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A SHORT NOTE ON WATER QUALITY AND SOME BIODIVERSITY COMPONENTS IN GURBAN VALLEY, GIURGIU COUNTY

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Abstract

Several field trips were carried out in 2022 and 2023, aiming to investigate the water quality parameters, ichthyofaunal and floristic diversity in some areas of Gurban Valley, located in the protected area Natural Park Comana, Giurgiu County, southern Romania.
Throughout the study period were identified fish specimens belonging to nine species: Prussian carp Carassius gibelio (Bloch, 1782); Gobio obtusirostris Valenciennes, 1842; Dnieper chub Petroleuciscus borysthenicus (Kessler, 1859); Roach Rutilus rutilus (Linnaeus, 1758); Danubian spined loach Cobitis elongatoides Băcescu & Mayer, 1969; Belica Leucaspius delineatus (Heckel, 1843); Southern ninespine stickleback Pungitius platygaster (Kessler, 1859); European bitterling Rhodeus amarus (Bloch, 1782) and European mudminnow Umbra krameri Walbaum, 1792. A total of 147 captured specimens were measured, weighed and photographed. For the capture of fish, minnow traps and plankton nets were used, on the Gurban River, right tributary of the Neajlov River, Giurgiu County.
The floristic inventory compiled so far included 58 plant species grouped into 31 families, with European, circumpolar, Eurasian, eurasiatic continental or cosmopolitan distribution.
*Related to physico-chemical characterization of water samples collected from four sampling points (SP), the results of laboratory analysis allowed to frame the water into quality classes and to evaluate if the water meets the requirements for aquatic organisms. Hence, on the basis of nitrite-nitrogen (N-NO_2^-) and nitrate-nitrogen (N-NO_3^-) water corresponds to I^{st} quality class, meanwhile chemical oxygen demand (COD), phosphate-phosphorus (P-PO_4^{3-}) and ammonium-nitrogen (N-NH_4^+) allowed to associate water quality with III^{rd} class. In addition, it has been found very significant correlations between electrical conductivity (EC) and total hardness (TH) with r = 0.9230*** and between pH and TH with r = 0.8821***, respectively.*

Key words*: biodiversity, Gurban Valley, freshwater fish, plant species, water quality, vulnerable species.*

INTRODUCTION

Located only at 30 km away from Bucharest, the protected area of natural interest Comana Natural Park was approached so far from both botanical and zoological perspectives (Papadopol & Petrescu, 1995; Burlacu et al., 2004; Iftime & Iftime, 2008; Paucă Comănescu & Negrean, 2009; Fălcuță et al., 2011; Dămoc et al., 2014; Pescott, 2018; Peyton, 2018; Grigorescu et al., 2020; Pelcaru & Alistar, 2021; Stavrescu-Bedivan et al., 2021). Although this Natural Park represented over the time a valuable resource for biological field trips, the same cannot be postulated concerning the Gurban Valley.

In regard with the water quality of Gurban River, it was stated before that this body of water has a good chemical and ecological condition, however it represents an area vulnerable to nitrate and sensitive to nutrients (National Management Plan, 2010).

Nine integral protection zones (ZPI) are currently demarcated and recognized in the Comana Natural Park, among which is the Gurban Valley - a protected area with an area of 123.8 ha. This is mostly represented by forest with mature trees and the body of water that gives this area its name. The main habitat type for this forest is 91M0 Pannonian-Balkanic turkey oak–sessile oak forests.

The river crosses the localities of Vlad Țepeș and Comana, and until the confluence with the Neajlov river, puddles with a surface of up to 2 ha and depths of up to 4 meters can be observed (Comana Natural Park Management Plan, 2022).

So far, 31 fish species have been inventoried in the freshwater basins of Comana Natural Park (Management Plan of Comana Natural Park, 2022).

Fish of great biological importance were identified in the study area, including *Umbra krameri* and *Rhodeus amarus*, species protected by national legislation, as well as by international agreements, such as: EU Habitats Directive - Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora - consolidated version 01/01/2007 and the Berne Convention Convention on the conservation of European wildlife and natural habitats.

Umbra krameri has a "vulnerable" status according to The Red Book of Romanian Vertebrates and the IUCN Red List, while the current population trend is decreasing.

A special conservation interest must be given to the species *Petroleuciscus borysthenicus*, as its distribution area is very limited and even more so as the species is considered endemic in the Gurban River (Crăciun, 1996; Botnariuc & Tatole, 2005; Oțel, 2007; Bulat et al., 2018).

Although it is not included in any international document, which imposes special conservation measures, at national level *P. borysthenicus* is listed in Annex 4B of GEO 57/2007, and in The Red Book of Romanian Vertebrates (2005) this species is considered vulnerable.

There is an almost lack of data on the biodiversity of aquatic ecosystems in the area of Gurban Valley, therefore, the main purpose of this survey conducted in 2022-2023 was to assess the physico-chemical parameters of the aquatic environment, along with compelling partially checklists of plants and freshwater fish species.

Water testing has been performed in order to evaluate certain parameters which could be interpreted in the terms of aquatic organisms' requirements, or from environmental point of view, since high levels of nutrients (nitrogen, phosphorus) may lead to eutrophication. For instance, there are concerns in our group related with water quality and fish requirements that were concretized into a plethora of studies (Stavrescu-Bedivan et al., 2015; Scăețeanu Vasile et al., 2019; Stavrescu-Bedivan et al., 2021; Stavrescu-Bedivan et al., 2022; Sandu et al., 2023).

MATERIALS AND METHODS

Study site

This survey was conducted in 2022 (May-June; September) and 2023 (June and July) in Gurban Valley, crossed by Gurban River, a right tributary of Neajlov River, placed in Giurgiu County, southern Romania (Figure 1).

The area chosen for the study is on the lower reaches of the Gurban River.

Along the valley, numerous sectors can be delineated where the river flow is strong, but also sections where the water tends to flow slowly or even stagnates and forms permanent puddles with abundant aquatic vegetation, suspended and sedimented organic matter, dead wood in the water and substrate muddy. Thus, the valley is composed of several types of wet habitats, even microhabitats, where biological diversity is present depending on the specific hydrological characteristics (rheophilic and limnophilic species) (Crăciun, 1996).

