

## Abundance and biomass of fishes in the Veleka River, Bulgaria

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Received 6 January 2003; Accepted 23 February 2004

**A b s t r a c t.** A total of 16 fish species have been identified in the Veleka River and its tributaries the Mladezhka River and the Aydere River. Three of the species are included in the Red Data Book of Bulgaria: *Anguilla anguilla*, *Chalcalburnus chalcoides* and *Rutilus frisii*. Mean abundance (N) and mean biomass (B) of fishes were as follows: 3093 ind. ha<sup>-1</sup> and 68.19 kg ha<sup>-1</sup> in the Veleka River, 1220 ind. ha<sup>-1</sup> and 16.73 kg ha<sup>-1</sup> in the Mladezhka River, and 1025 ind. ha<sup>-1</sup> and 41.18 kg ha<sup>-1</sup> in the Aydere River. The values obtained were much lower than the values of N and B of fishes in nine other Bulgarian rivers. The main reasons for the low fish abundance and biomass in the Veleka River and its tributaries were the intensive development of tourist industry in the region and the intensive, practically uncontrolled commercial and sport fishing and poaching.

**Key words:** Black Sea basin, fish stocks, rare species, protected species

### Introduction

Although the Veleka River is one of the biggest Bulgarian rivers emptying directly into the Black Sea, so far only the fish species composition in the river has been studied. Drensky (1951) reported on 20 fish species in the river. The ichthyofauna of the Veleka River was studied most extensively by Karapetkova (1975). She found 20 resident species in the river and 12 migrant species from the Black Sea. The most abundant species were *Barbus tauricus*, *Leuciscus cephalus* and *Vimba vimba*.

The present research aims to establish the abundance and biomass of fishes in the Veleka River and its tributaries the Mladezhka River and the Aydere River.

### Study Area

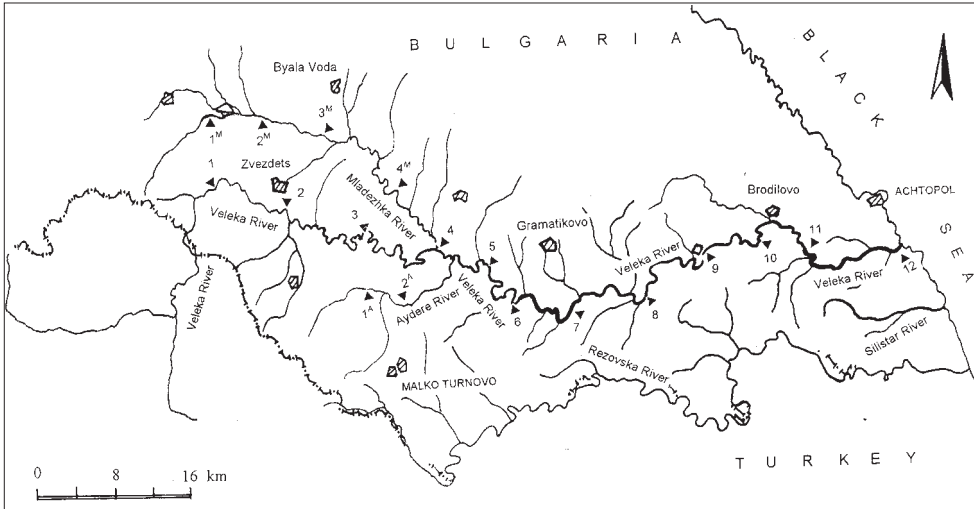
The Veleka River is 147 km long. It flows from many karst springs on the territory of Turkey near Kovchaz village in the Strandzha Mountains and empties directly into the Black Sea. Its catchment area is about 995 km<sup>2</sup>, 33% of which belongs to the rivers Mladezhka and Aydere (Fig. 1).

In its upper reaches the river valley is narrow and deep with very steep slopes (up to 33%). The slopes are afforested with cerris oak, maple, oak, beech, etc. Near the mouth of the Mladezhka River the height and the slope of the banks considerably decrease and the forests are replaced by cultivated land.

