Evaluation of the Quality of Environmental Factors, Soil and Water in the Parang Mountains, Romania

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This paper aims to assess the quality of environmental factors, soil and water in the Parang Mountains (Meridional Carpathians). To determine the degree of soil pollution areas: Baile Olăne'ti, Calimanesti-Caciulata, Voineasa, Obarsia Lotrului, Transalpina and Baile Govora, were sampled on two levels deep. To characterize the surface water samples were taken from rivers: Olanesti, Olt, Lotru, Hinta and Govora. In soil samples analyzed, it was found generally insignificant soil pollution with heavy metals (nickel, copper, cadmium, lead, zinc, chromium) and sulfates. There was a significant potential pollution with Total petroleum hydrocarbons (downstream the city Olanesti, 4 km upstream the city Caciulata) and a significant pollution with Total petroleum hydrocarbons (upstream the city Baile Olanesti and 4 km downstream the locality Obarsia Lotrului). In water samples, ammonia had values between 0.1 and 0.63 mg / L, nitrates values between 0.03 - 2.42 mg / L, nitrites values between 0.03 to 2.48 mg / L, phosphorus values between 0.02 to 1.36 mg / L. Also, there was not found a load of inorganic chlorides, calcium, sodium and sulfates and organic load (COD), all indicators complying with the limits of classes 1st and 2nd of quality. Exception did Hinta and Govora creeks that due to the mineral springs in the area had a high inorganic loading.

Keywords: environmental factors, surface water, soil

Surface water quality is variable in time due to natural or anthropogenic sources of contamination, which requires permanent monitoring of parameters that define water quality. Surface waters are receptors of the wastewater tributaries and pluvial water that significantly influence the chemical composition. In most cases, domestic and industrial wastewater is treated in wastewater treatment plants more or less modernized [1].

Water pollution can produces and its unorganized tourism in places situated on the river banks, lakes and groundwater, in the area with mineral character, where tourists through the garbage left, may contribute to decreased quality of surface water or groundwater. The spa treatments based on existing chemicals in mineral waters, sludge, various herbal medicinal procedures used in various medical procedures leading to erosion pipes equipment and medical supplies. Tourists behaviour to throw garbage anywhere, especially in lakes, rivers, streams and marine waters increases the concentration of coli form bacilli that can cause various diseases. It is required the use of detergents with low as phosphates, chlorine for bleaching lingerie in accommodation establishments and public alimentation. This form of pollution affects mainly by expanding the tourism arrangement and transport, which causes withdrawal from of some important forest and agricultural areas (realization of parking, fuel supply stations). Soils are mainly affecting the quantities of solid waste that can affect their quality as well as the multitude of recreational structures - ski, sports, cable transport installations etc.. For example, many foreign expeditions that go to the different Himalayan peak, each year are reported to have left a great deal of garbage in the mountains which pollute the environment. Increase in non-biodegradable solid waste such as batteries, bottles and others results in environment pollution. Unmanaged solid waste and open defecation may contaminate drinking water. Trails, campsites and other infrastructures are vulnerable to landslide and erosion due to fragile geology of that area which is side effect of tourism. The pollution problem is now no longer confined to solid waste. Water resources along the trails are being contaminated from improper discharge, human waste and garbage dumping. Sewage and toilet waste can be found piped into nearby streams and rivers [2].Sources of pollutants are: 1) human waste (toilet) disposed to the water bodies, 2) different type of litter employed in the agriculture field, and 3) solid waste, human wastes (excreta) and solid waste disposal mainly by tourists.

Non-scientific solid waste management, open defecation and poor condition of septic tanks, and direct disposal of toilet waste to water courses or on the exposed surface, are major sources of surface water pollution. High solid waste generation due to high tourism flow, no proper management practice of solid waste, open defecation, starting the use of chemical fertilizer, construction of garbage pit near to the water coarse are found the root causes for water pollution. Improvement in the conditions of toilets and septic tanks can prevent the pollutants from sources to the water bodies [2, 3].

Water use has so far been neglected compared to carbon but is likely to become an important parameter of

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sustainable tourism in the foreseeable future, not only where water is currently scarce but also where climate change is expected impact local water resources [4, 5].

