

Advancing land use practices to ensure suitable groundwater quality for the black proteus in the Dinaric karst (Bela krajina, SE Slovenia)

Rozalija Cvejić¹, Miha Curk¹, Nina Mali², Janez Mulec³, Metka Petrič³, Marina Pintar¹, Janko Urbanc², Mitja Prelovšek³

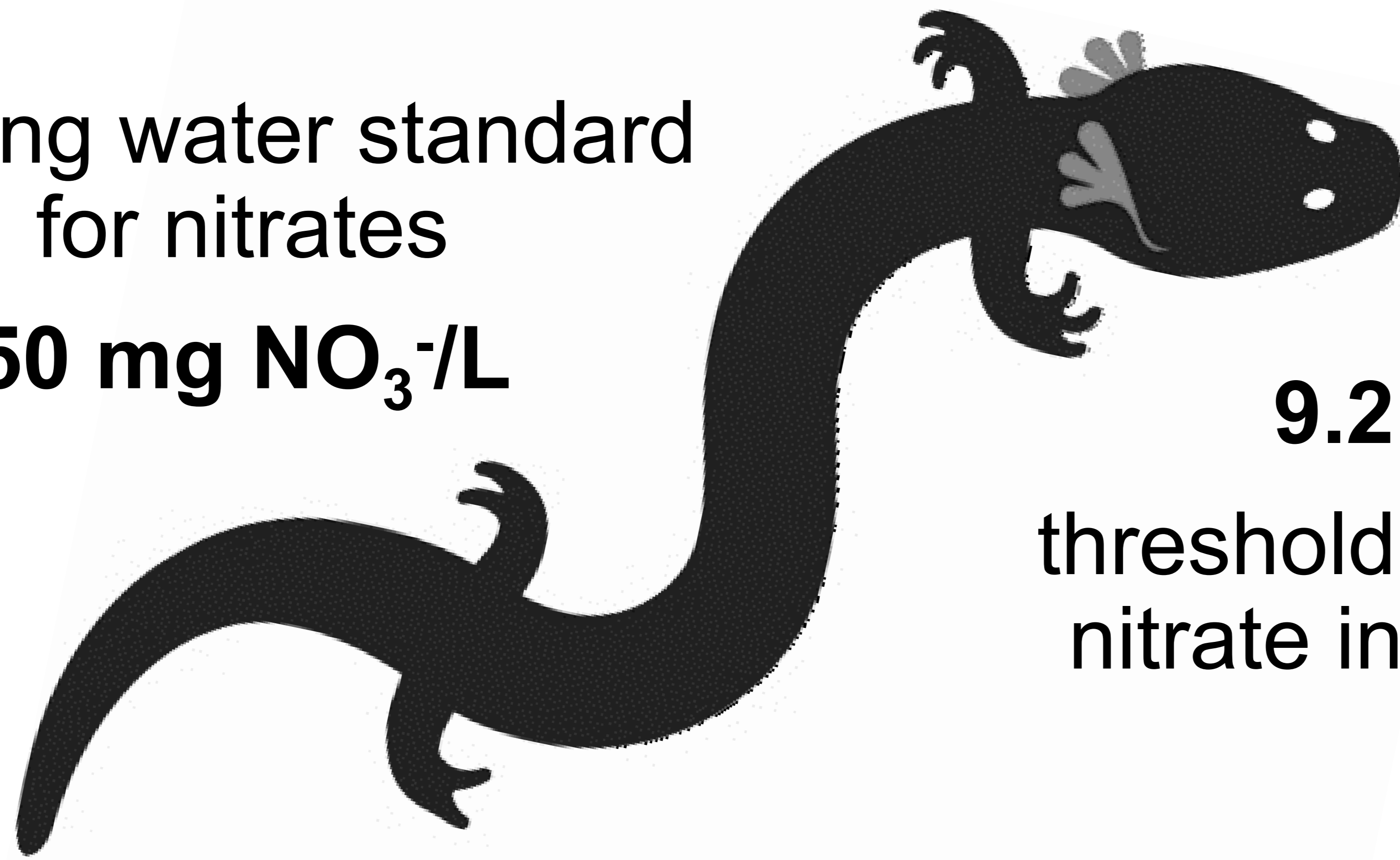
¹ University of Ljubljana, Biotechnical Faculty, Jamnikarjeva 101, SI-1000 Ljubljana, Slovenia

² Geological Survey of Slovenia, Dimičeva ulica 14, SI-1000 Ljubljana, Slovenia

³ Karst Research Institute ZRC SAZU, Titov trg 2, SI-6230 Postojna, Slovenia

drinking water standard
for nitrates

50 mg NO₃⁻/L



9.2 mg NO₃⁻/L

threshold concentration for
nitrate in groundwater for
proteus

Above-standard environmental monitoring is essential to effectively integrate urban, agricultural and environmental policy

INTRO

- Karst - home of the biggest underground amphibian, endangered *Proteus anguinus*.
- Environmental pressures degrade its habitat.