Aquatic habitats can be influenced by any surface runoff that may occur, as along on the length of the river, from the headwaters to the spillway, there are numerous areas of agricultural land.

Water sampling and analyses

In order to evaluate the water quality from study site, a sampling campaign was carried out in September 2022 on four sampling points (SP 1 - 44.152821, 26.142403; SP 2 - 44.156179, 26.145664; SP 3 - 44.128711, 26.126066; SP 4 - 44.128502, 26.125165) (Figure 1) at a depth of 0.5 m. Sampling points 1 and 2 are represented by very shallow ponds where there is sedimented organic matter and the substrate is silty. Despite this fact, it was documented before that in this area the water is clear, well oxygenated by the slow current (Crăciun, 1996).

There is aquatic vegetation and dead wood fallen into the water, which favors the life cycle of aquatic invertebrates and thereby creates feeding and spawning areas for limnophilous fish species such as *Umbra krameri* and *Pungitius platygaster*.

Sampling points 3 and 4 are represented by large, permanent bodies of water where the water stagnates, and the vegetation and habitat characteristics are different from those in the previous points. In this case, the biotope in these areas acquires a eutrophic character.

Water samples were collected in sterile recipients, labeled and stored at 4°C to minimize physical and chemical changes. The physico-chemical analyses of water samples were conducted as previously reported (Stavrescu-Bedivan et al., 2015), on the basis of protocols recommended for drinking water by Mănescu et al. (1994). Analyses, methods and instrumentation are summarized in Table 1. Chemical reagents used for determinations were of analytical purity. The analyses were conducted in triplicates and the presented results are the average of determinations.

Fish species

The fish specimens were caught with the aid of two different devices: a plankton net (Water net Macrozoobenthos V2A 25 x 25 cm mesh bag 500 µm - 3 mm V2A stainless steel bracket, 0.5 mm standardized gauze net bag 60 cm deep with straight bottom, synthetic yarn stitching) (2022) and a minnow trap (Hakuyo umbrella type, 1 m diameter, 1.2 m length) (2023) (Figure 2).

The scientific name and classification for fish species mentioned herein were given according to FishBase database (Kottelat & Freyhof, 2007; https://www.fishbase.se/).

Fish individuals were measured for total and standard length (TL, SL - in cm) and weighed (TW=total body weight, in grams) to the nearest 1.0 mm and 0.1 g, respectively.

Plant species

Within the Kingdom Plantae, the genera were arranged alphabetically, with the corresponding order and family names given in parentheses, while vernacular names followed the online data bases such as Global Biodiversity Information Facility, Plants For A Future and World Flora Online (Stavrescu-Bedivan et al., 2021).

RESULTS AND DISCUSSIONS

I. Fish inventory

For each season sampling, nine species were collected (Table 2; Figure 3), as follows:

***May 2022* -** two individuals of Southern ninespine stickleback *Pungitius platygaster* (Kessler, 1859): TW average = 0.58 g, TL average = 3.4 cm, SL average = 3.0 cm; five individuals of European mudminnow *Umbra krameri* Walbaum, 1792: TW average = 3.07 g, TL average = 6.2 cm, SL average = 5.4 cm; three individuals of Danubian spined loach *Cobitis elongatoides* Băcescu & Mayer, 1969: TW average = 4.11 g, TL average = 6.9 cm, SL average = 6.0 cm.

***June 2022* -** one individual of Roach *Rutilus rutilus* (Linnaeus,1758): TW = 1.45 g, TL = 4.6 cm, SL = 3.9 cm; four individuals of Danubian spined loach *Cobitis elongatoides* Băcescu & Mayer, 1969: TW average = 6.54 g, TL average = 8.7 cm, SL average = 7.6 cm; six individuals of European mudminnow *Umbra krameri* Walbaum, 1792: TW average = 2.41 g, TL average = 5.6 cm, SL average = 4.9 cm; five individuals of Dnieper chub *Petroleuciscus borysthenicus* (Kessler, 1859): TW average = 3.14 g, TL average = 6.8 cm, SL average = 5.8 cm; one individual of Belica *Leucaspius delineatus* (Heckel, 1843): TW = 1.97 g, TL = 4.9 cm, SL = 4.0 cm.

