Scientific Papers. Series D. Animal Science. Vol. LXII, No. 2, 2019
ISSN 2285-5750; ISSN CD-ROM 2285-5769; ISSN Online 2393-2260; ISSN-L 2285-5750

WATER QUALITY IN DIFFERENT AREAS OF TIMIS RIVER COURSE IN ROMANIA

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Abstract

Researchers have been conducted in the Timis River, which springs from the Semenic Mountains, in the western part of Romania. On its course on Romania's territory were established 6 sampling stations (Accumulation Three waters-Feneşti Confluence, Teregova, Lugoj-CFR Bridge, Lugoj-Timişana Confluence, Şag and Grăniceri) where analyzes were made of the chemical composition of the water. Analysis of the results showed an increase from upstream to downstream of 5 days-biochemical oxygen demand (B.O.D.5) (from 1.75 to 3.66 mg/l), also the accumulation of nitrates (from 1.53 to 3.08 mg/l), nitrites (from 0.01 to 0.10 mg/l), chloride (from 2.50 to 8.51 mg/l) and water hardness (from 1.12 to 6.02 dH°).

Key words*: river course areas, Timis River, water chemical composition..*

INTRODUCTION

The Timiş River, which springs from the Semenic Mountains, is the largest drainage river in the Banat hydrographic area. It collects the waters from a basin area of 5673 km, taking the water from rivers that drain the Ţarcu-Godeanu Mountains, as well as the Semenic and Poiana Rusca Mountains. From the Ţarcu-Godeanu Mountains receives the Rece River (Hidişelul), with a narrow and very deep valley and from the Semenic Mountains receives the Bistra River, with well-defined valleys and steep slopes. The middle course of Timiş River crosses the depressed area between Lipova and Buziaş Hills, having a large major riverbed and an average slope of 0.7-0.8 m/km. In the lower course, it has a wide meandering and rambling riverbed, with a particularly low slope, generating floods. Through a double interconnection of Timiş-Bega Rivers, the natural hydrological regime of the two rivers is regularized. In the lower course, the Timiş River receives as the most important tributary of Pogăniş.

MATERIALS AND METHODS

During the entire course of the Timiş River, 6 fishing stations were established, in which determinations of the chemical composition of the water were made.

The fishing stations were set at Accumulation Three waters-Feneşti Confluence (Figure 1), Teregova (Figure 2), Lugoj-CFR Bridge (Figure 3), Lugoj-Timişana Confluence (Figure 4), Şag (Figure 5) and Grăniceri (Figure 6).

The first two fishing stations (Accumulation Three waters-Feneşti Confluence and Teregova) were included in the upper part of Timiş, in the mountain area, the two from Lugoj (Lugoj-CFR Bridge and Lugoj-Timişana Confluence) in the hill area and the last two in the plain area (Şag and Grăniceri).

For the study of water chemical composition of each fishing station, the 5 days-biochemical oxygen demand (B.O.D.5), dissolved oxygen, pH, nitrates (NO_3^-), nitrites (NO_2^-), chlorides and hardness was determined.

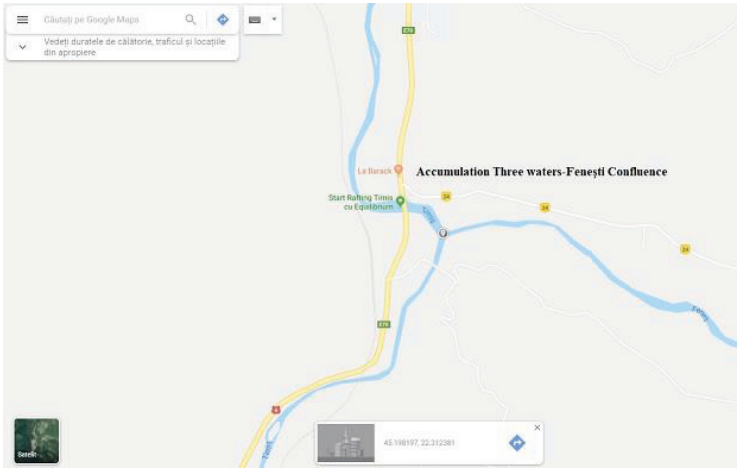

Figure 1. Timiș River at Accumulation Three waters-Fenești Confluence on Google Maps

