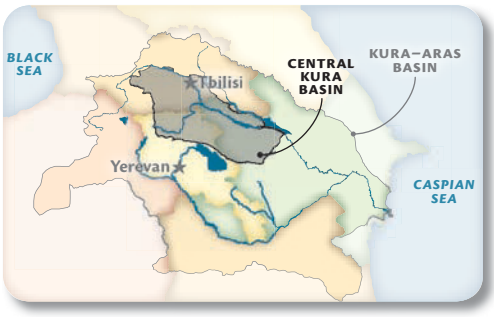
SOUTH CAUCASUS REGION TRANSBOUNDARY REPORT CARD

The central Kura River basin is a large river basin in the mountainous South Caucasus region of Eurasia. It contains important water resources for three countries—Georgia, Armenia, and Azerbaijan—and has a combined population of some 17 million people. There are many threats to these shared water resources, including nutrient inputs, heavy metal pollution, and sediment erosion. Successful management of these shared resources is critical to the social, economic, and ecological prosperity of the region. This newsletter details the first attempt at an integrated water quality report card for the central Kura River basin.

Threats to the central Kura River water resources have changed considerably from the time when the region was part of the former Soviet Union until the present (including some improvements such as reduced toxicant inputs with the closure of factories). However, even though many monitoring efforts have been and are being undertaken, a clear synthesis of the water quality throughout the basin within all three countries has yet to be developed. One approach towards reaching this goal is the development of a geographically explicit water quality report card, which can act as a focus for geographic and temporal syntheses of water quality data. This approach is also well suited to effective science communication to a broad audience, from scientists to managers and the public. In the long term, such a trilateral synthesis for the central Kura River basin could be expanded and assist in linking water quality monitoring programs throughout the entire basin and provide a mechanism to allow this information to be better utilized for regional management of the water resources. The style of a 'report card' synthesis also allows for easy interpretation of key messages by a broad audience and as such will assist in widely communicating these results to strengthen the engagement in stewardship of these valuable water resources by the public on a trilateral (watershed) basis.

The South Caucasus region of Eurasia is located between the Black and Caspian Seas, and spans the southern portion of the Caucasus Mountains and their lowlands.



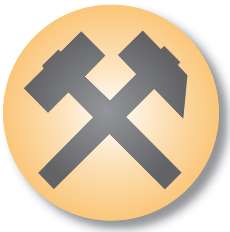
The central Kura River basin is located within the larger Kura–Aras River watershed which drains to the Caspian Sea.

The Kura River in Tbilisi.

The central Kura River basin is part of the larger Kura–Aras River watershed, which drains to the Caspian Sea. Primary threats to the central Kura River basin include untreated wastewater inputs, mining activities, agricultural runoff, and irrigation ditches. The Caspian Sea has a general north-to-south flow, so the plume from the Kura–Aras River tends to flow south. Sediments near the mouth of the river have high concentrations of zinc (Zn) and copper (Cu), which may have been involved in mass mortalities of the Caspian seal. Sea level in the Caspian Sea rose 3 m between 1977 and 1995 and continues to rise.

CURRENT & EMERGING THREATS

CURRENT THREATS



Mining activites in the central Kura River basin operate with limited treatment systems or control. This combined with the finding of high concentrations of zinc and copper in the tissues of Caspian seals after a mass mortality means that mining is a current threat to the basin.

Cu Zn

There is a general lack of adequate wastewater treatment facilities in the central Kura River basin, leading to poor quality of drinking and irrigation water in the watershed.

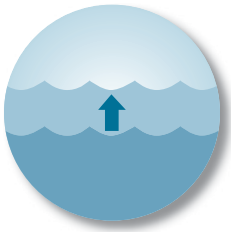
O_2 N P

Agriculture is a primary land use, particularly in the lowland plain areas of the South Caucasus region. Nutrient inputs from agriculture is increasing and is potentially a source of conflict.

N P

EMERGING THREATS

Sea level in the Caspian Sea rose by approximately 3 m between 1977 and 1995, although this was preceded by a 3 m drop in sea level.[1] A sea level maximum was reached in 1995, and smaller oscillations have occurred since then. Sea level is predicted to continue rising over the next two decades.



Deforestation of the South Caucasus region is already causing problems due to erosion, and is expected to increase in the future. Timber is exported and also required for the survival of rural residents who often do not have alternative fuel sources.

Overgrazing is an emerging threat that is already causing problems to the water resources of the South Caucasus area. Overgrazing strips the sensitive subalpine and alpine zones of vegetation, leaving it vulnerable to erosion.

