

SPATIO-TEMPORAL SULPHATE ACCUMULATIONS IN WATER OF FELENT STREAM (KÜTAHYA, TÜRKİYE)

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Abstract

Felent Stream is one of the most significant branches of Porsuk Stream (sub-basin of Sakarya River). It is affected by wastes of industrial, agricultural and thermal springs of Kütahya Province. In this research, spatio-temporal distributions of sulphate (SO₄) levels in water of Felent Stream were investigated. For this purpose, 7 stations including up-mid-downstream locations and lentic – lotic components were selected. Water samples were collected in wet and dry seasons of 2022. Also, Cluster Analysis (CA) was applied to detected data in order to classify the stations in terms of SO₄ contents. According to detected data, SO₄ levels were recorded between 65 – 146 ppm in the wet season, while they were found between 71 – 171 ppm in the dry season. As a result of applied CA, 2 statistically significant clusters were formed named as "Relatively more contaminated zone" and "Relatively less contaminated zone".

Keywords: Felent Stream, Water quality, Sulphate accumulation.

INTRODUCTION

Riverine habitats are significant components of the biosphere. They play an important role as a receiving environment of anthropogenic sourced wastewaters. Seasonal variations of rainfall and surface runoff have a strong effect on fluvial discharges. Permanent water quality monitoring of lotic ecosystems helps to assess the pollution sources, provide an effective management and protect the aquatic life [1 – 5].

Felent Stream is one of the most important branches of Porsuk Stream, which is the most important sub-basin of Sakarya River Basin. It is known to be exposed to significant pollution including agricultural and industrial activities, thermal tourism stress and wastes of settlement areas [6 – 11].

Sulphate (SO₄) concentrations in freshwater habitats have increased all over the world in especially last few decades. However, the extent of increased SO₄ concentrations in freshwater and terrestrial

ecosystems remain poorly understood regarding many aspects of ecosystem structure [12 – 14].

The aim of this study was to determine the spatio-temporal variability of sulphate in water of Felent Stream.

MATERIALS AND METHODS

1. Study Area

Felent Stream has a length of 35 km and the average flow rate of the stream is 0.56 m³/s. It is the most important branch of Porsuk Stream and affected by wastes of industrial, agricultural and thermal springs of Kütahya Province [6 – 11]. The study area and selected stations on the Felent Stream are given in Figure 1. Water samples were collected in wet and dry seasons of 2022.

2. Measurement of Sulphate

Sulphate (SO₄) parameter was measured by using Hach branded (DR 3900) Spectrophotometer Device.

3. Cluster Analysis

CA was applied to detected data by using PAST statistical packed program in

order to classify the stations in terms of SO_4 contents.