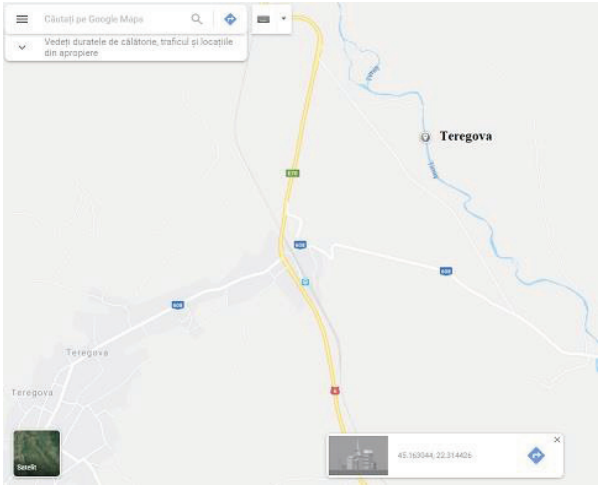

Figure 2. Timiș River at Teregova on Google Maps

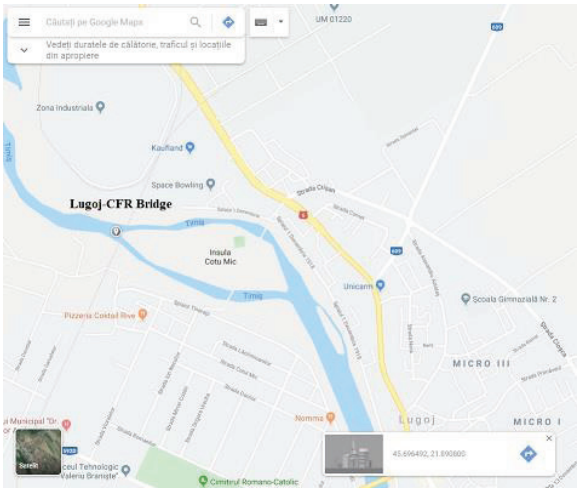

Figure 3. Timiș River at Lugoj-CFR Bridge on Google Maps

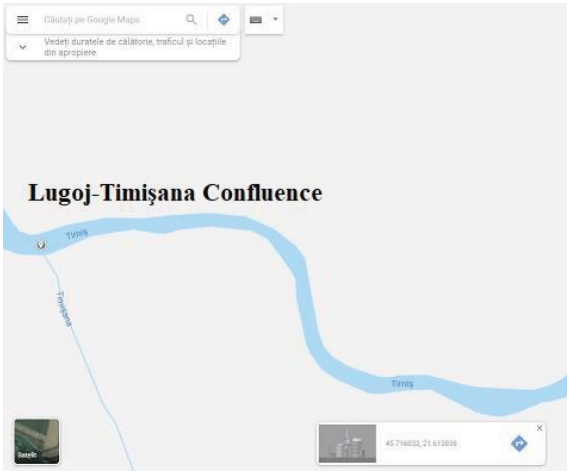

Figure 4. Timiș River at Lugoj-Timișana Confluence on Google Maps

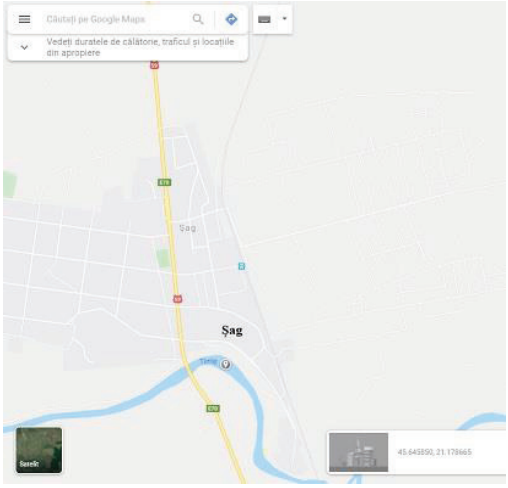

Figure 5. Timiș River at Șag on Google Maps

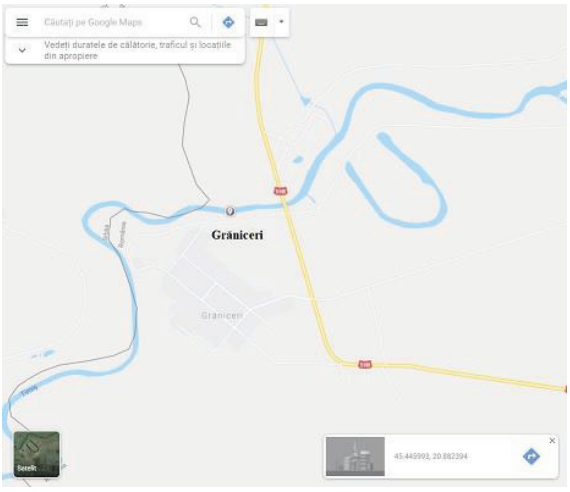

Figure 6. Timiș River at Grăniceri on Google Maps

RESULTS AND DISCUSSIONS

Table 1 shows the chemical composition of the water from the 6 fishing stations along the Timiş River.