METHODS

- Monthly, real-time and passive environmental monitoring at 12 springs;
- Modelling nutrient transport and land-use change scenarios with SWAT;
- Raising stakeholder awareness.

RESULTS

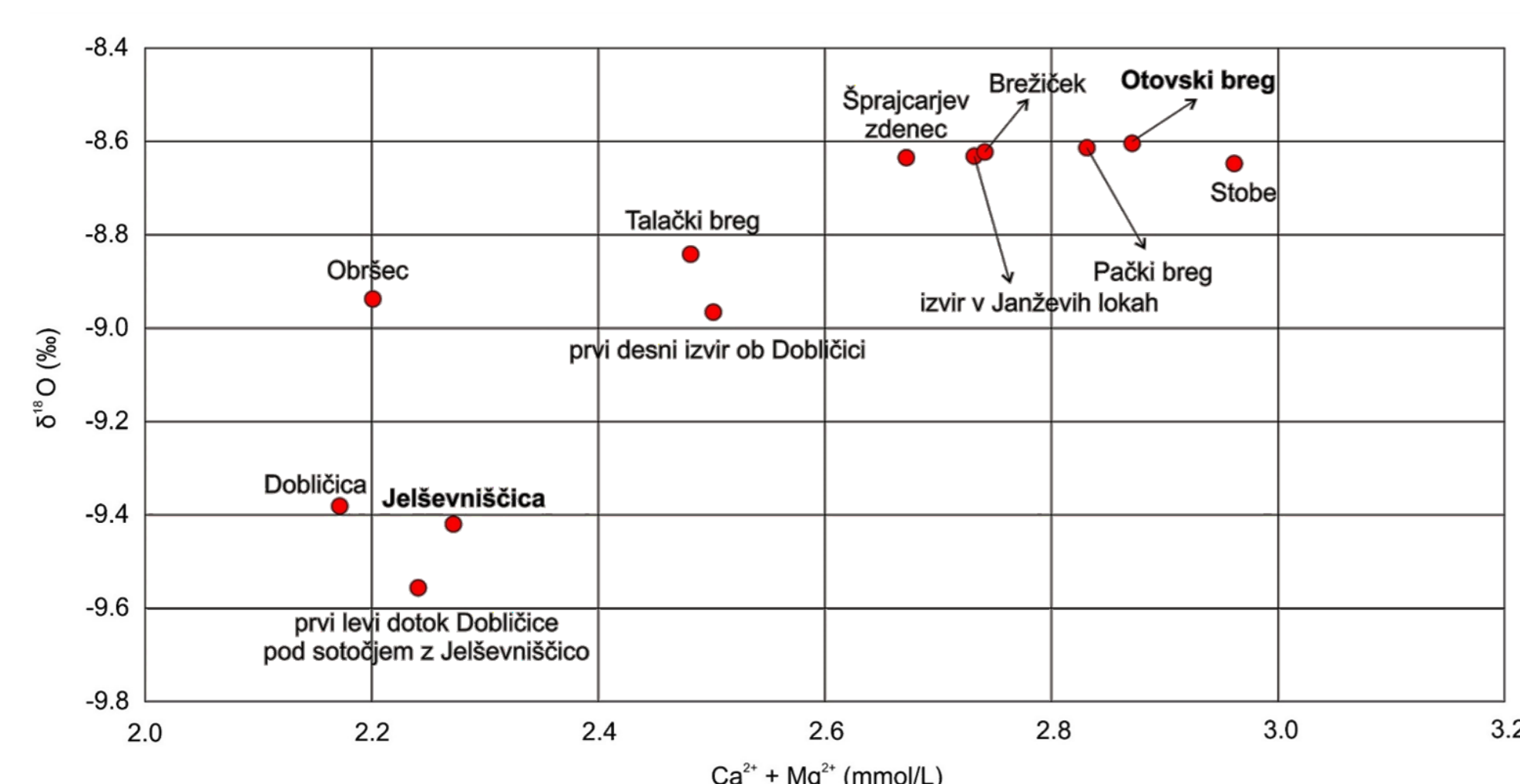


Figure 2. Two parameters showing different elevation of spring's catchment areas: on the left below are springs with a higher (Jelševniščica) and on the right above with a lower (Otovski breg).

Table 1. Higher actual and potential exposure of black proteus to environmental pressures at the spring Otovski breg.