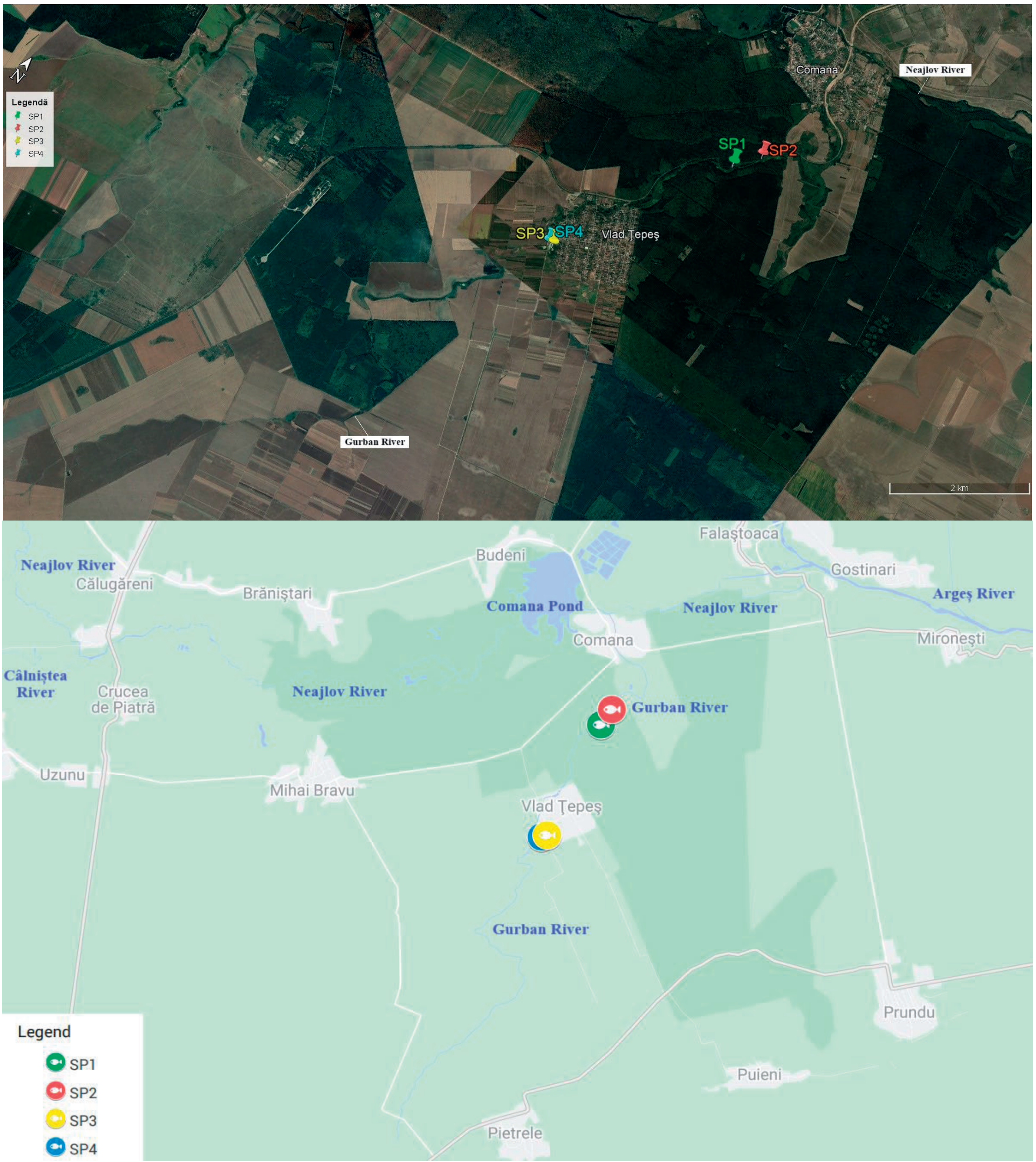

Figure 1. Sampling points (SP) in the study area for water samples

Table 1. Performed analyses, analytical techniques and instrumentation

Analysis	Analytical technique	Instrumentation
pH	Potentiometry	Inolab WTW pH-meter
Electrical conductivity (**EC**)	Conductometry	Hach SensIon7
Total hardness (**TH**)	Complexonometry	-
Chemical oxygen demand (**COD**)	Manganometry	-
Phosphate phosphorus (**P-PO_4^{3-}**)	Spectrophotometry	Metertek SP830 Plus spectrophotometer
Nitrite nitrogen (**N-NO_2^-**)		
Nitrate nitrogen (**N-NO_3^-**)		
Ammonium nitrogen (**N-NH_4^+**)		

Table 2. Number (N) of specimens from each fish species identified in Gurban Valley, according to sampling season

Fish species and scientific classification (Order, Family)	May 2022	June 2022	Aug. 2022	Sept. 2022	June 2023	July 2023	**N**
Carassius gibelio (Bloch, 1782) (Cypriniformes, Cyprinidae)	-	-	-	-	-	1	1
Cobitis elongatoides Băcescu & Mayer, 1969 (Cypriniformes, Cobitidae)	3	4	1	-	4	-	12
Gobio obtusirostris Valenciennes, 1842 (Cypriniformes, Gobionidae)	-	-	-	-	1	1	2
Leucaspius delineatus (Heckel, 1843) (Cypriniformes, Leuciscidae)	-	1	-	-	-	-	1
Petroleuciscus borysthenicus (Kessler, 1859) (Cypriniformes, Leuciscidae)	-	5	-	12	87	8	107
Pungitius platygaster (Kessler, 1859) (Perciformes, Gasterosteidae)	2	-	1	-	-	-	3
Rhodeus amarus (Bloch, 1782) (Cypriniformes, Acheilognathidae)	-	-	1	-	-	-	1
Rutilus rutilus (Linnaeus, 1758) (Cypriniformes, Leuciscidae)	-	1	-	-	-	-	1
Umbra krameri Walbaum, 1792 (Esociformes, Umbridae)	5	6	3	-	-	-	14
N	10	17	6	12	92	10	**147**

Figure 2. Fish sampling in Gurban Valley: a. September 2022; b. June 2023; c. July 2023

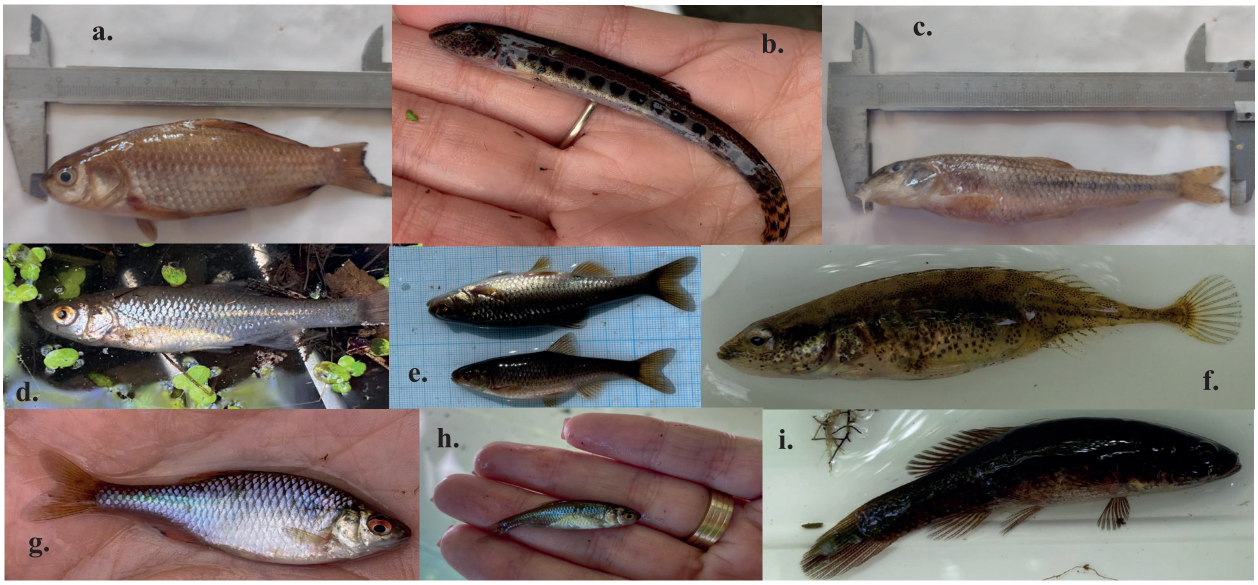

Figure 3. Fish species identified in Gurban Valley:
a. *Carassius gibelio*; b. *Cobitis elongatoides*; c. *Gobio obtusirostris*; d. *Leucaspius delineatus*; e. *Petroleuciscus borysthenicus*; f. *Pungitius platygaster*; g. *Rhodeus amarus*; h. *Rutilus rutilus*; i. *Umbra krameri*