As emphasized by the World Tourism Organization (WTO), tourism operations in protected areas need to be carefully planned, managed and monitored to ensure their long-term sustainability. Otherwise, such operations will have negative consequences, and tourism will contribute to the further deterioration of these areas. While the negative effects of tourism are of significant concern, many protected areas have promoted tourism development to improve their economic conditions, particularly to generating revenue to finance other social and economic development activities and to provide direct income and employment opportunities for local people. The debate on the limits of growth is not new; it has existed since the 1930s in the case of the tourism sector [6].

Despite the long history of recreation ecology, the field has become stagnant due to a lack of theory-based research or work that builds on previous work. Historically, recreation ecology assessments have focused on less developed wild-land settings where managers must rely more on preventing recreation impacts due to limitations on facility development [7].

Studies have been performed which tried to identify the environmental impact of human disturbances caused by water study of several lakes mountain [8-10] and concluded that the water has a good quality although these lakes are visited by many tourists.

In some studies to determine the potential risk of thermal waters on the environment because they can leach into groundwater and nearby soils can become alkaline due to accumulation of salts [11].

This paper aims at monitoring water and soil environment factors in the Parang Mountains (Meridional Carpathians). To determine the degree of soil pollution areas: Baile Olanesti, Calimăneşti-Caciulata, Voineasa, Obarsia Lotrului, Transalpina and Baile Govora, were sampled on two levels deep. To characterize the surface water samples were taken from rivers: Olaneşti, Olt, Lotru, Hina and Govora.

Experimental part

Areas studied

This paper aims at monitoring water and soil environment factors in areas with seasonal growth and development of tourism activities. To determine the degree of soil pollution areas: Baile Olanesti, Calimăneşti-Caciulata, Voineasa, Obarsia Lotrului, Transalpina and Baile Govora, were sampled on two levels deep. To characterize the surface water samples were taken from rivers: Olaneşti, Olt, Lotru, Hina and Govora (fig.1).

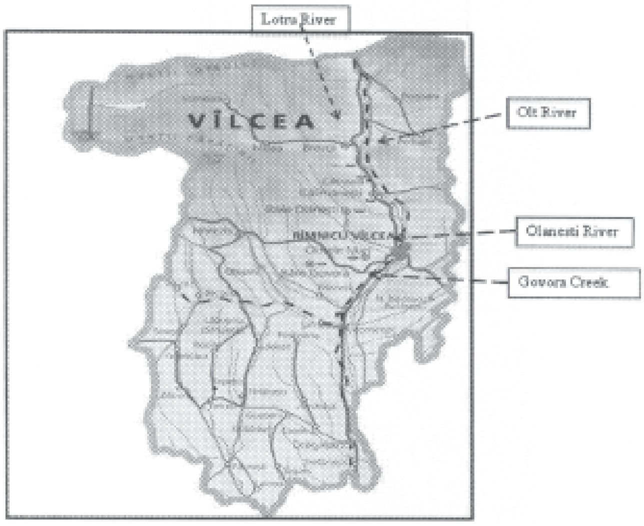

Fig. 1.Localization rivers

Methods of analysis

Soil Analysis

In August 2013, were sampled soil of 18 points, two levels of depth (0-10 cm and 30-40 cm) and were determined indicators: *p*H, cadmium, nickel, copper, zinc, lead, chromium, mercury, sulphates and Total petroleum hydrocarbons (table 1). The soil samples collected were analysed using standard methods of analysis: electrochemical method for *p*H, atomic absorption spectrometry method for metals, gravimetric method for sulphates and total petroleum hydrocarbons.

Water Analysis

To characterize the surface water, samples were taken from rivers: Olanesti, Olt, Lotru, Hinta and Govora and were determined: pH, COD, BOD5, ammonia, nitrite, nitrate, Total phosphorus, detergents, Filterable residue at 105°C, chloride, calcium, sodium, iron (table 2).The methods were used: volumetric method for COD, chloride and calcium, electrochemical method for *p*H, BOD5, spectrophotometric method for ammonia, nitrite, nitrate, total phosphorus, detergents and Iron, flam photometric method for sodium and gravimetric method for filterable residue.