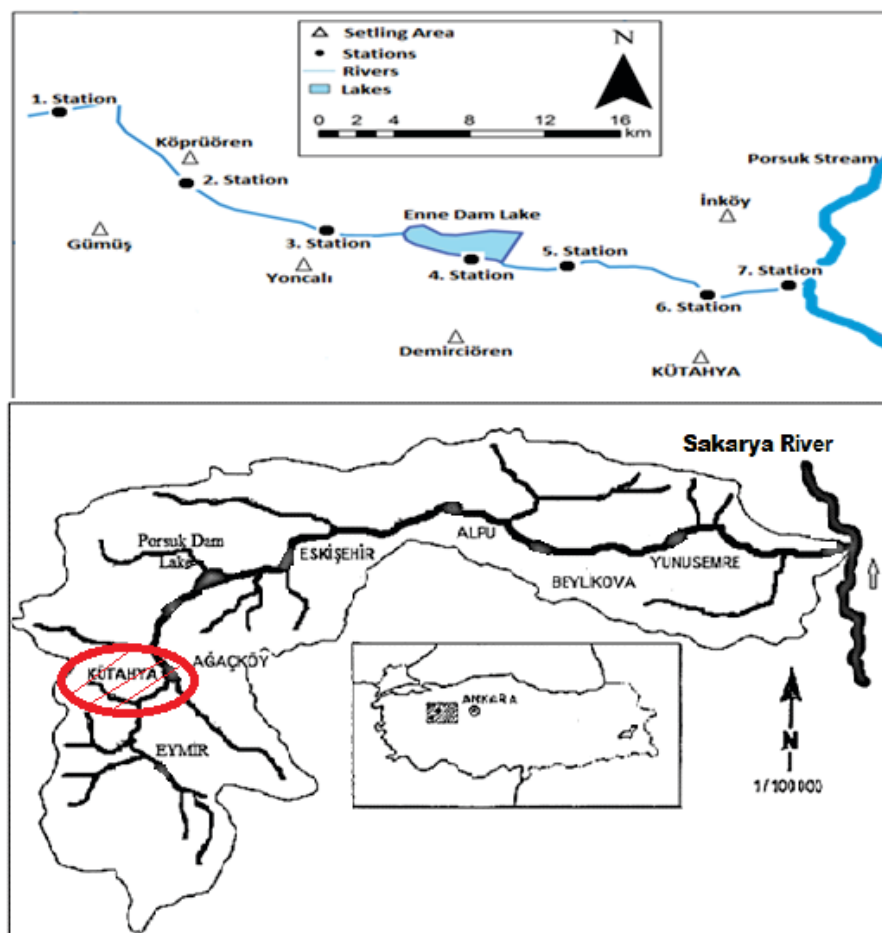


Fig. 1. Felent Stream and selected stations

RESULT AND DISCUSSION

Spatio-temporal sulphate distributions in water of Felent Stream are given in Figure 2. According to detected data, SO_4 levels were recorded between 65 (F1) – 146 (F5) ppm with an average of 110 ppm in the wet season, while they were found between 71 (F1) – 171 (F7) ppm with an average of 127 ppm in the dry season. In general, it was also noted that sulphate values increased by approximately 16% in water of Felent Stream during the dry season.

The lowest SO_4 contents were detected in the Enne Dam Lake (F4), which is the only lentic habitat of the basin. In addition, except for the Yoncalı Region (F3), which is exposed to intense thermal tourism pressure, it has been determined that the sulphate contents recorded in the downstream waters (F5, F6 and F7) are generally higher than those in the upstream

waters (F1 and F2).

Although sulphate accumulations were recorded at quite high levels in the Yoncalı Region and the lower basin, according to the Turkish Regulations (2012), Felent Stream has 1st – 2nd class water quality in terms of SO_4 levels (< 200 ppm) and any of the detected data did not exceed the Turkish Standards (2007) drinking water limit value (< 250 ppm) [15, 16].

When we compare our current study data with similar studies conducted in the fluvial habitats of Türkiye, although the SO_4 contents detected in the water of the Felent Stream are generally lower than the data detected in the water of Emet Stream, they are higher than those of the Tunca, Meriç, Ergene Rivers and Anadere, Çorlu, Kınık, Dursunbey, Seydisuyu and Şehirban Streams [17 – 21] (Table 1).