The mean annual discharge of the Veleka River is about 2.42 m<sup>3</sup> s<sup>-1</sup> near Zvezdets village, reaching 8.3 m<sup>3</sup> s<sup>-1</sup> near Gramatikovo village. There are large seasonal fluctuations in discharge. The mean annual water temperature of the river is 11 °C, range 0 °C to 26.5 °C. The water is slightly alkaline, pH varies between 7.2 and 8.8. Total sum of ions is 242 mg l<sup>-1</sup>. General and carbonate hardness are 7.49 meq l<sup>-1</sup> and 9.26 dH°. Biological oxygen demand is 3.1 mg O<sub>2</sub> l<sup>-1</sup>, varying between 1.5 and 6.5 mg O<sub>2</sub> l<sup>-1</sup>.

The outflow zone of the river, regardless of the direct and constant connection with the sea, has a mixooligohaline- $\beta$ -oligohaline regime (K a r a p e t k o v a 1975). In the region along the Veleka River irrigation work is minimal and pollution caused by industrial effluents is negligible. However, the development of tourism has been extended recently and this has had a negative influence on the biology of the river.

Fishing was carried out at twelve sites in the Veleka River, four sites in the Mladezhka River and two sites in the Aydere River (Fig. 1).



**Fig. 1.** Map of the Veleka River drainage basin and the sites at the time of investigation.

The specific characteristics of different sites in the Veleka River were as follows: length from 18 to 120 m; width of 1–4 m (Aydere River), 2–8 m (Mladezhka River) and 6.5–15.0 m (Veleka River); depth of 0.1–0.8 m (Aydere River), 0.2–0.8 m (Mladezhka River) and 0.1–1.5 m (Veleka River). The bottom was covered with stones and sand (Sites 1<sup>A</sup>–2<sup>A</sup>, 1<sup>M</sup>–4<sup>M</sup>, 1–8), with mud (Site 9) or with sand and mud (Sites 10–12). Usually one of the banks was unwooded and gravel, and the other overgrown with alder (*Alnus* sp.) and willow (*Salix* sp.). Water temperature in August ranged between 12.5–19.0 °C (Sites 1<sup>M</sup>–4<sup>M</sup>), 17.5 °C (Sites 1<sup>A</sup>–2<sup>A</sup>), 16.5–20.5 °C (Sites 1–5) and 20–22 °C (Sites 6–12).

## Material and Methods

Fishes were caught in August 1995. DC electric-fishing was used (2 kW, 600 V, 10 A). It was carried out twice at each site by wading upstream between two stop nets using anode dipnets. Population abundance was estimated according to the method of S e b e r & L e C r e n (1967). Biomass was calculated using the formula suggested by M a h o n et al. (1979).

## Results

A total of 1303 fishes were caught. They belonged to the following species: *Anguilla anguilla*, *Alburnoides bipunctatus*, *Barbus tauricus*, *Chalcalburnus chalcoides*, *Gobio gobio*, *Leuciscus borysthenticus*, *Leuciscus cephalus*, *Rutilus frisii*, *Phoxinus phoxinus*, *Rhodeus*

*amarus*, *Vimba vimba*, *Cobitis taenia*, *Salmo trutta fario*, *Mesogobius batrachocephalus*, *Neogobius gymnotrachelus*, and *Neogobius melanostomus*.

Mean abundance of fishes in the rivers was as follows: 1220 ind. ha<sup>-1</sup> in the Mladezhka River; 1025 ind. ha<sup>-1</sup> in the Aydere River (Table 1); and 3903 ind. ha<sup>-1</sup> in the Veleka River (Table 2). Mean biomass was: 16.73 kg ha<sup>-1</sup> in the Mladezhka River; 41.18 kg ha<sup>-1</sup> in the Aydere River; and 68.19 kg ha<sup>-1</sup> in the Veleka River (Tables 1 and 2).

**Table 1.** Abundance (ind., numerator) and biomass (kg, denominator) of fish populations at the sites of the Mladezhka River and the Aydere River (Fig. 1) (data were converted to 1 ha water surface).

