Assessment of the complex anthropogenic impact on fish population in the Danube River

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Background

The Danube River is the second longest river in Europe. About twenty percent or 588 km of its total flow passes through Serbia making its middle and lower part. The main tributaries (the Tisa, the Sava and the Tamis), pouring into the Danube River in this part increase river flow rate from $72 \cdot 10^9$ m^3/year on border with Hungary to $183 \cdot 10^9$ m^3/year on Bulgarian border inducing significant changes in ion composition, contents of organic matter and micro pollutants. Anthropogenic impacts on fish populations in this part of the River Danube include not only water pollution, but also the extensive fishery, as well as habitat destruction by dam building and river modifications.

Aims

A complex investigation was performed to determine anthropogenic impacts on pike (*Esox lucius* L.) as a predatory fish and sterlet (*Acipenser ruthenus* L.) as a bottom fauna feeder. The purpose of this investigation was to determine if the examined features are suitable for evaluation of anthropogenic effects on this large and important freshwater ecosystem.

Methods

Analysis of age structure, food and growth analysis were performed. Investigation of reproductive cycle was designed on histological examination of gonads together with determination of gonado-somatic (GSI) and hepato-somatic (HSI) indices during annual cycle. Specific part of the investigation was related to analysis of blood biochemical parameters and their correlation with water temperature and photoperiod. Attempt was made to establish standard values for the examined parameters.

Results

The total amount of 692 specimens of pike and 193 specimens of sterlet were examined. The age structure of both species showed a prevalence of one and two years old individuals in catch. Growth analysis exhibited wide range in total length and total weight among individuals inside age classes. Standard values for biochemical parameters in pike blood sera were in range of 190.9-659.7 U/L for aspartate aminotransferase (ASAT), 2.2-19.6 U/L for alanine aminotransferase (ALAT), 27.6-116.1 U/L for alakaline phosphatase (ALP), 26.6-63.4 g/L for total protein, 0.39-2.20 mmol/L for urea and 10.62-155.76 µmol/L for creatinine. ALAT was positively correlated ($P<0.01$) to the day length during the period from spring to autumnal equinox and negatively correlated ($P<0.01$) to day length from autumnal to spring equinox. A significant positive correlation ($P<0.01$) with water temperature was observed in urea and creatinine in both sexes and in activity of ALP but only in male specimens. On the basis of data relating to gonad histological and blood sera analysis, increase in activity of ALP was noticed in females on the start and the end of exogenous vitellogenesis. GSI was correlated significantly ($P<0.01$) with HSI in females perhaps as a consequence of hepatic synthesis of vitellogenin. The catch of pike and sterlet were often observed in place with high organic pollution due to prey occurrence in that places. The principal food item (55.5%) of pike was bleak (*Alburnus alburnus*), which is very often found near outflows of collectors where water contents high percent of organic matter. The population of sterlet was also abundant downstream of outflow of the biggest collector in Belgrade.

Discussion

The prevalence of one and two year old specimen in both investigated species is perhaps a consequence of common effects of overfishing and water pollution, while in the case of sterlet the changes in river bottom may also play important role.

The investigated biochemical parameters can be useful indicators of water pollution, but only after establishing standard values in annual cycle and their correlation with exogenous (water temperature, photoperiod) and endogenous (reproductive cycle) factors. Based on results from this investigation urea and creatinine could be used like good indicator of state of fish population in some water systems especially because they are also indicators of gill and kidney dysfunction, respectively.

Fish blood can be easily obtained without killing the fish and the same can be said for the gathering of pike scale and section of pectoral fin rays of sterlet. Analysis based on this material can provide valuable data and ensure further monitoring of fish population without any changes of its abundance.