Water quality parameter	Spring	
	Jelševnik	Otovski breg
δO18 [‰]	-9.2	-8.7
T [°C]	10.2 ± 0.23	12.0 ± 0.04
EC [μS/cm]	420 ± 11	555 ± 42
CO ₂ (eq. conc.) [ppm]	7,000 ± 800	27,300 ± 6,700
O ₂ saturation [%]	98.1 ± 2.8	85.5 ± 5.7
NO ₃ ⁻ [mg NO ₃ ⁻ /L]	3.5 ± 0.7	12.8 ± 3.3
Cl ⁻ [mg Cl ⁻ /L]	2.0 ± 0.2	12.3 ± 8.0
SO ₄ ²⁻ [mg SO ₄ ²⁻ /L]	3.9 ± 0.2	5.4 ± 0.6
K ⁺ [mg K ⁺ /L]	0.2	1.3 ± 0.8
<i>E. coli</i> [CFU/100 mL]	1-18	34-1,260
Enterococcus [CFU/100 mL]	40-327	100-3,300

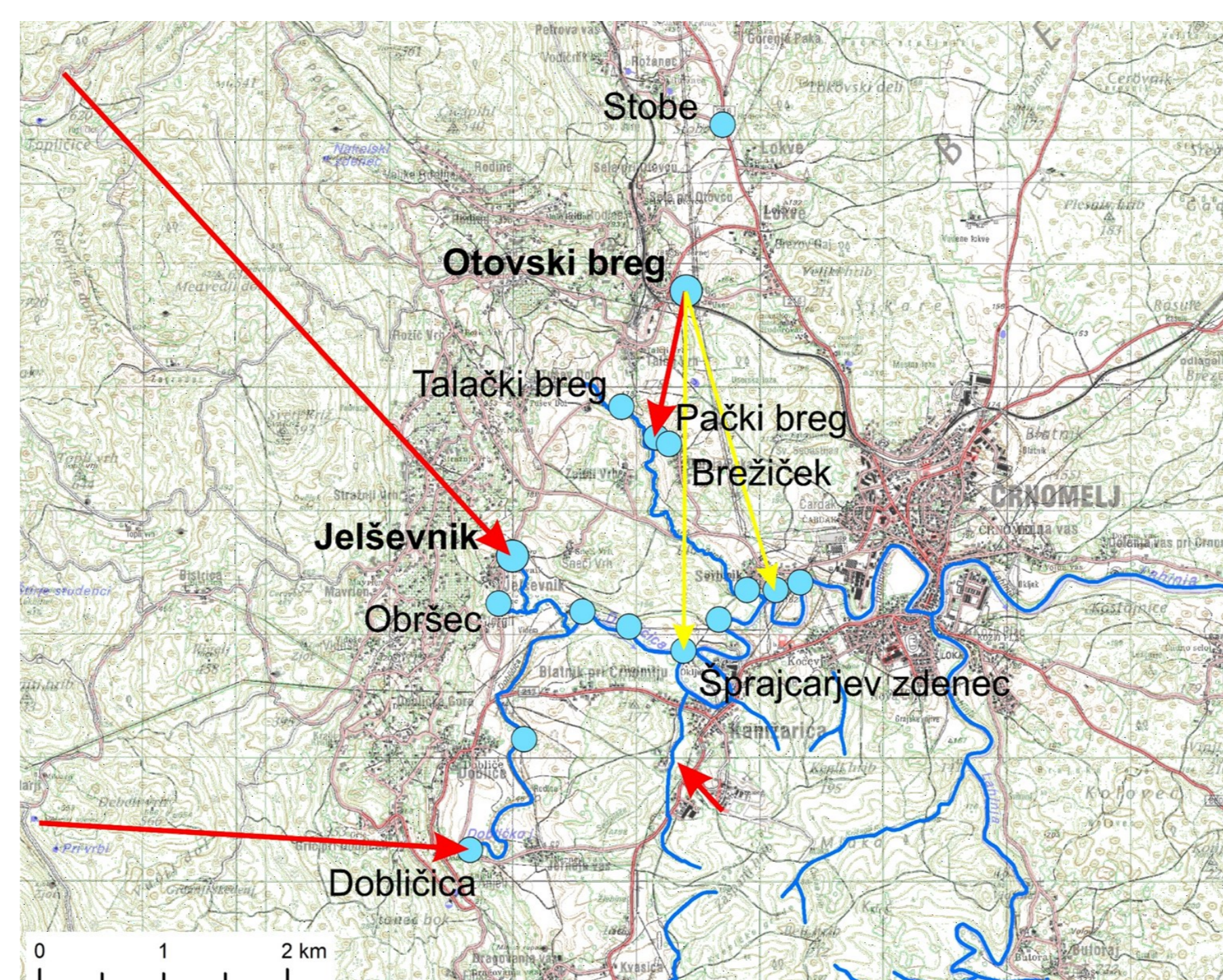


Figure 1. Locations of springs (blue dots) and the results of underground water tracing (red line-main connection, yellow line-secondary connection).

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CONCLUSIONS

- **Otovski breg spring:** overexposure of the proteus to environmental pressures due to poorly treated wastewater, agriculture and low dilution capacity;
- **Jelševniščica spring:** occasional overexposure of the proteus to environmental pressures due to overuse of slurry in the catchment.

UNDERWAY

- **Passive sampling** for emerging organic pollutants;
- Calculation of the **hydrological balance** and spatial distribution of environmental pressures;
- Nutrient transport **modelling** under different land-use scenarios;
- **Co-designing** site specific land-use measures.