Table 1
SOIL SAMPLING POINTS

Sample designation	Soil samples - sampling point
S1	The city of Comanca, 2 km upstream the city Baile Olanesti
S2	The city Baile Olanesti
S3	The village Pausesti – Maglasi, 5 km downstream the city Baile Olanesti
S4	The village Pausesti, 10 km downstream the city Baile Olanesti
S5	2 km upstream the locality Caciulata
S6	4 km upstream the locality Caciulata
S7	The city Brezoi, before the discharge into the Lotru river in the Olt river
S8	5 km downstream the city Voineasa
S9	500 m upstream the city Voineasa
S10	4 km downstream the locality Obarsia Lotrului
S11	500 m upstream the locality Obarsia Lotrului
S12	5 km upstream the locality Obarsia Lotrului
S13	Transalpina - altitude of 1700 m
S14	Transalpina - altitude of 2145 m (The Peak Lespezi)
S15	Transalpina - altitude of 2135 m
S16	The locality Ranca
S17	The locality Novaci
S18	The city Govora

Sample designation	Water samples - sampling point
P1	The Olanesti River, 2 km upstream the city Baile Olanesti
P2	The Olanesti River, city Baile Olanesti
P3	The Olanesti River, 2 km downstream the city Baile Olanesti
P4	The Olanesti River, 5 km downstream the city Baile Olanesti
P5	The Olanesti River, 10 km downstream the city Baile Olanesti
P6	The Olt River, locality Calimanesti
P7	The Olt River, 100 m downstream the locality Calimanesti
P8	The Olt River, 2 km upstream the locality Caciulata
P9	The Olt River, 4 km upstream the locality Caciulata
P10	The Lotru River, before the discharge into the Olt river
P11	The Lotru River, locality Malaia
P12	The Lotru River, 5 km downstream the city Voineasa
P13	The Lotru River, 500 m upstream the city Voineasa
P14	The Lotru River, 4 km downstream the locality Obarsia Lotrului
P15	The Lotru River, 500 m upstream the locality Obarsia Lotrului
P16	The Lotru River, 5 km upstream the locality Obarsia Lotrului
P17	The Hinta Creek, the city Baile Govora
P18	The Hinta Creek, downstream the city Baile Govora
P19	The Govora Creek, before the confluence with the Hinta Creek
P20	The Govora Creek, after the confluence with the Hinta Creek

Table 2
WATER SAMPLING POINTS

Results and discussions

Characterization of soil

The analyses were compared with the national legislation regulations (table 3), [12] (Order No. 756/1997).

Table 4 shows the concentrations of the analysed indicators in soil samples.

From the soil samples analysed upstream and downstream of the Baile Olanesti, were found insignificant soil pollution with heavy metals (nickel, copper, cadmium, lead, zinc, chromium and mercury) and sulphates. There was a significant pollution potential with Total petroleum hydrocarbons (downstream of the resort) and a significant pollution Total petroleum hydrocarbon (upstream of the resort - Comanca).

In soil collected upstream and downstream of the Calimanesti-Caciulata was found insignificant soil pollution with heavy metals (nickel, copper, cadmium, lead, zinc, chromium), sulfates and potentially serious pollution with total petroleum hydrocarbons (4 km upstream the locality Caciulata).

From the soil samples analyzed upstream and downstream of the locality Voineasa and Obarsia Lotrului was found insignificant soil pollution with heavy metals (nickel, copper, cadmium, lead, zinc, chromium and mercury) and sulphates. At the 4 km downstream of the Obarsia Lotrului there was a significant pollution with Total petroleum hydrocarbons. Also, to the 500 m upstream the Voineasa city was a potentially serious pollution with Total petroleum hydrocarbons. In soil collected upstream and downstream of Obarsia Lotrului revealed a higher content in nickel and chromium; these values are due to the soil characteristics.

In soil analyzed upstream and downstream of the Transalpina was found a non-significant soil pollution with heavy metals (nickel, copper, cadmium, lead, zinc and mercury), sulphates and total petroleum hydrocarbons. In soil collected from an altitude of 1700 m, 2145 m - Lespezi Peak and 2135 m - Urdele Pass, have been found higher concentrations of chromium, values that are found in natural background in the area. In soil samples taken from the Transalpina was observed acidity of the soil, *p*H having values between 5.08 and 5.89.

In the soil samples analyzed from Baile Govora was found non-significant soil pollution with heavy metals (copper, cadmium, lead, zinc), sulphates and total petroleum hydrocarbons and potentially significant pollution with nickel and chrome.

