Nutrient ratios in surface freshwaters of the Balkans and possible controlling factors

Nikos Skoulikidis
Institute of Inland Waters, Hellenic Centre for Marine Research, 46.7km Athens – Sounio Av, 19013, Anavissos, Greece. nskoul@ath.hcmr.gr

Sixteen large Balkan rivers that contribute 83% to the total Balkan river outflows in the Mediterranean, 29 small/medium Greek rivers, 37 reference streams and 19 major Greek lakes were examined for their nutrient levels and ratios. In the vast majority of the rivers, nutrient ratios indicate P-limited photosynthesis. In large rivers, N/P ratios range between 7 for the Axios/Vardar, a heavily polluted river with industrial P inputs, and 409 for Krathis, a nearly ´pristine´ river in N. Peloponnese (average: 90.6, median: 37.8, StDev: 120%).

Balkan rivers drain three zones with distinct climatic, geological and hydrochemical features. Zone 1, located in the NE Balkans, displays silicate geology. Zone 3, that extends along the western Balkans, presents carbonate geology, while zone 2, placed in-between, exhibits a mixed geology. In large Balkan rivers, average N/P ratios increase from zone 1 towards zone 3 together with the portion of carbonate rocks in the respective basins. The same result is valid for small/medium Greek rivers, where N/P ratios are positively correlated with the percentage of carbonate rocks in their basins. Finally, in the majority of reference sites photosynthesis is also P-limited, while N/P ratios also increase from zone 1 to 3.

Focusing on individual rivers, a downstream N/P ratio increase is apparent in the Acheloos R. (W. Greece). In the Evrotas R. (S. Peloponnese), only 7 of 36 sites that generally lie on clean tributaries of mostly silicate basins reveal N-limited photosynthesis. In the Krathis R., a downstream increase of dissolved N together with a decrease of N bound on river sediments is attributed to leaching and/or mineralization processes. The opposite is apparent for P, due to its retention in river sediments. These mechanisms may control photosynthesis which is by far P-limited.

In the Greek lakes, according to data of the Ministry of Agricultural Development and Food, photosynthesis is governed by N, which generally presents lower levels than in the rivers. In fact, in nine out of sixteen lakes, photosynthesis is N-limited, as a result of relatively low DIN concentrations. This result needs to be validated with newer data from individual lake studies.

N and P pollution inputs, geological background and biogeochemical processes acting in the water column and sediments may control nutrient ratios and photosynthesis in surface freshwaters of the Balkans.

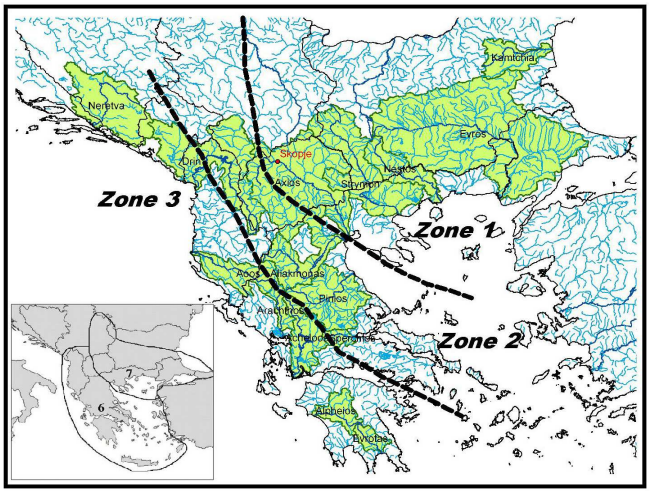

Fig. 1. Large Balkan rivers and river zones

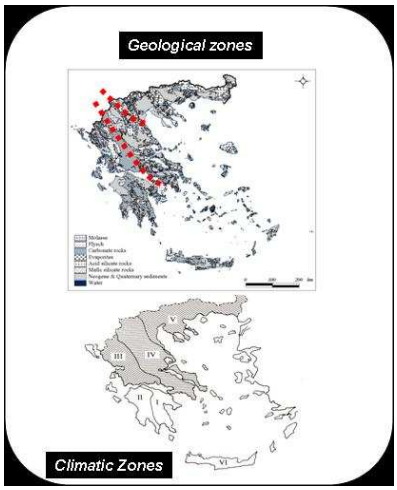

Fig. 2. Geological – climatic zones

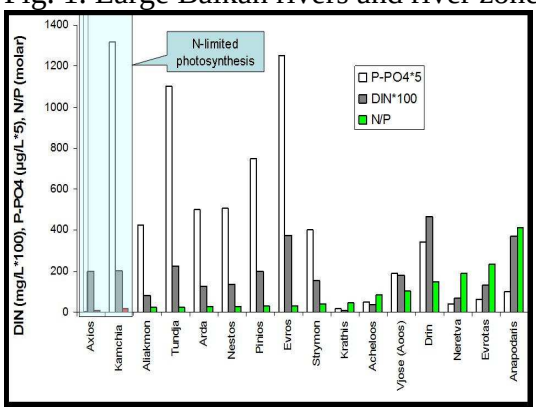

Fig. 3. Nutrient levels and ratios in Balkan rivers

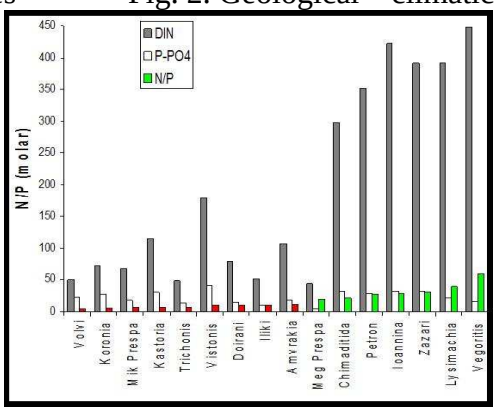

Fig. 4. Nutrient levels and ratios in major Greek lakes