August 2022 **-** one individual of European bitterling *Rhodeus amarus* (Bloch, 1782): TW = 6.98 g, TL = 6.5 cm, SL = 5.4 cm; one individuals of Danubian spined loach *Cobitis elongatoides* Băcescu & Mayer, 1969: TW = 6.94 g, TL = 9.2 cm, SL = 7.9 cm; one individuals of Southern ninespine stickleback *Pungitius platygaster* (Kessler, 1859): TW = 0.5 g, TL = 3.2 cm, SL = 2.9 cm; three individuals of European mudminnow *Umbra krameri* Walbaum, 1792: TW average = 2.64 g, TL average = 5.8 cm, SL average = 5 cm.

September 2022 **-** 12 individuals of Dnieper chub *Petroleuciscus borysthenicus* (Kessler, 1859): TW average = 9.14 g, TL average = 8.4 cm, SL average = 7.2 cm.

June 2023 **-** four individuals of spined loach *Cobitis elongatoides* Băcescu & Mayer, 1969: TW average = 5.37 g, TL average = 7.2 cm, SL average = 6.3 cm; 87 individuals of Dnieper chub *Petroleuciscus borysthenicus* (Kessler, 1859): TW average = 23.41 g, TL average = 10.7 cm, SL average = 9.2 cm; one individual of *Gobio obtusirostris* Valenciennes, 1842: TW = 21.07 g, TL = 11.5 cm, SL = 10.1 cm.

July 2023 **-** one individual of Prussian carp *Carassius gibelio* (Bloch, 1782): TW = 34.5 g, TL = 12.9 cm, SL = 10.4 cm); one individual of *Gobio obtusirostris* Valenciennes, 1842: TW = 23 g, TL = 12.8 cm, SL = 10.7 cm; eight individuals of Dnieper chub *Petroleuciscus borysthenicus* (Kessler, 1859): TW average = 3.96 g, TL average = 6.67 cm, SL average = 5.62 cm.

The area is very important for ichthyologists, as the species identified herein are either mentioned in international documents, which give them a certain protection status, or they are vulnerable, rare species, whose population or habitat has a decreasing trend, being included in the lists of the national legislation. Overall, the species with the most numerous specimens in this survey was Dnieper chub *Petroleuciscus borysthenicus*.

It is necessary to pay special attention to the fish species in the habitats of Gurban Valley, since the water bodies are isolated from the rest of the regions where the species *P. borysthenicus* has been reported. According to Crăciun (1996), the population in Comana is represented by the subspecies *Leuciscus borysthenicus celesticus*. Meșter et al. (2003) assessed the populations identified in the Neajlov River sector, from the Comana area and Valea Gurbanului, as *Leuciscus celensis* species.

Likewise, in the Red Book of Vertebrates (2005), Bănărăscu presents the species *Leuciscus borysthenicus*, referring strictly to the "population from Comana" - Comana chub, noting that the population is endemic to Balta

Comana and the Gurban River. Cristea (2004) also mentioned the presence of Dnieper chub in Gurban River.

Among the collected fishes for the present study, several specimens of *P. borystenicus* and the specimen of *Carassius gibelio* had their caudal fins eaten, which may suggest, as the specialized literature postulated, that predatory fish also exist in these bodies of water (Crăciun, 1996; Meșter et al., 2003).

II. Floristic inventory

During the study period, the following species were noticed, identified and photographed in Gurban Valley (Figure 4):

1. *Acer campestre* L. (Sapindales, Sapindaceae), Field maple;
2. *Acer tataricum* L. (Sapindales: Sapindaceae), Tatarian maple;
3. *Alisma plantago-aquatica* L. (Alismatales, Alismataceae), European water plantain;
4. *Amaranthus retroflexu*s L. (Caryophyllales: Amaranthaceae), Red-root amaranth;
5. *Anchusa officinalis* L. (Boraginales: Boraginaceae), Common bugloss;
6. *Arctium tomentosum* Mill. (Asterales, Asteraceae), Woolly burdock;
7. *Ballota nigra* L. (Lamiales, Lamiaceae), Black horehound;
8. *Berula erecta* (Hudson) Coville (Apiales, Apiaceae);
9. *Carduus acanthoides* L. (Asteraceae, Asteraceae), Spiny plumeless-thistle;
10. *Clematis vitalba* L. (Ranunculales, Ranunculaceae), Traveller's joy;
11. *Cornus mas* L. (Cornales, Cornaceae), European cornel;
12. *Cornus sanguinea* L. (Cornales, Cornaceae), common dogwood;
13. *Coronilla varia* L. (Fabales, Fabaceae), Crownvetch;
14. *Corylus avellana* L. (Fagales, Betulaceae), Common hazel;
15. *Crataegus monogyna* Jacq. (Rosales, Rosaceae), Common hawthorn;
16. *Crepis pulchra* L. (Asterales, Asteraceae), Smallflower hawksbeard;
17. *Dioscorea communis* (L.) Caddick & Wilkin (Dioscoreales, Dioscoreaceae), Black bryony;
18. *Dipsacus laciniatus* L. (Dipsacales, Caprifoliaceae), Cutleaf teasel;
19. *Doronicum hungaricum* L. (Asterales, Asteraceae);
20. *Echinops sphaerocephalus* L. (Asterales, Asteraceae), Greater globe-thistle;
21. *Elymus caninus* (L.) L. (Poales, Poaceae), Bearded wheatgrass;
22. *Epilobium palustre* L. (Myrtales, Onagraceae), Marsh Willow Herb;
23. *Euphorbia esula* L. (Malpighiales, Euphorbiaceae), Green spurge;
24. *Euonymus europaeus* L. (Celastrales, Celastraceae), European spindle tree;
25. *Fraxinus excelsior* L. (Oleales, Oleaceae), Ash;
26. *Galega officinalis* L. (Fabales, Fabaceae), Galega;
27. *Galium aparine* L. (Gentianales, Rubiaceae), Catchweed bedstraw;
28. *Lavatera thuringiaca* L. (Malvales, Malvaceae), Lavatera;
29. *Lemna minor* L. (Alismatales, Araceae), Common duckweed;
30. *Linaria vulgaris* Mill. (Lamiales, Plantaginaceae), Common toadflax;
31. *Ornithogalum fimbriatum* Willd. (Asparagales, Asparagaceae);
32. *Orchis purpurea* Hudson (Orchidales, Orchidaceae), Lady orchid;
33. *Phragmites australis* (Cav.) Trin. ex Steud. (Poales, Poaceae), Common reed;
34. *Pleurospermum austriacum* (L.) Hoffm. (Apiales, Apiaceae);
35. *Polygonatum* sp. (Aspagarales, Asparagaceae);
36. *Polygonum persicaria* L. (Caryophyllales, Polygonaceae), Lady's Thumb;
37. *Prunus fruticosa* Pall. (Rosales, Rosaceae) European dwarf cherry;
38. *Prunus spinosa* L. (Rosales, Rosaceae), Blackthorn;
39. *Quercus pedunculiflora* C. Koch. (Fagales, Fagaceae), Grayish oak;
40. *Quercus cerris* L. (Fagales, Fagaceae), Turkey oak;
41. *Quercus robur* L. (Fagales, Fagaceae), Pedunculate oak;
42. *Robinia pseudoacacia* L. (Fabales, Fabaceae), Black locust;
43. *Rubus caesius* L. (Rosales, Rosaceae), Dewberry;
44. *Rumex conglomeratus* Murray (Caryophyllales, Polygonaceae), Clustered

