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Water Quality Monitoring of Meriç and Tunca Rivers (Edirne, Turkey) in Rainy Season

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Abstract – Meriç River is the longest river ecosystem of the Balkans and most lotic ecosystem in Thrace Region of Turkey. Tunca River is one of the most important tributary of Meriç River. Therefore it is significantly effective on the water quality of Meriç River. In this study, water quality of Meriç and Tunca Rivers in rainy season of 2018 was monitored and the pressure of Tunca River on the system was evaluated. Water samples were collected from 2 stations before the rivers mixing during the autumn season of 2018. Total of 13 water quality parameters (1. Dissolved Oxygen; 2. Oxygen Saturation; 3. pH; 4. EC; 5. TDS; 6. Salinity; 7. Turbidity; 8. Nitrate; 9. Nitrite; 10. Ammonium; 11. Phosphate; 12. Sulfate; 13. BOD) were measured. According to detected data, pollution levels of the investigated rivers as follows; Tunca River > Meriç River in general. It was also determined that Tunca River negatively affects and reduces the water quality of Meriç River.

Keywords – Meriç River, Tunca River, Water quality, Monitoring, Organic pollution

I. Introduction

Lotic ecosystems are among the most vulnerable water bodies to pollution due to their role in carrying off the municipal and industrial wastewater and run-off from agricultural lands in their vast drainage basins. Therefore it is required to evaluate a large number of water quality data for an effective quality control and a useful water resource management [1, 2].

Meriç River has a length of 480 km and the catchment area of the river is more than 56,000 km2. It covers an area of 32,700 km2 in Bulgaria, 14,600 km2 in Turkey and 8,700 km2 in Greece. Tunca River is a lotic ecosystem in Bulgaria and Turkey and one of the most important tributary of Meriç River, emptying into it on Turkish territory near Edirne City [3 – 5].

The aim of this study was to monitor the water quality of Meriç and Tunca Rivers and to determine the pressure of Tunca River on the system.

II. Materials and Method

A. Study Area and Collection of Samples

Water samples were collected during the autumn (rainy) season of 2018 for 3 times (first, second and third weeks of October) from 2 stations selected on the rivers before they mixing. Coordinate informations are given in Table 1 and map of study area is given in Figure 1.

Table 1. Location properties of selected stations

Station Number	Locality	Coordinates		Explanation
		North	South	
S1	Edirne Province	41.662	26.551	Upsetream of Meriç River
S2		41.668	26.554	Downstream of Tunca River

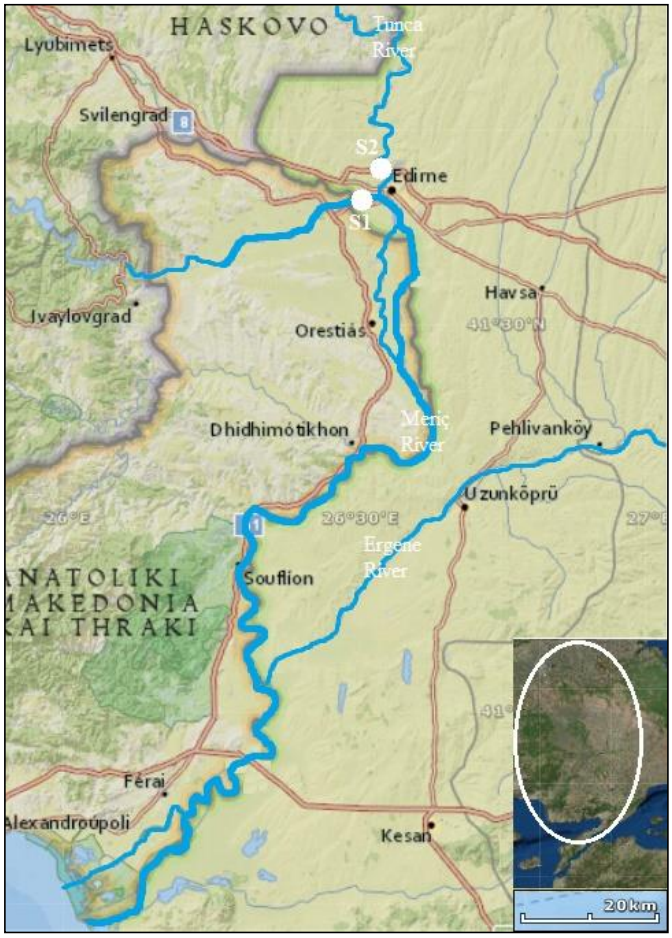


Fig. 1. Map of study area

B. Water Quality Analysis

Dissolved oxygen, oxygen saturation, pH, electrical conductivity (EC), total dissolved solids (TDS) and salinity parameters were determined by using "Hach Lange HQ40D Multiparameter" device during the field studies; turbidity parameter was determined by using "Hach Lange 2100Q Portable Turbiditymeter" device during the field studies; nitrat (NO3), nitrite (NO2), ammonium (NH4), phosphate (PO4) and sulphate (SO4) parameters were determined by using "Hach Lange DR3900 Spectrophotometer" device during the laboratory studies; biological oxygen demand (BOD) parameter was determined by using "Hach Lange BOD Trak II" device during the laboratory studies.

Results of investigated total of 13 water quality parameters on the upstream of Meriç River (S1) and the downstream of Tunca River (S2) are given in Table 2. Also the limit values of Water Pollution Control Regulation criteria in Turkey and some national (Turkish Standards Institute – TS) and international (European Union – EU and World Health Organization – WHO) drinking water quality and fish health standards are given in the same table (Table 2).