Characterization of surface water

In water samples collected from the Olanesti River was not found any pollution by ammonium, nitrate, nitrite, total phosphorus, detergents but was found higher load iron (2nd and 3rd class of quality). Also there was a loading of inorganic chlorides, calcium, sodium and sulphates and no organic load expressed in COD, with one exception in point at 10 km downstream from Baile Olanesti where COD, was assigned to the 3rd class of quality.

In the Olt River was not found pollution with ammonia, nitrite, nitrate, total phosphorus, detergents. Also, there was not found a load of inorganic chlorides, calcium, sodium and sulphates, organic load expressed in COD, all indicators complying with the limits of 1st and 2nd classes of quality, made exception, point P7 (100 m downstream the Căciulata) where chlorides were within the 3rd class of quality.

Indicators analysed	Normal value	Thresholds Alert (PA) Types of uses (mg / kg DRY WEIGHT)		Thresholds for Intervention (PI) Types of uses (mg / kg DRY WEIGHT)	
		Sensitive	Less sensitive	Sensitive	Less sensitive
pH	-	-	-	-	-
Ni	20.0	**75.0**	200.0	**150.0**	500.0
Cd	1.0	**3.0**	5.0	**5.0**	10.0
Cu	20.0	**100.0**	250.0	**200.0**	500.0
Pb	20.0	**50.0**	250.0	**100.0**	1000.0
Zn	100.0	**300.0**	700.0	**600.0**	1500.0
Cr (total)	30	**100**	300	**300**	600
Hg	0.1	**1**	4	**2**	10
SO_4^{2-}	-	-	-	-	-
Total hydrocarbons from oil (THP)	*< 100*	***200***	*1000*	***500***	*2000*

Table 3
REFERENCE VALUES IMPOSED BY ORDER NO. 756/1997

Sample designation	Level	Quality indicators analysed								
		pH	Cd	Ni	Cu	Zn	Pb	Cr	SO_4^{2-}	THP
S_1	I	6.47	<0.1*	7.68	22.9	59.4	<1.0*	24.10	0.0	45.0
	II	6.8	<0.1*	11.9	14.9	43.6	<1.0*	16.0	0.0	590.0
S_2	I	6.54	<0.1*	<1.0*	5.04	49.8	<1.0*	19.2	0.0	20.0
	II	6.71	<0.1*	<1.0*	4.75	40.6	<1.0*	19.6	0.0	35.0
S_3	I	6.59	<0.1*	22.4	15.2	54.9	<1.0*	31.4	0.0	230.0
	II	6.64	<0.1*	32.6	14.5	58.9	<1.0*	26.2	0.0	60.0
S_4	I	7.52	<0.1*	11.57	14.5	62.2	<1.0*	34.7	0.0	45.0
	II	7.31	<0.1*	11.7	5.0	69.5	<1.0*	20.66	0.0	350.0
S_5	I	7.14	<0.1*	45.6	<1.0*	23.2	12.1	23.7	0.0	200.0
	II	7.28	<0.1*	51.2	<1.0*	52.7	<1.0*	6.31	0.0	180.0
S_6	I	7.10	<0.1*	41.8	111.9	49.9	<1.0*	16.05	0.0	270.0
	II	7.21	<0.1*	41.8	24.5	83.7	<1.0*	16.07	0.0	15.0
S_7	I	7.34	<0.1*	<1.0*	<1.0*	29.7	<1.0*	20.7	0.0	45.0
	II	7.28	<0.1*	<1.0*	<1.0*	45.3	<1.0*	17.03	0.0	55.0
S_8	I	7.22	<0.1*	22.6	<1,0*	23.9	<1.0*	26.6	0.0	50.0
	II	7.2	<0.1*	21.6	<1.0*	36.3	<1.0*	24.4	0.0	60.0

* The limit of detection of the method

Table 4a
CHARACTERIZATION OF SOIL (mg/kg *DRY WEIGHT*)