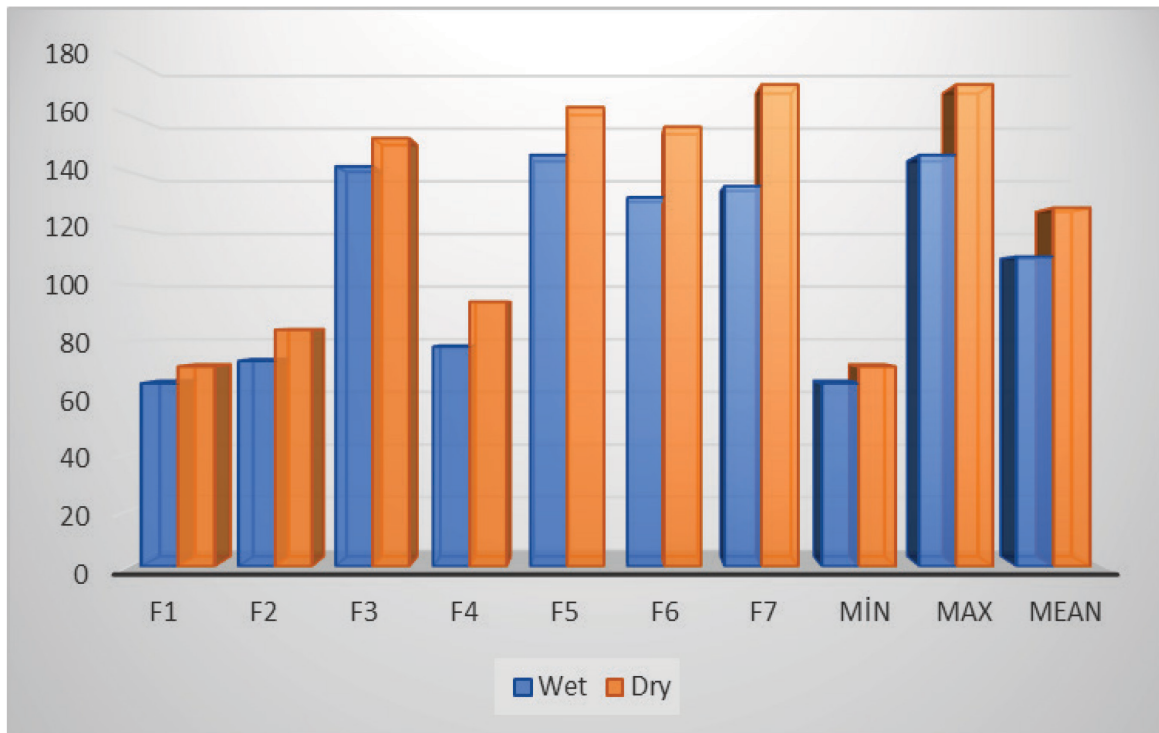


Fig. 2. Sulphate levels in water of Felent Stream

Table 1. Comparison of sulphate data

Habitat	SO ₄ Level (ppm)	Reference
Felent Stream	119	Current study
Şehriban Stream	34	[17]
Tunca River	75	[18]
Meriç River	77	[18]
Ergene River	82	[18]
Anadere Stream	51	[18]
Çorlu Stream	105	[19]
Kınık Stream	16	[20]
Dursunbey Stream	6	[20]
Emet Stream	176	[20]
Seydisuyu Stream	61	[21]

According to the results of applied CA, 2 statistically significant clusters were formed (Figure 3). Cluster 1 (C1) was named as "Relatively more contaminated zone" that was corresponded to the stations of F3, F5, F6 and F7. Cluster 2 (C2) was named as "Relatively less contaminated zone" that was corresponded to the stations of F1, F2 and F4 (Table 2).

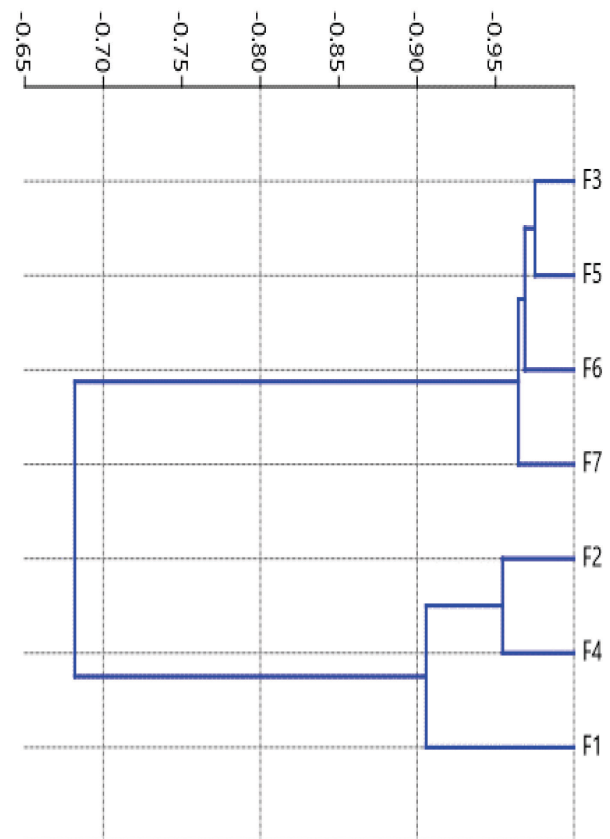


Fig. 3. CA dendrogram

Table 2. Similarity and distance indices results

	F1	F2	F3	F4	F5	F6	F7
F1	1.00000						
F2	0.92833	1.00000					
F3	0.63256	0.69623	1.00000				
F4	0.88312	0.95441	0.73820	1.00000			
F5	0.61124	0.67382	0.97512	0.71518	1.00000		
F6	0.64303	0.70721	0.97418	0.74946	0.96309	1.00000	
F7	0.61538	0.67819	0.95667	0.71967	0.96911	0.96796	1.00000

CONCLUSION

In this study, the spatio-temporal distribution of sulphate contents in waters of Felent Stream were investigated.

According to the results obtained, it was determined that the SO₄ contents of the lower basin (F5, F6 and F7 stations) and the Yoncalı Region (F3 station) were higher than those in the upper basin (F1, F2 and F4), and according to the results of applied CA, these locations formed a separate cluster (Relatively more contaminated zone).

Additionally, during the dry season, increases in sulphate values were generally recorded in all the basin waters.

Despite this, it was determined that the SO₄ values determined in the waters of the Felent Stream did not exceed the limit values at any station, in any season investigated.

This study is also important as it shows the importance of permanent water quality monitoring studies to protect and ensure the sustainability of freshwater ecosystems.

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