dock;
45. *Salix alba* L. (Salicales, Salicaceae), White willow;
46. *Salix caprea* L. (Salicales, Salicaceae), Goat willow;
47. *Salvia nemorosa* L. (Lamiales, Lamiaceae), Woodland sage;
48. *Sambucus ebulus* L. (Dipsacalaes, Adoxaceae), Dwarf elder;
49. *Scutellaria altissima* (Lamiales, Lamiaceae), Someret skullcap;
50. *Scutellaria galericulata* L. (Lamiales, Lamiaceae), Common skullcap;
51. *Silene vulgaris* (Moench) Garcke (Caryophyllales, Caryophyllaceae), Bladder campion;
52. *Solidago virgaurea* L. (Asterales, Asteraceae), Goldenrod;
53. *Stachys germanica* L. (Lamiales, Lamiaceae), german hedge-nettle;
54. *Symphytum officinale* L. (Boraginales, Boraginaceae), Common comfrey;
55. *Typha angustifolia* L. (Poales, Typhaceae), Small reed mace;
56. *Typha latifolia* L. (Poales, Typhaceae), Broadleaf cattail;
57. *Verbascum nigrum* L. (Lamiales, Scrophulariaceae), Black mullein;
58. *Verbascum speciosum* Schrad. (Lamiales, Scrophulariaceae), Hungarian mullein.

The determined species belong to a number of 31 families, the most numerous plants identified being included in the Asteraceae family.
Ornithogalum fimbriatum from Asparagaceae family is a rare species (Ciocârlan, 2000) and *Prunus fruticosa* (syn. *Cerasus fruticosa*) is an edifying species for the priority habitat 40A0* Subcontinental peri-Pannonic scrub (Ciocârlan, 2000; Doniță et al., 2005; Paucă Comănescu & Negrean, 2009). Some species such as *Dioscorea communis* (Dioscoreaceae family) and *Polygonatum latifolium* (Asparagaceae) could have a toxic potential to humans, due to their poisonous content.
In terms of general distribution, most of the identified plants in Gurban Valley are European (*Anchusa officinalis, Acer campestre, Ballota nigra, Cornus sanguinea, Carduus acanthoides, Crepis pulchra, Euonymus europaeus, Fraxinus excelsior, Rubus caesius, Quercus robur*), circumpolar (*Alisma plantago-aquatica, Berula erecta, Galium aparine, Scutellaria galericulata, Solidago virgaurea, Rumex conglomeratus, Elymus caninus, Typha angustifolia*), Eurasian (*Arctium tomentosum, Crataegus monogyna, Euphorbia esula, Linaria vulgaris, Sambucus ebulus, Verbascum nigrum*), eurasiatic continental (*Dipsacus laciniatus, Lavatera thuringiaca*), adventive (*Amaranthus retroflexus*), cosmopolitan (*Phragmites australis, Typha latifolia*), pioneer (*Silene vulgaris*) (Ciocârlan, 2000).