Sample designation	Level	Quality indicators analysed								
		pH	Cd	Ni	Cu	Zn	Pb	Cr	SO_4^{2-}	THP
S_9	I	7.21	<0.1*	<1.0*	15.1	64.9	<1.0*	21.36	0.0	350.0
	II	6.68	<0.1*	<1.0*	22.5	70.6	12.7	28.7	0.0	330.0
S_{10}	I	7.21	<0.1*	<1.0*	6.2	36.5	<1.0*	25.7	0.0	680.0
	II	6.89	<0.1*	90.16	4.48	50.2	<1.0*	<1,0*	0.0	1130.0
S_{11}	I	5.86	<0.1*	56.7	<1.0*	54.7	<1.0*	17.6	0.0	193.0
	II	6.02	<0.1*	48.0	5.81	53.6	<1.0*	7.34	0.0	151.0
S_{12}	I	5.89	<0.1*	31.6	14.7	42.9	<1.0*	15.97	0.0	34.0
	II	5.62	<0.1*	32.1	14.9	47.1	<1.0*	21.12	0.0	144.0
S_{13}	I	5.89	<0.1*	22.9	5.31	20.7	0.14	268.0	0.0	10.0
	II	5.62	<0.1*	45.8	5.54	32.6	<1.0*	49.8	0.0	0.0
S_{14}	I	5.68	<0.1*	12.57	<1.0*	3.01	14.76	62,5	0.0	0.0
	II	5.48	<0.1*	12.5	5.37	3.0	<1.0*	122.1	0.0	0.0
S_{15}	I	5.56	<0.1*	<1.0*	<1.0*	2.78	<1.0*	140.1	0.0	0.0
	II	5.32	<0.1*	<1.0*	<1.0*	18.7	<1.0*	164.5	0.0	0.0
S_{16}	I	5.21	<0.1*	<1.0*	<1.0*	39.3	14.9	63.14	0.0	0.0
	II	5.08	<0.1*	<1.0*	<1.0*	25.03	15.0	<1.0*	0.0	0.0
S_{17}	I	5.12	<0.1*	12.03	<1.0*	37.24	14.0	59.8	0.0	0.0
	II	5.32	<0.1*	11.06	5.08	50.2	13.9	58.9	0.0	0.0
S_{18}	I	8.21	<0.1*	63.7	45.3	100.0	25.9	60.5	0.0	10.0
	II	8.36	<0.1*	96.5	76.9	130.0	26.5	120.9	0.0	0.0

* The limit of detection of the method

Table 4b
CHARACTERIZATION OF SOIL (CONTINUATION) (mg/kg *DRY WEIGHT*)