According to results of this study, in all field studies, almost all the investigated parameters detected in Tunca River were significantly higher than detected in Meriç River in general.

III. RESULTS

Table 2. Results of detected parameters and some limit values

Limits and Results		Parameters												
		DO (mg/L)	**OS** (%)	**pH**	**EC** (mS/cm)	**TDS** (mg/L)	**Sal** (‰)	**Tur** (NTU)	**NO_3** (mg/L)	**NO_2** (mg/L)	**NH_4** (mg/L)	***PO_4** (mg/L)	**SO_4** (mg/L)	**BOD** (mg/L)
Water Quality Classes [6]	I. Class	8	90	6.5-8.5	400	500	-	-	5	0.002	0.2	0.02	200	4
	II. Class	6	70	6.5-8.5	1000	1500	-	-	10	0.01	1	0.16	200	8
	III. Class	3	40	6.0-9.0	3000	5000	-	-	20	0.05	2	0.65	400	20
	IV. Class	<3	<40	Out of 6.0-9.0	>3000	>5000	-	-	>20	>0.05	>2	>0.65	>400	>20
Drinking Water Limits	TS266 [7]	-	-	6.5-9.5	2500	-	-	5	50	0.5	0.5	-	250	-
	EC [8]	-	-	6.5-9.5	2500	-	-	-	50	0.5	0.3	-	250	-
	WHO [9]	-	-	-	-	-	-	-	50	0.2	-	-	-	-
Fish Health Limits [10]	EC/C Cyprinid	4	-	6-9	-	-	-	-	-	0.03	0.2	-	-	6
	EC/S Salmon	6	-	6-9	-	-	-	-	-	0.01	0.04	-	-	3
Present Study 1. week	**S1** (Meriç)	8.35 I. Class	96.9 I. Class	8.75 I. Class	286 I. Class	142 I. Class	0.14	7.23	0.94 I. Class	0.020 **III. Class**	0.027 I. Class	0.106 II. Class	39.5 I. Class	3.9 I. Class
	S2 (Tunca)	8.03 I. Class	95.2 I. Class	7.97 I. Class	665 II. Class	329 I. Class	0.33	36.7	2.11 I. Class	0.056 **IV. Class**	0.191 I. Class	0.279 **III. Class**	74.8 I. Class	3.1 I. Class
2. week	**S1** (Meriç)	8.48 I. Class	94.9 I. Class	8.34 I. Class	278 I. Class	142 I. Class	0.14	13.7	0.99 I. Class	0.015 **III. Class**	0.026 I. Class	0.125 II. Class	37.7 I. Class	2.3 I. Class
	S2 (Tunca)	8.50 I. Class	93.8 I. Class	8.47 I. Class	630 II. Class	335 I. Class	0.33	16.1	2.08 I. Class	0.032 **III. Class**	0.096 I. Class	0.255 **III. Class**	72.1 I. Class	2.5 I. Class
3. week	**S1** (Meriç)	8.16 I. Class	92.3 I. Class	8.07 I. Class	275 I. Class	141 I. Class	0.14	4.05	0.79 I. Class	0.018 **III. Class**	0.015 I. Class	0.063 II. Class	32.9 I. Class	2.5 I. Class
	S2 (Tunca)	8.09 I. Class	90.2 I. Class	7.94 I. Class	704 II. Class	377 I. Class	0.38	36.8	2.26 I. Class	0.048 **III. Class**	0.152 I. Class	0.283 **III. Class**	87.6 I. Class	2.7 I. Class

*: According to another water quality classification specified by Uslu and Türkman [11]; TS266 – Turkish Standards Instıtute, EC – European Communities, WHO – World Health Organization; DO – Dissolved oxygen, OS – Oxygen saturation, Sal – Salinity, Tur – Turbidity

IV. DISCUSSION

According to the Water Pollution Control Regulation criteria in Turkey [7], Meriç and Tunca Rivers has I. Class water quality in terms of dissolved oxygen, oxygen saturation, pH, TDS, nitrate, ammonium, sulphate and BOD parameters; Meriç River has I. Class and Tunca River has II. Class water quality in terms of EC parameter; and Meriç River has III. Class and Tunca River has III. – IV. Class water quality in terms of nitrite parameter. According to another water quality classification specified by Uslu and Türkman [8], Meriç River has II. Class and Tunca River has III. Class water quality in term of phosphate parameter.

Nitrite is known as an intermediate product in the biological oxidation process reaching from ammonium to nitrate. It can reach to high concentrations in especially organically contaminated water. Also organic and inorganic fertilizers, municipal and industrial wastewater discharges are the most important factors on increasing the amount of phosphate in water [12, 13]. The main reason of the recorded high values of nitrite and quite high levels phosphate in water of Meriç and Tunca Rivers are thought to be the runoff from agricultural lands and the sewage discharges from residential areas.

V. CONCLUSION

In this study, water qualities of Meriç and Tunca Rivers were monitored in rainy season by investigating some limnologic parameters including dissolved oxygen, oxygen saturation; pH; electrical conductivity (EC), total dissolved solids (TDS), salinity, turbidity, nitrate – nitrogenous, nitrite – nitrogenous, ammonium – nitrogenous, phosphate, sulfate and biological oxygen demand (BOD).

According to detected data, the pressure of Tunca River on the Meriç River was presented and the pollution levels of the investigated rivers were recorded as; Tunca River > Meriç River in general. According to data observed, nitrite and phosphate concentrations in water of Meriç and Tunca Riveris were detected in high levels and exceed the critical limit values.

The detected data clearly reveals that agricultural runoff caused from intensive fertilizer applications and municipal sewage water caused from settlement areas are the main pollution sources for the system.

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