Species	Sites	Mladezhka River				Aydere River	
		1 <sup>M</sup>	2 <sup>M</sup>	3 <sup>M</sup>	4 <sup>M</sup>	1 <sup>A</sup>	2 <sup>A</sup>
<i>Salmo trutta fario</i>		<u>163</u> 9.29		<u>48</u> 5.07	<u>200</u> 34.71	<u>656</u> 56.53	<u>444</u> 21.51
<i>Phoxinus phoxinus</i>		<u>109</u> 0.38	<u>411</u> 1.37	<u>857</u> 2.26	<u>1686</u> 5.09	<u>906</u> 4.19	<u>44</u> 0.13
<i>Neogobius gymnotrachelus</i>			<u>685</u> 2.33	<u>262</u> 1.24	<u>400</u> 2.14		
<i>Leuciscus cephalus</i>					<u>57</u> 3.09		
Total		<u>272</u> 9.67	<u>1096</u> 3.70	<u>1167</u> 8.57	<u>2343</u> 45.03	<u>1562</u> 60.72	<u>488</u> 21.64

In the Mladezhka River, where we found four fish species, *P. phoxinus* had the highest abundance with a mean value of 766 ind. ha<sup>-1</sup>, and *S. t. fario* had the highest biomass with a mean value of 16.34 kg ha<sup>-1</sup>. In the Aydere River, where only two species were found, *S. t. fario* had the highest mean abundance (550 ind. ha<sup>-1</sup>) and biomass (39.02 kg ha<sup>-1</sup>) (Table 1). In the Veleka River the dominant fish species were *L. cephalus* with a mean abundance of 935 ind. ha<sup>-1</sup> and mean biomass of 32.08 kg ha<sup>-1</sup>, and *B. tauricus* with a mean abundance of 801 ind. ha<sup>-1</sup> and mean biomass of 16.32 kg ha<sup>-1</sup>. *B. tauricus* dominated in the upper reaches and *L. cephalus* – in the lower reaches of the river (Table 2). The abundance of the two species was about one half of the total abundance and their biomass amounted to 70% of the total biomass. *A. bipunctatus* had the highest abundance and biomass among the rest of the species. Its abundance varied between 115 ind. ha<sup>-1</sup> (Site 4) and 1038 ind. ha<sup>-1</sup> (Site 1), and its biomass – between 0.35 kg ha<sup>-1</sup> (Site 4) and 4.54 kg ha<sup>-1</sup> (Site 3).

Three of the species found in the Veleka River are included in the Red Data Book of Bulgaria in the category Threatened with Extinction. These are: *A. anguilla*, *C. chalcoides* and *R. frisii*. The *R. frisii* was found only in the region of Site 11, and it had an abundance of 208 ind. ha<sup>-1</sup> and biomass of 1.74 kg ha<sup>-1</sup>. *C. chalcoides* occurred in the river section between Site 5 and the river mouth. Its abundance varied between 36 ind. ha<sup>-1</sup> and 590 ind. ha<sup>-1</sup>, and its biomass – from 0.15 kg ha<sup>-1</sup> to 0.40 kg ha<sup>-1</sup>. *A. anguilla* was found only in the river mouth and its abundance and biomass were 46 ind. ha<sup>-1</sup> and 53.00 kg ha<sup>-1</sup> (Table 2).

*L. borysthenticus* is not registered in the Red Data Book of Bulgaria as endangered but it also had very low abundance (from 69 to 1336 ind. ha<sup>-1</sup>) and biomass (from 0.83 to 14.47 kg ha<sup>-1</sup>). It occurred only in the lower reaches of the river and it has never been found in other rivers from the Black Sea basin.

**Table 2.** Abundance (n, numerator) and biomass (kg, denominator) of fish populations at the sites (Fig. 1) of the Veleka River (data were converted to 1 ha water surface).