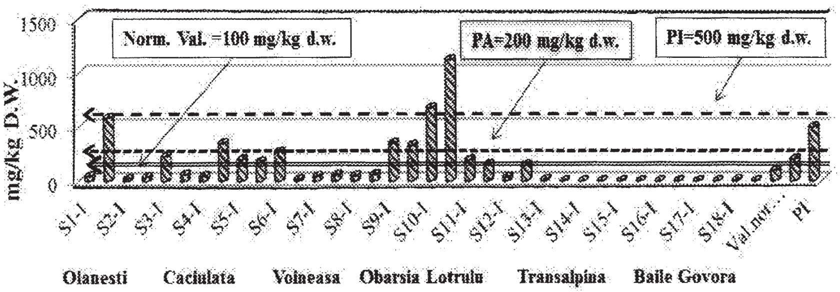

Fig. 2. Total petroleum hydrocarbon content in soil

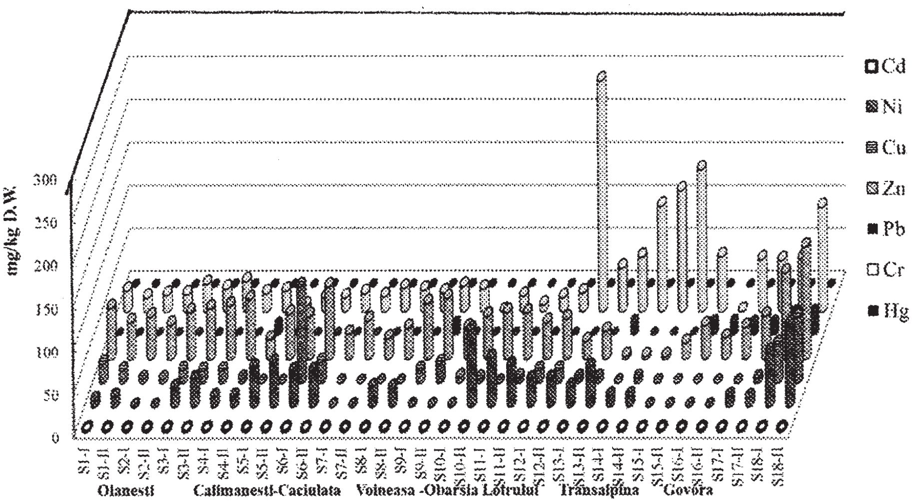

Fig.3. Metals content in the soil

Indicators	U.M.	1st Class	2nd Class	3rd Class	4th Class	5th Class
$N\text{-}NH_4^+$	mg/L	0.4	0.8	1.2	3.2	>3.2
$N\text{-}NO_3^-$	mg/L	1	3	5.6	11.2	>11.2
$N\text{-}NO_2^-$	mg/L	0.01	0.03	0.06	0.3	>0.3
Pt	mg/L	0.15	0.4	0.75	1.2	>1.2
COD	mgO_2/L	10	25	50	125	>125
BOD-5	mgO_2/L	3	5	7	20	>20
pH	Unit.pH			6.5-8.5		
Rezid.	mg/L	500	700	1000	1300	>1300
Cl^-	mg/L	25	50	250	300	>300
SO_4^{2-}	mg/L	60	120	250	300	>300
Ca^{2+}	mg/L	50	100	200	300	>300
Na^+	mg/L	25	50	100	200	>200
Detergents	mg/L	0.1	0.2	0.3	0.5	>0.5
Fe	mg/L	0.3	0.5	1	2	>2

Table 5
CLASSIFICATION OF SURFACE WATER QUALITY BY ORDER 161/2006 [13]

Sample designation		Quality indicators analysed							
		pH	Rezid.	Cl^-	SO_4^{2-}	Ca^{2+}	Na^+	Detergents	Fe
Olanesti River	P_1	7.53	260	10.3	21.8	22.4	4.04	<0.01*	0.68
	P_2	7.47	270	10.3	21.8	24.0	4.04	<0.01*	0.68
	P_3	7.44	410.0	14	26.4	28.8	8.0	<0.01*	0.43
	P_4	7.40	340.0	17.7	29.5	34.4	18.16	<0.01*	1 .14
	P_5	7.50	240.0	17.7	32.5	32.0	17.15	<0.01*	0.43
Olt River	P_6	7.28	172.0	31.9	31.03	32.0	19.17	<0.01*	0.13
	P_7	6.52	208.0	67.3	27.9	36.0	30.25	<0.01*	0.14
	P_8	6.95	140.0	35.4	25.65	32.0	20.17	<0.01*	<0.01*
	P_9	6.54	160.0	35.4	26.4	44.0	20.17	<0.01*	0.17
Lotru River	P_{10}	7.12	228.0	10.6	29.5	18.4	5.05	<0.01*	0.04
	P_{11}	6.85	190.0	10.7	26.4	12.8	1.52	<0.01*	0.10
	P_{12}	7.23	244.0	14.0	28.0	16.0	5.05	<0.01*	0.17
	P_{13}	7.46	192.0	35.4	32.5	20.0	6.06	<0.01*	0.36
	P_{14}	6.90	198.0	10.6	20.3	14.4	0.0	<0.01*	<0.01*
	P_{15}	7.40	232.0	7.0	18.7	16.0	0.0	<0.01*	<0.01*
	P_{16}	7.72	216.0	3.5	15.6	24.0	0.0	<0.01*	<0.01*
Hinta Creek	P_{17}	6.52	980	198.5	618.4	120	145.9	<0.01*	0.17
	P_{18}	6.78	5340	2694	194.7	156.3	790.3	0.024	0.024
Govora Creek	P_{19}	7.31	1290	425.4	130.3	120.2	242.6	0.024	0.49
	P_{20}	7.28	1400	538.9	136.4	108.2	291.8	0.089	0.69

* The limit of detection of the method

Table 6
CHARACTERIZATION OF SURFACE WATER (mg/L)

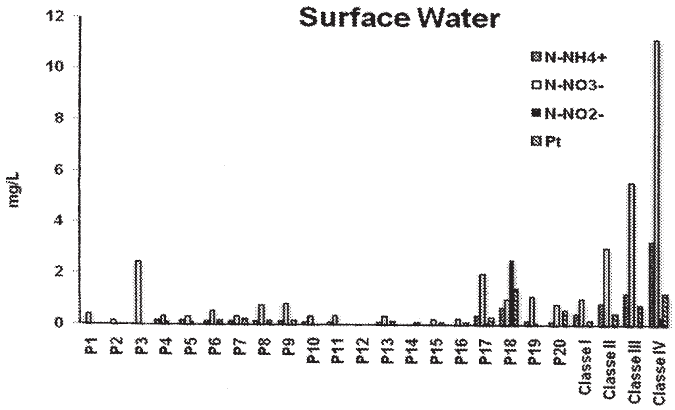

Fig. 4. Concentration of ammonium, nitrates, nitrites and total phosphorus in the surface water