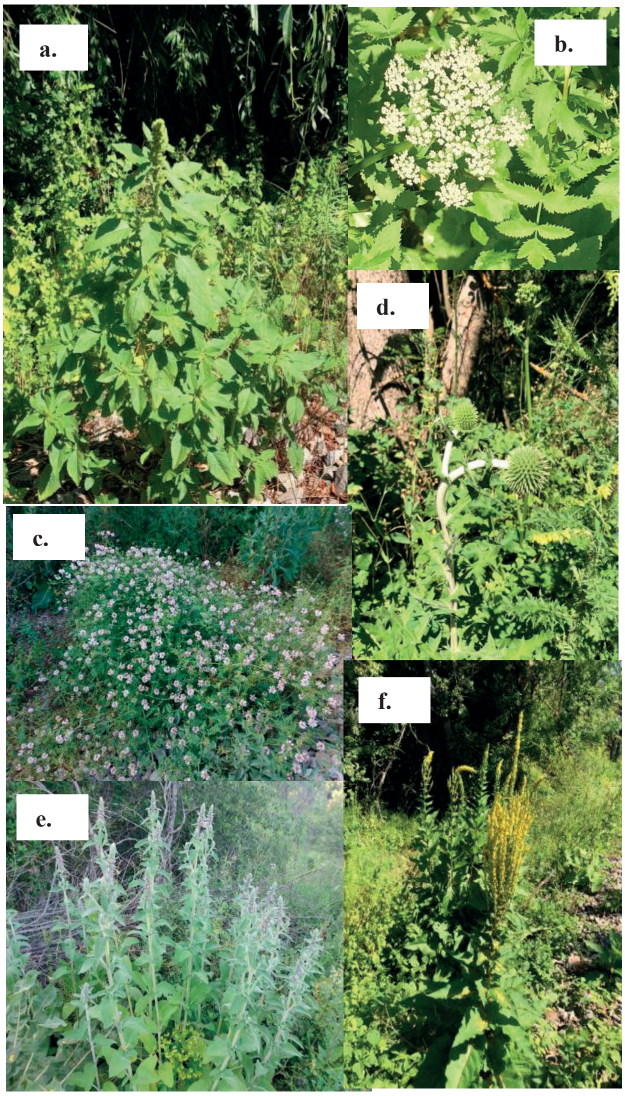

Figure 4. Some plant species identified in Gurban Valley (July 2023): *a. Amaranthus retroflexus*; *b. Berula erecta*; *c. Coronilla varia*; *d. Echinops sphaerocephalus*; *e. Stachys germanica*; *f. Verbascum speciosum*

III. Classification of surface water quality from Gurban Valley
The results provided by physico-chemical analyses for each sampling profile, averages and limits/quality classes are centralized in

Table 3. The assignment of quality classes for each parameter according to legislation (Directive 2000/60/EC; Order 161/2006) is depicted in Figure 5.

Table 3. Determined values, average values and limits/quality classes
for characterization of water samples collected from Gurban Valley

Sample	**pH**	**EC**	**TH,**	**COD**	**P-PO_4^{3-}**	**N-NO_2^-**	**N-NO_3^-**	**N-NH_4^+**
		µS/cm	mg CaO/L	mg O_2/L	mg P/L	mgN/L		
1	7.32	1194	32.20	11.59	0.294	<LD	<LD	1.077
2	7.34	1336	33.55	13.11	0.326	<LD	0.288	0.967
3	6.90	1054	28.84	9.59	0.160	<LD	<LD	0.979
4	7.09	1068	30.18	10.31	0.122	<LD	<LD	1.150
Average	**7.16**	**1163**	**31.19**	**11.15**	**0.226**	**-**	**-**	**1.043**
Limits/Quality classes*	6.50-8.50	NA	NA	III	III	I	I	III

The results represent the average of three determinations.
LD = detection limit of the method; *according to Order 161/2006 for the approval of the Normative concerning the classification of surface water quality to establish the ecological status of water bodies; **NA** = not available.

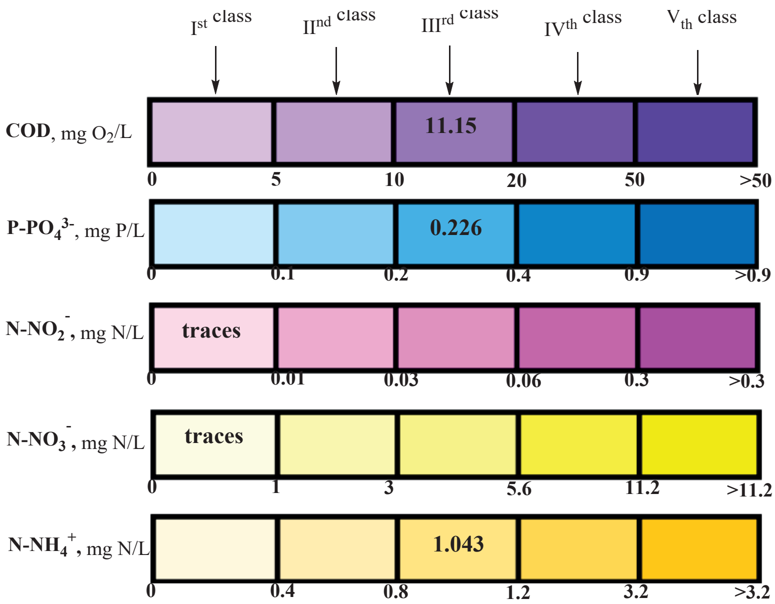

Figure 5. Quality classes for surface water according to legislation and assigned quality classes for water collected from Gurban Valley

a) Results concerning pH, EC and TH and correlations between them

Determined pH values for water samples are within recommended range (6.50-8.50) for surface waters (Order 161/2006) (Table 3). This parameter presents great importance the more so as, significantly influences the biological and chemical interactions in aquatic environment. Some authors (Dastagir et al., 2014) stated that pH values below 8.4 indicate that the respiratory processes in waters are greater than the photosynthetic ones. Also, ammonia and hydrogen sulphide are released when temperature and pH values are unbalanced. For instance, at pH lower than 6, sulphide is in the H_2S toxic form. In addition, low pH values increase metals' toxicity (Sallenave, 2012).

For aquaculture, Allatore and his team (2011) concurs that an ideal pH has to be near to 7, values lower than 5 and higher than 10 being lethal for most fish species.

Previously reported studies regarding quality of ponds evidence similar average pH values, as for example: 7.17 (Comana fish pond) (Stavrescu-Bedivan et al., 2021), 7.35 (Bițina fish pond) (Stavrescu-Bedivan et al., 2022), 7.42 (Moara Domnească pond) (Sandu et al., 2023).

Dissolved ions conduct electricity and from this behavior arises EC parameter. Even if for surface waters legislation does not provide a limit value or safe interval, literature data indicate desirable range for most fish species as 60-2000 μS/cm, even if there are some species (channel catfish) that can tolerate more salinity (Austin et al., 2016). EC values, for analyzed water samples, range between 1054 and 1336 μS/cm (1163 μS/cm, as average) (Table 3).

As concerning TH, determined values are within 28.84-33.55 mg CaO/L (31.19 mg CaO/L, as average) (Table 3), this parameter being given by the concentrations of divalent ions, Ca^{+2} ang Mg^{+2} in particular, which are involved in biological processes that occur in aquatic organisms. No limit value or safe interval is provided by legislation for TH either, but values between 28-84 mg CaO/L are considered optimum for aquaculture (Stone & Thomforde, 2004).

Notwithstanding, determined average value (31.19 mg CaO/L) is almost double in comparison with previously reported results for other ponds (Stavrescu-Bedivan et al., 2021; Stavrescu-Bedivan et al., 2022; Sandu et al., 2023).