Species	Site	1	2	3	4	5	6	7	8	9	10	11	12
<i>Leuciscus cephalus</i>		<u>192</u>	<u>739</u>	<u>733</u>	<u>1269</u>	<u>354</u>	<u>1704</u>	<u>1594</u>	<u>1603</u>	<u>1111</u>	<u>1084</u>	<u>417</u>	<u>415</u>
		7.50	103.35	19.05	34.69	12.92	25.22	52.97	30.76	29.58	45.46	18.40	5.02
<i>Barbus tauricus</i>		<u>1154</u>	<u>1261</u>	<u>1172</u>	<u>1462</u>	<u>133</u>	<u>593</u>	<u>652</u>	<u>1108</u>	<u>278</u>	<u>442</u>	<u>556</u>	
		12.23	57.00	4.76	21.39	7.26	5.52	7.21	22.97	6.18	7.67	27.36	
<i>Alburnoides bipunctatus</i>		<u>1038</u>	<u>435</u>	<u>1026</u>	<u>115</u>	<u>487</u>	<u>593</u>	<u>181</u>	<u>612</u>	<u>347</u>	<u>201</u>	<u>799</u>	<u>230</u>
		3.50	2.00	4.54	0.35	2.26	2.30	0.65	2.16	1.18	1.17	3.89	1.34
<i>Salmo trutta fario</i>		<u>808</u>	<u>43</u>	<u>37</u>	<u>38</u>	<u>221</u>							
		6.62	7.83	1.53	5.15	8.36							
<i>Phoxinus phoxinus</i>		<u>335</u>	<u>43</u>		<u>38</u>	<u>44</u>	<u>111</u>						
		0.85	0.13		0.08	0.09	0.19						
<i>Gobio gobio</i>		<u>231</u>	<u>304</u>										
		2.65	3.78										
<i>Rhodeus amarus</i>			<u>87</u>	<u>73</u>			<u>111</u>	<u>36</u>			<u>924</u>	<u>451</u>	<u>599</u>
			0.09	0.51			0.37	0.04			3.41	2.74	3.04
<i>Cobitis taenia</i>			<u>43</u>	<u>73</u>						<u>40</u>			<u>1152</u>
			0.04	0.22						0.16			3.64
<i>Neogobius gymnotrachelus</i>				<u>476</u>	<u>154</u>	<u>531</u>	<u>185</u>	<u>145</u>	<u>292</u>	<u>625</u>	<u>884</u>	<u>625</u>	<u>876</u>
				2.20	0.65	2.30	1.11	0.40	1.37	1.46	4.30	3.30	2.35
<i>Neogobius melanostomus</i>				<u>110</u>		<u>442</u>	<u>259</u>		<u>58</u>			<u>243</u>	
				1.10		4.65	0.70		0.26			1.63	
<i>Vimba vimba</i>					<u>115</u>	<u>44</u>	<u>370</u>	<u>36</u>	<u>350</u>	<u>972</u>	<u>201</u>	<u>833</u>	<u>2028</u>
					2.39	0.09	3.30	0.48	3.00	13.68	5.42	15.76	18.57
<i>Chalcalburnus chalcoides</i>						<u>88</u>	<u>37</u>	<u>36</u>	<u>87</u>	<u>347</u>		<u>590</u>	<u>230</u>
						0.53	0.52	0.15	0.32	1.67		2.40	1.20
<i>Leuciscus borysthenicus</i>										<u>69</u>	<u>361</u>	<u>521</u>	<u>1336</u>
										0.83	4.34	5.21	14.47
<i>Rutilus frisii</i>											<u>208</u>	<u>208</u>	
											1.74	1.74	
<i>Anguilla anguilla</i>													<u>46</u>
													52.99
<i>Mesogobius batrachocephalus</i>													<u>46</u>
													0.10
Total		<u>3758</u>	<u>2955</u>	<u>3700</u>	<u>3191</u>	<u>2344</u>	<u>3963</u>	<u>2680</u>	<u>4110</u>	<u>3789</u>	<u>4097</u>	<u>5243</u>	<u>6958</u>
		33.35	174.22	33.91	64.70	38.46	39.23	61.90	60.84	54.74	71.77	82.43	102.72

## Discussion

Based on the results obtained the Veleka River can be divided into three zones:

1st zone – this is the river section from the river crossing of the Bulgarian border to the mouth of the Mladezhka River. This section has a big longitudinal slope and comparatively low water temperature. For instance, in August the water temperatures at sites 1, 2 and 3 were 16.5 °C, 19.0 °C and 19.5 °C. Although there were good conditions for the development of *S. t. fario* the abundance of its population was very low. *B. tauricus* and *L. cephalus* were found in this section as well. Based on the morphological and chemical characteristics of water the zone can be identified as trout-barbel zone. The total mean fish abundance there was 3414 ind. ha<sup>-1</sup>, and total mean biomass – 76.54 kg ha<sup>-1</sup>.