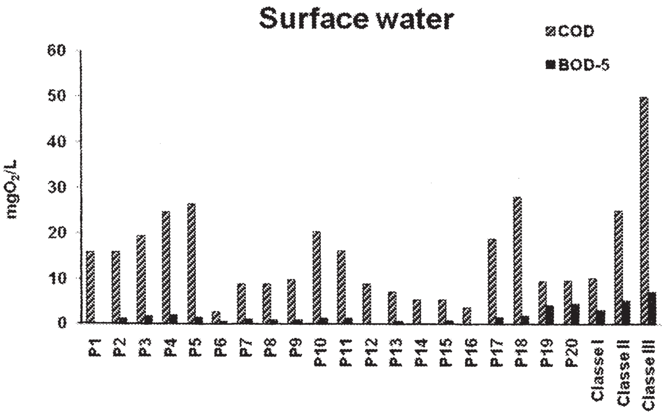

Fig. 5. Concentration of COD and BOD- 5 in surface water (mgO_2/L)

In water samples collected from the Lotru River was not found any pollution by ammonium, nitrate, nitrite, total phosphorus, detergents. Also there was a loading of inorganic chlorides, calcium, sodium and sulphates and no organic loading expressed in the COD, all indicators complying with the 1st and 2nd class of quality.

Generally, in water samples taken from the Hinta Creek, was not found any pollution by ammonium, nitrate, detergents. Downstream of the resort was a loading of nitrite and phosphorus total (the 5th class of quality) and was a loading of inorganic chlorides, sodium and filterable residue (the 5th class of quality) and an organic loading expressed in the COD (3rd class of quality). Inorganic load is on the sulphur, sodium chlorate and sulphur, bicarbonate (sulphate), sodium (calcium) springs.

In water samples collected from the Govora Creek was not found any pollution by ammonium, nitrate, total phosphorus, detergents. Downstream the resort and after discharge the Hinta Creek in the Govora Creek, was a loading of inorganic chlorides, sodium and filterable residue (the 5th class of quality). The inorganic load originates from the Hinta Creek. The upstream the Baile Govora was a nitrite load (3rd class of quality). This the nitrogen load can be explained by the fact that around the Baile Govora there are many households.

Conclusions

This paper aims to assess of the quality of environmental factors, soil and water in the Parang Mountains (Meridional Carpathians).

In soil samples analyzed, it was found generally insignificant soil pollution with heavy metals (nickel, copper, cadmium, lead, zinc, chromium) and sulfates. There was a significant potential pollution with Total petroleum hydrocarbons (downstream the city Olanesti, 4 km upstream the city Caciulata, 500m upstream the city Voineasa) and a significant pollution with Total petroleum hydrocarbons (upstream the city Baile Olanesti and 4 km downstream the locality Obarsia Lotrului). This pollution is due to untended parking lots and by car stationary on vegetal carpet.

In generally, in surface water, was not found pollution with ammonium, nitrate, nitrite, total phosphorus, detergents. Also, there was not found a load of inorganic chlorides, calcium, sodium and sulfates and organic load expressed in COD, all indicators complying with the limits of classes 1^{st} and 2^{nd} of quality. In the Hinta Creek, downstream the Baile Govora, was found load of a total phosphorus and nitrite (the 5^{th} class of quality) and a load of inorganic chlorides, sodium and filterable residue (the 5^{th} class of quality) and organic loading expressed in COD (the 3^{rd} class of quality). The inorganic loading chlorinated water is date sodium and sulfur, bicarbonate (sulphate), sodium (calcium), from springs. In the Govora Creek, downstream the Baile Govora, was found load of inorganic chlorides, sodium and filterable residue (the 5^{th} class of quality). The inorganic load originates from the Hinta Creek. In the upstream the Baile Govora was found a nitrite load (the 3^{rd} class of quality).

Episodes of pollution represents a cumulative effect of seasonal tourism activities and activities (household and industrial) developed in those areas.

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