The 5 days-biochemical oxygen demand (B.O.D.5) showed the lowest average value of the two years (1.80 mg O_2/l) to the station from reservoir lake Three Waters-Feneş and the junction with the highest average value of the two years (3.58 mg O_2/l) to the Grăniceri station. The extreme values of 5 days-biochemical oxygen demand were between 1.75 mg O_2/l at Feneş station and 3.66 mg O_2/l at Grăniceri station, both determined in 2016.

Table 1. Chemical composition of waters in different fishing stations of Timis River

Fishing stations	B.O.D.5 (mg O_2/l)		Dissolved oxygen (mg O_2/l)		pH		Nitrates (mg/l)		Nitrites (mg/l)		Chlorides (mg/l)		Hardness (dH°)	
	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
Three Waters Lake Accumulation-Feneş confluence	1.85	1.75	11.05	10.75	7.05	7.40	2.45	1.53	0.02	0.02	2.50	2.50	1.15	1.37
Teregova	2.00	1.80	10.90	10.80	7.10	7.40	1.87	1.77	0.02	0.01	2.50	2.50	1.44	1.12
Lugoj-CFR Bridge	2.49	3.00	10.29	9.73	7.25	7.50	1.70	2.16	0.04	0.06	2.50	2.50	3.57	3.99
Lugoj-Timişana Confluence	2.57	3.04	8.61	8.33	7.13	7.05	1.53	2.21	0.07	0.10	4.80	7.09	5.14	4.57
Şag	2.20	2.63	9.09	9.13	7.25	7.25	2.68	1.98	0.07	0.05	8.51	5.67	6.02	4.47
Grăniceri	3.50	3.66	10.54	8.24	7.55	7.50	3.08	2.46	0.05	0.04	8.51	8.51	5.99	5.61

The highest average level of dissolved oxygen of the two years - DO (oxygen dissolved in water) was 10.90 mg O_2/l water in Feneş Station and the lowest average level of the two years in Lugoj Station-confluent with Timişana 8.47 mg O_2/l water. In Teregova station the average dissolved oxygen level of the two years was close (10.85 mg O_2/l) to that of the Feneş station. As extreme values, the dissolved oxygen was between a minimum of 8.33 mg O_2/l at the Lugoj Station-confluent with Timişana and a maximum of 11.05 mg O_2/l at the Fenes Station.

Depending on the relationship between the acidic and basic components of the aquatic environment, according to the opinion of Bud et al. (2001, 2016), Bura et al. (2008) and Man (1989) water can have a neutral (pH=7), acid (pH<7) or alkaline (pH>7) reaction. The authors note that the flowing waters had an alkaline pH, given by the contained bicarbonates, while the stagnant fresh waters gradually became acid, due to the accumulation of humic substances, mineral acids, and carbon dioxide. Bogdan et al. (2002), and Grozea and Bura (2002), are of the opinion that both high acidity and strong alkalinity have a negative effect on aquatic organisms.

In all waters of the fishing stations, the pH was alkaline. On average of the two years, the pH ranged between 7.09 in the Lugoj Station-confluence with Timişana and 7.52 in the Grăniceri Station. The individual values were between a minimum of 7.05 in Feneş Station (the year 2015) and Timişana confluence Station (the year 2016), as well as a maximum of 7.55 in Grăniceri Station.

According to Bud et al. (2016), the water favorable for the development of fish must have a pH between 6 and 8. In the presented situation, the pH ranges from 7.05 to 7.55, shows favorable values for the development of aquatic fauna.

If the nitrates and the nitrites in the deep water have a mineral origin and do not have a harmful effect on the fish organism, those in the groundwater have an organic origin and are the consequence of water contamination, according to Bates et al. (2003), Ionescu et al. (1986) and Păcală et al. (2006).

On average of the two years, nitrates recorded values between 1.82 mg NO_3^-/l in the water of the Teregova Station and 2.77 mg NO_3^-/l in the Grănicieri. The highest values of nitrates were recorded at the Şag Stations (2.68 mg NO_3^-/l) and Grănicieri (3.08 mg NO_3^-/l).

The nitrites were reported in extremely small quantities, their average values being between 0.015 mg NO_2^-/l at Teregova Station and 0.085 mg NO_2^-/l at Lugoj Station-confluence with Timişana.

According to the determinations of Ionescu et al. (1986) the salts of Ca^{2+}, Mg^{2+}, Na^{2+}, HCO_3-, SO_4^{2-}, Cl^- ions predominate in natural waters. In the fresh waters, calcium carbonates and bicarbonates dominate.

In relation to the abundance of precipitations (when they decrease) or evaporation (when they grow), the concentration of chlorides, sulphates, and carbonates makes different evolutions. Freshwater contains between 0-0.5 g salts/l water. For most fish species the optimum salinity is between 0.10-0.50 g/l water.