2nd zone – the section from the mouth of the Mladezhka River to Site 10. In August the water temperature varied there between 19.0 °C and 21.5 °C. This section can be identified as a barbel-carp zone. Almost all fish species established in the river occurred in this section. The total fish abundance (mean value of 3747 ind. ha<sup>-1</sup>) and biomass (mean value of 58.48 kg ha<sup>-1</sup>), with the exception of Section 11, were below or about the average values for the river.

3rd zone – the section between Site 10 and the river mouth. The river flowed very slowly in this section. This zone had the greatest number of species and the highest fish abundance and biomass.

The comparative analyses of fish abundance and biomass in the Veleka River and its tributaries and other rivers studied by us (D i k o v & J a n k o v 1985, J a n k o v & D i k o v 1985, P e n c z a k et al. 1985, K a r a p e t k o v a & D i k o v 1986, D i k o v et al. 1988, 1994) have shown that the Veleka River had considerably low abundance and biomass of the fish stocks. For instance, fish abundance and biomass in the Rivers Sredetska and Palakarija were 157537 and 39288 ind. ha<sup>-1</sup> and 392.05 and 332.03 kg ha<sup>-1</sup>, respectively, and these in the Rivers Mesta and Arda: 6638 and 8785 ind. ha<sup>-1</sup> and 142.71 and 117.28 kg ha<sup>-1</sup>. Only the Zlatna Panega River had lower fish abundance (2339 ind. ha<sup>-1</sup>) and biomass (50.36 kg ha<sup>-1</sup>) than the Veleka River. In this river about 85% of the river course was not inhabited by fishes due to industrial and municipal pollution. According to the classification of S z c z e r b o w s k i (1981) based on the abundance and biomass of brown trout, the Mladezhka River has very low total fish abundance (below 300 ind. ha<sup>-1</sup>) and biomass (below 20 kg ha<sup>-1</sup>); the Aydere River has low abundance (300–700 ind. ha<sup>-1</sup>) and from low to moderate biomass (35–60 kg ha<sup>-1</sup>); and the Veleka River – very low abundance and biomass (except Site 1). The rivers are included in the same categories according to the classification of V o s t r a d o v s k ý (1977) as well. L i b o s v á r s k ý & L u s k (1973), L i b o s v á r s k ý (1976) considered the status of a river normal when from 300 to 500 brown trout can be found on 1 ha water surface. Only the Aydere River comes under this category.

It is difficult to make conclusions about the abundance and biomass of rare and protected species (*A. anguilla*, *C. chalcoides*, *L. borysthenicus* and *R. frisii*), since there are no data from previous years. However, the results obtained show that the abundance and biomass of these species as well as the other fish species do not correspond to the natural ecological potential of the rivers for the development of the fish fauna. The shape of the river banks, river bottom, stream velocity, water chemistry and water temperature would suggest a much higher fish production. Moreover, water pollution is negligible, since the source of industrial pollution in the 1980s, the Washery near Malko Turnovo, ceased its function. Also no irrigation work and associated drainage, damming and river bed changing activities have

been undertaken. The only factor, playing a negative role on the ecological status of the river, is the direct human influence, which is a result of intensive development of tourist industry in the region. It is manifested by building of summer houses and camping along the river banks, intensive sports fishing, disposal of wastes, using motor boats in the lower reaches, etc. Recently, a tendency of decrease in the mean annual discharge of the river is observed. However, we think that the main reason for the low fish abundance and biomass as well as the unfavorable size structure of fish populations in the Veleka River and its tributaries is the intensive, practically uncontrolled commercial and sports fishing and poaching.

#### A c k n o w l e d g e m e n t s

We would like to thank Dr Maria Karapetkova for her valuable assistance in the collection of the material studied. The study was financed by a grant of the National Science Fund, Ministry of Education and Science, within the project B-1124. We are also much obliged to Prof. Dr R. H. K. Mann, Dr P. Blahák and Ing. M. Peňáz, DrSc. for valuable critical remarks and recommendations on the manuscript.

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