebissoni* K r a m m e r et L a n g e-B.
Fragilaria capucina var. *perminuta* (G r u n.) L a n g e-B.	*Surirella ovalis* B r e b.
Fragilaria ulna (Nitzsch) L a n g e-B. agg.	*Surirella spiralis* K u e t z.
Fragilaria ulna (Nitzsch) L a n g e-B. var. *acus*	*Surirella variabilis* var. *pyriformis* C l.

downstream Elbasani to the sea the phosphor may increase from 50 to 650 µg/l, which exceeds evidently the EU standards of water quality. From a theoretical scheme given by Dell'Uomo[8], it may be further considered that the water quality from Proptishti to La.-Fushe may be considered fairly good to slightly polluted water (Level 2), and from Elbasani to the Adriatic sea slightly polluted to strongly polluted water (Level 2-3), especially during summer period.

Growing interest in Albania for water use, drinking, irrigation, aquaculture, hydro-energetic, tourism, etc., urges a further awareness and interest on evaluation, restoration and protection of rivers. As a matter of fact, the lower part of Shkumbini, from Elbasani to the Adriatic sea, represents a real risk for the economy and human health. The same situation should be also for the other rivers, running in the Albanian western lowland. The liquid wastes from urban, industrial activities are discharged directly to the canals and rivers. The monitoring is not taken regularly. Also, during the last decade waste deforestations and overgrazing have been happened in watershed areas of many rivers, accelerating the erosion. It is strongly recommended the protection and restoration, supporting as soon as possible waste water and waste disposal treatment. There are also many agricultural lands in hilly areas, which are almost abandoned. The most common effect may be the increase of nutrient content and the change of biodiversity, with sever natural and economic consequences, not only in the river itself, but for the close seaside, too.

CONCLUSIONS

More than 95 species of diatoms have been found in stomach content of barbel from different parts of the Shkumbini river. There were ca. 115 species of diatoms known already for that river. The diatom trophic index showed that the upper mountainous part was mesotrophic to eutrophic; probably, it should be caused by a moderate quantity of organic matter of anthropic origin. The plain part, from Elbasani to the Adriatic sea, varied from meso-eutrophic to polytrophic, showing strongly polluted water, caused by high quantities of nitrogen and phosphor. Waste treatment and restoration activities, like reforestation and sustainable land use must start as soon as possible.

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