N P

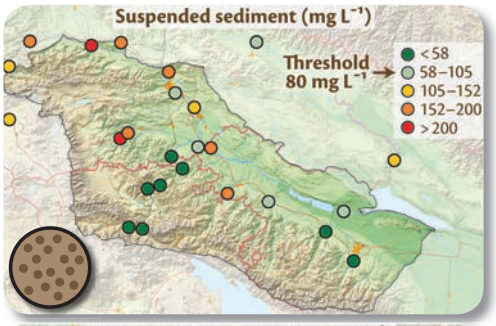
Inputs from wastewater (left) and agriculture (right) are degrading water quality in the central Kura River basin.

Overgrazing by sheep and cattle (right) is already causing erosion in the South Caucasus region.

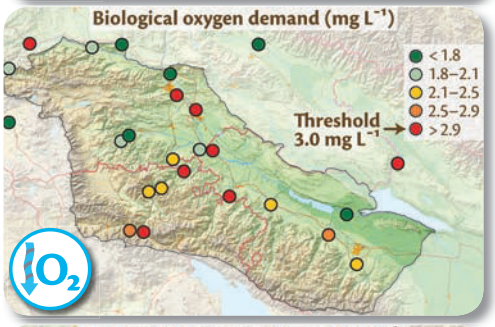
Objective	Indicator	Threshold (mg L^{-1})
Clean water	Suspended sediment	< 80[2]
	Biological oxygen demand (O_2)	< 3.0[3]
	Dissolved inorganic nitrogen (N)	< 0.15[4]
Aquatic health	Dissolved inorganic phosphorus (P)	< 0.067[4]
	Copper (Cu)	< 0.02[5]
	Zinc (Zn)	< 0.09[6]

Water quality thresholds used in the central Kura River basin report card. Indicators were chosen that can be linked to various human activities, in particular agriculture (total suspended solids, nitrogen, and phosphorus), human development (biological oxygen demand, nitrogen, and phosphorus), and mining (copper and zinc).

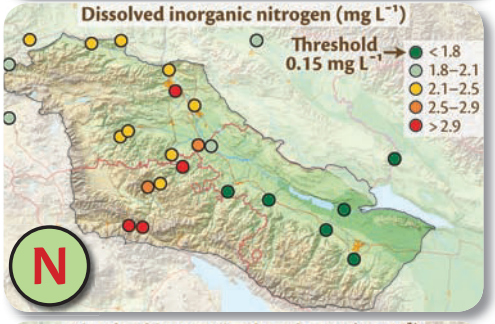
WATER QUALITY INDEX



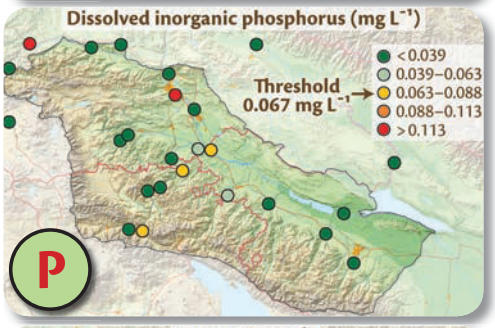
Summary: Suspended sediment showed a highly variable pattern, with medium-to-high values in the northwestern (upper) parts of the watershed and relatively low values downstream and in the Debed River basin in Armenia.
Implications: High suspended sediment impacts benthic freshwater habitats.



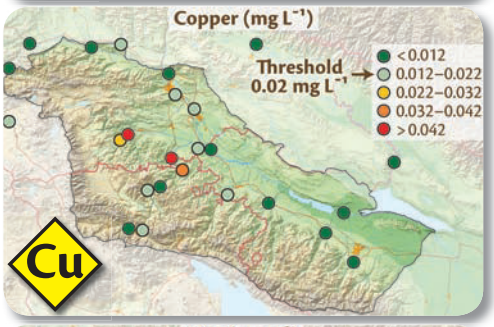
Summary: Biological oxygen demand values were highest downstream of Tbilisi, as well as in the Debed River basin.
Implications: High biological oxygen demand indicates a large amount of organic material (pollution).



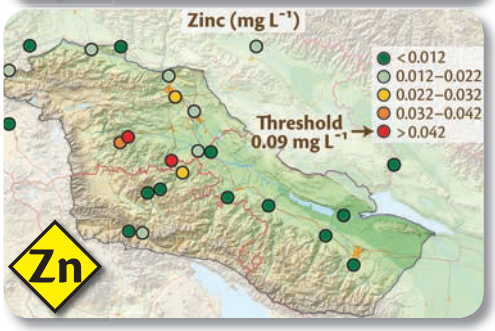
Summary: Dissolved inorganic nitrogen values were highest in the Debed River in Armenia and in the Kura River upstream of Tbilisi.
Implications: High nitrogen values can have negative effects on freshwater ecosystems.