Chlorides are commonly seen in terrestrial waters and may have an inorganic or organic origin. Chlorines from deep layers have an only inorganic origin and can be clearly tolerated when they exceed permissible level (20 mg/l). The chlorides in groundwater are chemically organic, being the consequence of contamination with waste-water.

In the six fishing stations on the Timiş River, the level of chlorides was between 2.50 mg/l in Fenes, Teregova and Lugoj-CFR Bridge stations, and the maximum value of 8.51 mg/l was reached in the Grăniceri station. The first decreasing value, of 7.09 mg chlorides/l, was reached at Şag station.

The hardness of the water is generated by the concentration of calcium and magnesium salts in the water. Bănărescu (1964) notes that calcium and magnesium bicarbonates give the water a temporary hardness, while calcium and magnesium chlorides and sulphates give the permanent hardness. By summing the two harnesses of water the total hardness is obtained, which, in our system, is expressed in German degrees of hardness (dH°) and represents the amount of calcium and magnesium salts dissolved in one liter of water, equivalent to 1 dH° = 10 mg CaO. In the case of flowing waters the total hardness is generally below 15 dH°. Moderate hardness is between 12-18 dH°.

Depending on the degree of hardness achieved, Man (1989) classifies the waters in: very soft (0-4 dH°), soft (4-8 dH°), medium (8-12 dH°), moderately harsh (12 -18 dH°), hard (18-20 dH°) and very hard waters (>30 dH°). For fish farming, the best waters are those with medium to moderate hardness (Bura et al., 2008).

On average, the water hardness recorded the lowest value (1.26 dH°) at the Feneş fishing station and the highest value at the Grăniceri fishing station (5.80 dH°). The lowest water hardness was recorded at Teregova station (1.12 dH°) in 2016, and the highest hardness at Şag station (6.02 dH°) in 2015.

Table 2 presents the chemical composition of the Timiş River in different areas.

Table 2. Chemical composition of water in different areas of Timis River

Area	B.O.D.5 (mg O_2/l)		Dissolved oxygen (mg O_2/l)		pH		Nitrates (mg/l)		Nitrites (mg/l)		Chlorides (mg/l)		Hardness (dH°)	
	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
Upper course	1.93	1.78	10.98	10.79	7.08	7.40	2.16	1.65	0.02	0.01	2.50	2.00	1.29	1.24
Middle course	2.52	3.02	9.45	9.03	7.19	7.28	1.62	2.19	0.05	0.08	3.65	4.79	4.35	4.28
Lower course	2.75	3.15	9.82	8.69	7.40	7.38	2.88	2.22	0.06	0.05	8.51	7.09	6.00	5.04

The six fishing stations on the Timiş River were divided by two on each area of the river course, constituting for analysis three zones: upper (Feneş and Teregova stations), middle (the two Lugoj stations) and lower (Şag and Grăniceri)

The 5th days-biochemical oxygen demand showed on average of the two years an increased evolution from the upper (1.80 mg O_2/l) to the lower water area (3.58 mg O_2/l). In relation to this consumption, the level of oxygen dissolved in water on average of the two years was highest in the upper river of the Timiş River (10.90 mg O_2/l) and much lower in the middle river (10.01 mg O_2/l) and lower (9.39 mg O_2/l). The water of all investigated

areas had a high level of oxygen dissolved in water, which ensures their existential comfort.
In all three areas, the average of the two years pH level was weakly alkaline, being between 7.22 and 7.52. This level places the water along the entire Timiş River at a level favorable to the development of many species of fish caught.
In the water of the Timiş River, the average of nitrates from the two years (between 1.82 and 2.77 mg/l) and the average of nitrites from the two years (between 0.015 and 0.06 mg/l) are found in small quantities, which do not endanger the life of the fish.
The average of chloride level from the two years in the Timiş River water was the lowest in the upper area (2.25 mg/l), almost doubled in the middle area (4.22 mg/l) and tripled in the lower area (7.80 mg/l).
The average of water hardness recorded from the two years increasing values from the upper area of the Timiş River (1.26 dH°), towards the middle area (4.31 dH°) and reached the maximum hardness in the lower area of this river (5.52 dH°).

CONCLUSIONS

During the passage from the springs to the water in the Timiş River the level of 5 days-biochemical oxygen consumption increased (from 1.75 to 3.66 mg O_2/l), the accumulation of nitrates (from 1.53 to 3.08 mg/l), of nitrites (from 0.01 to 0.10 mg/l) and of chlorides (from 2.50 to 8.51 mg/l). Compared to these parameters, the level of oxygen dissolved in water decreased (from 11.05 to 8.24 mg O_2/l) and the pH of the water recorded relatively uniform alkaline values (between 7.05 and 7.55).
The Timiş River water recorded the average lowest hardness from the two years in the upper area (1.26 dH°), which increased in the middle area to (4.31 dH°) and reached the maximum value in the lower area (5.52 dH°).

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