The analysis of the results indicated that EC (μS/cm) presents very significant correlation with TH (mg CaO/L) with correlation coefficient r = 0.9230***. Between pH values and TH (mg CaO/L) it has been evidenced very significant correlation with r = 0.8821*** (Figure 6)..

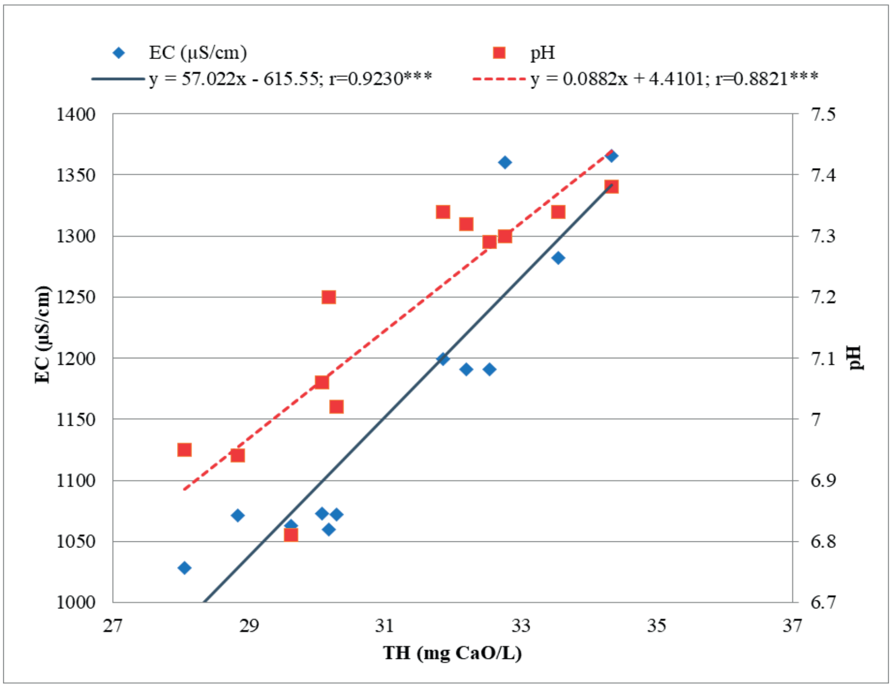

Figure 6. Correlations between EC and pH values with total hardness of water samples from Gurban Valley

b) Results concerning COD parameter

COD refers to the quantity of oxygen required to decompose by oxidation organic species from a given water sample and it is associated with organic pollution. In addition, according to literature, COD value for clean water range between 2 and 4 mg O_2/L (Cohl et al., 2014). According to the surface water legislation (Order 161/2006), there are five quality classes associated with the O_2 content, the lower content meaning the better quality.

For analyzed samples, the COD average value is 11.15 mg O_2/L (Table 3), this content being associated with IIIrd quality class (Figure 5). The same quality class was attributed to water from Comana (Stavrescu-Bedivan et al., 2021) and Moara Domnească pond (Sandu et al., 2023, meanwhile water samples from Bițina 3 pond (Stavrescu-Bedivan et al., 2022), Brănești fish pond (Stavrescu-Bedivan et al., 2015), Tătaru fish pond (Scăețeanu Vasile et al., 2019), Mogoșoaia, Herăstrău and Pantelimon lakes (Ionescu et al., 2015) were characterized by better quality being framed into IInd quality class from this point of view

c) Results related with phosphorus and nitrogen species content

Phosphorus and nitrogen are nutritive elements involved in many life processes, but lately must be carefully monitored, the more so as due to use of fertilizers and industrialization their concentrations increased in water bodies, the main environmental issue being eutrophication (Shen et al., 2020). Therefore, phosphorus and nitrogen levels in surface waters are regulated by legislation (Order 161/2006) for concentration ranges being associated quality classes.

Phosphate phosphorus concentrations quantified in water samples from Gurban Valley range between 0.122 and 0.326 mg P/L (0.226 mg P/L, as average) (Table 3), this value framing the water into the IIIrd quality class Figure 5. Beside eutrophication, phosphorus influences aquatic organisms' life. Consequently, some studies report that increase of phosphorus levels in water determines the decrease of cyprinids body weight (Jeppesen et al., 2000).

In surface waters, nitrogen is encountered in organic and inorganic forms (nitrate NO_3^-, nitrite NO_2^- and ammonium NH_4^+) and elevated concentrations are associated with eutrophication even with fish death (Chen et al., 2017). Nitrite form is an intermediary form in the oxidation process of ammonium to nitrate (Kroupova et al., 2005).

Nitrite nitrogen levels are below detection limit of the method used for determinations (Table 3), this suggesting very low concentrations that allow to frame the water to the Ist quality class according to legislation (Order 161/2006) (Figure 5). For fish, high nitrite levels are related with brown blood disease and hypoxia (Durborow et al., 1997). Furthermore, nitrite is taken by the fish across gills in competition with chloride anions (Kroupova et al., 2005).

In our study, considering nitrate nitrogen concentrations, excepting one sampling point in the case of which was determined 0.288 mg N/L, the other sampling points present very low levels (Table 3). According to literature, nitrate toxicity to aquatic organisms is related as in the case of nitrite with oxidation of oxygen-carrying pigments converting them into either methemoglobin or methemocyanin (Camargo & Alonso, 2006).

In surface waters, ammonia (NH_3) is involved into an equilibrium with ammonium ion (NH_4^+) that depends on temperature and pH. Hence, ammonia is stabilized at high pH in warmer water meanwhile ammonium ion is predominant at lower pH values (Sallenave, 2012).

Ammonium nitrogen levels determined in our research range between 0.967 and 1.150 mg N/L (1.043 mg N/L, as average) (Table 3), this being consistent with IIIrd quality class (Order 161/2006) (Figure 5). Higher values were reported for Moara Domnească pond (Sandu et al., 2023).