Summary: Dissolved inorganic phosphorus values overall were relatively low, with relatively high values in the Debed River in Armenia.
Implications: Phosphorus is considered the most limiting nutrient in freshwater systems and when in excess, will cause harmful effects to the ecosystem.

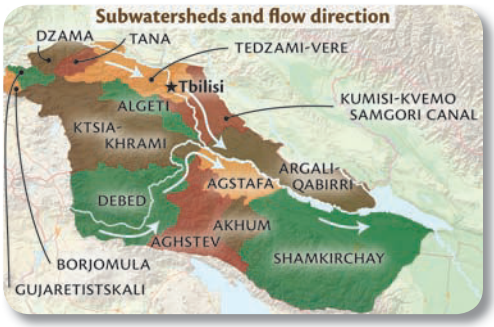


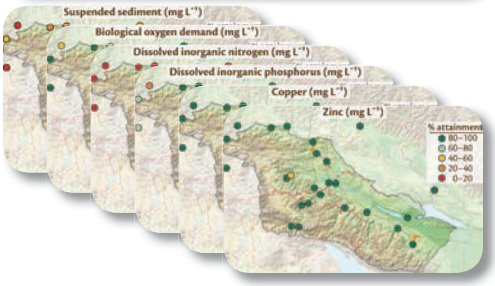
Summary: Copper was highly localized in the Ktsia–Khrami basin in Georgia and can be attributed to proximity to two of the most active mining areas in the region.
Implications: Heavy metals such as copper accumulate in the environment and can negatively impact fish and other wildlife.



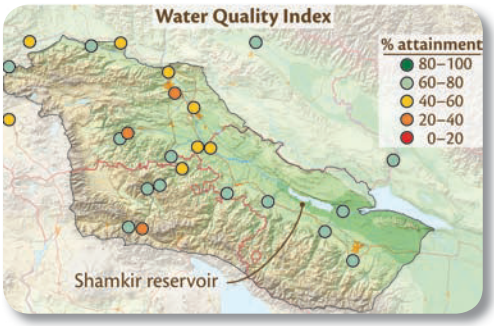
Summary: Zinc was similar to copper in that it was highly localized near the same mining areas in the Ktsia–Khrami basin in southern Georgia.
Implications: Heavy metals such as zinc accumulate in the environment and can negatively impact fish and other wildlife.

Results of the individual indicator percentage attainment show a range of results.

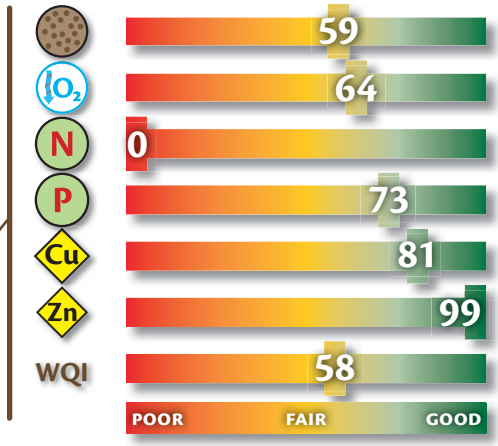




Indicator results were calculated into threshold attainment scores, which were then combined to result in the Water Quality Index.



Water quality overall was worse upstream. A combination of stressors in the upper basin contributed to this—inadequately treated wastewater, mining activities, and agricultural runoff. Interestingly, the single sampling site downstream of the Shamkir reservoir consistently returned good results for every indicator. This suggests that sediments, nutrients, and toxicants are being trapped in this reservoir, improving downstream water quality. However, sediments in the reservoirs are likely highly enriched with these pollutants, and could cause future challenges.



CONCLUSIONS & RECOMMENDATIONS

MANAGEMENT, MONITORING, AND RESEARCH RECOMMENDATIONS

	Management	Monitoring	Research
	Implement wastewater treatment to remove nutrients.	Continue transboundary basin-wide water quality monitoring program and expand analysis, interpretation, and reporting.	Investigate the sediment trapping capacity of the reservoirs.
	Employ best land management practices to reduce sediment and nutrient inputs from agriculture, forestry, and grazing.		
	Implement best mining practices to reduce heavy metal pollution.	Continue to monitor heavy metal inputs from localized sources.	Research into sources of other pollutants such as organochlorides from pesticides such as DDT and heavy metals such as mercury.
	Manage towns, farms, and industry for sea level rise in the future.	Implement sea level rise monitoring in the Caspian Sea and Kura River.	Investigate the factors contributing to the large sea level fluctuations in the Caspian Sea.

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