Considering obtained results for nutrients ($P\text{-}PO_4^{3-}$, $N\text{-}NH_4^+$) and association with IIIrd quality class, it is possible to encounter eutrophication. Forsooth, this hypothesis was confirmed by the visual observations (Figure 7), therefore monitoring periodically of nutrient levels corroborated with other relevant parameters is recommended to avoid undesirable environmental effects.

d) Correlations between COD, nitrogen and phosphorus

Increasing levels of phosphate phosphorus and ammonium nitrogen correlates with COD values at sampling moment, this variation being related with decrease of water quality (Figure 8, Figure 9). In addition, these correlations were emphasized also by other researchers (Kawabe & Kawabe, 1997; Liu et al., 2017).

Figure 7. Eutrophication of waterbody in Gurban Valley, near Vlad Țepeș, Giurgiu County

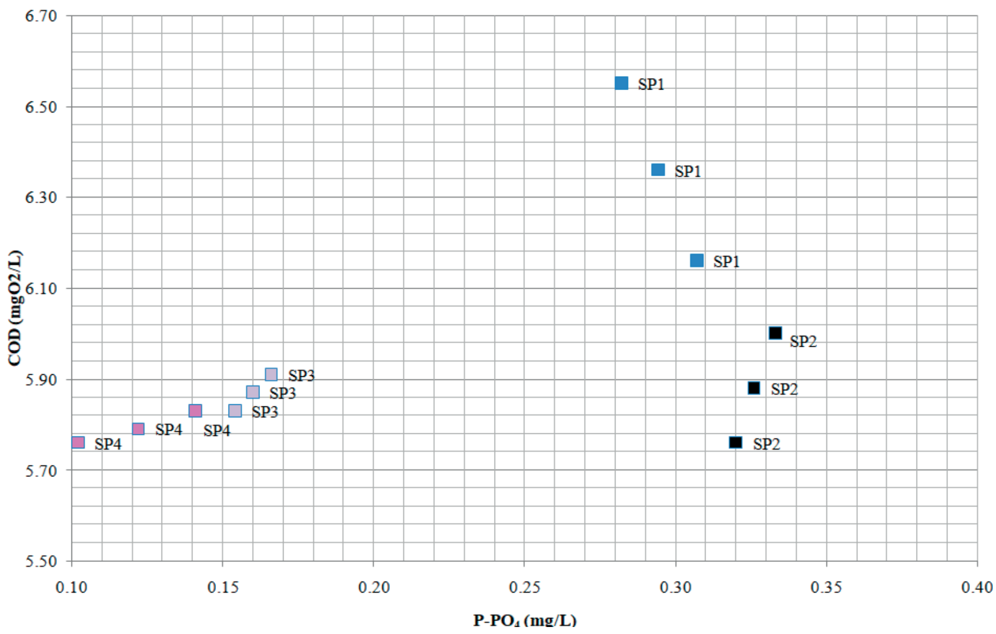

Figure 8. The Cartesian coordinates given by COD and P-PO_4^{3-} at sampling moment

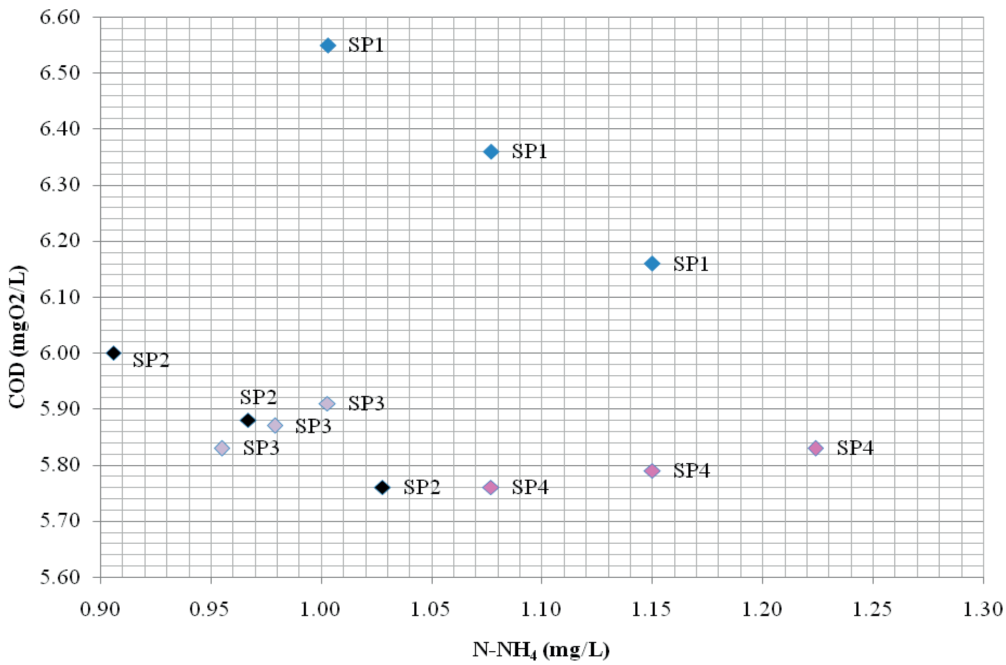

Figure 9. The Cartesian coordinates given by COD and N-NH_4^+ at sampling moment

CONCLUSIONS

This work presents novel data concerning the water quality and diversity of plants and fishes encountered in some parts of Gurban Valley, Giurgiu County, southern Romania.
Water physico-chemical analysis provided results that allowed framing the water into Ist quality class (N-NO_2^-, N-NO_3^-) and IIIrd quality class (COD, P-PO_4^{3-}, N-NH_4^+) according to legislation (Order 161/2006). Considering found levels of phosphorus and ammonium nitrogen, it would be indicated to monitor nutrients concentrations periodically, since their levels are associated with algae blooms, eutrophication and consequences on other water quality parameters (dissolved oxygen levels, for example) and therefore, aquatic organisms' life. In addition, pH values correspond to reccomended range for surface waters and are also optimum for aquaculture. Furthermore, EC values are within desirable range for most fish species. It has been also found a very significant correlation of TH with

EC (r=0.9230***) and with pH (r=0.8821***). From the ichthyological perspective, the study carried out concluded that the predominant species in this area is *Petroleuciscus borystenicus*, followed by *Umbra krameri* and *Cobitis elongatoides*.

Regarding the floristic inventory compiled so far for the investigated habitats, from a total of 31 families, Asteraceae is represented by the most numerous species.

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