

The European Green Deal misses Europe's subterranean biodiversity hotspots

To the Editor — To tackle climate change, environmental degradation and biodiversity loss, the European Commission in 2021 initiated the European Green Deal (EGD)¹, designed to achieve a sustainable and carbon-neutral economy by 2050. An important action within the EGD is the Biodiversity Strategy for 2030 (BS2030), a comprehensive plan for protecting nature, reversing degradation of ecosystems, and securing ecosystem services². Biodiversity protection is considered essential for a successful implementation of the EGD, and the program is designed such that actions should also not harm biodiversity outside the EU¹. These are laudable and necessary aims, but we argue that some actions of the EGD collide with its goal of protecting biodiversity. This is particularly evident when considering the effects of planned hydropower development on subterranean biodiversity in the Western Balkans.

Hydropower is a source of renewable energy, yet it is often not sustainable. Devastating effects of hydropower on aquatic and riparian biotas have been documented³. While the BS2030 aims to restore 25,000 km of rivers in some parts

of the EU, an action that includes dam removal², paradoxically, there are extensive plans to build new hydropower plants in other parts. These pressures are especially strong in the Western Balkans⁴, where many rivers are still free-flowing and are waterways considered an unexploited source of renewable energy⁵. We are concerned that their conversion will have devastating effects on biodiversity in the region.

The Western Balkans are considered a global hotspot for above-ground biodiversity⁶. It also harbours an even higher below-ground biodiversity⁷, including extraordinary and enigmatic organisms, such as the olm, the world's largest cave amphibian, and unique subterranean clams, sponges, cnidarians and tube worms. The groundwater crustaceans of the region represent one of the most species-rich adaptive radiations known globally⁸, parallel to anole lizards or East African cichlids. Most of these species are narrow endemics, distributed within only a few square kilometers⁹. Many groundwater species are relict¹⁰, representing very old evolutionary lineages.

The subterranean biodiversity hotspot of the Western Balkans extends across

two EU countries, Slovenia and Croatia, and five non-EU countries: Albania, Bosnia and Herzegovina, Serbia, Montenegro and Kosovo (Fig. 1). Most of the water in the region is captured in 'hidden' and generally neglected ecosystems, the subterranean network of caves and riverine interstitial passages that makes up the area's karstic landscape. Thus, the groundwater fauna of the Western Balkans represents a unique and irreplaceable part of Europe's biodiversity that is also closely associated to important ecosystem services, including the provision of drinking water¹¹. Despite its importance, groundwater biodiversity is mostly overlooked in conservation acts, including the EGD.

The threats to subterranean fauna originate from the surface¹². Damming affects not only surface fauna, but also groundwater, especially in sensitive, porous karstic areas. The increased sedimentation accompanying damming fills the spaces between gravel and blocks the exchange of water between river and groundwater, leads to anoxia and biodiversity loss in groundwater, and lowers the groundwater table. Damming also disturbs natural flooding and food supply to subterranean

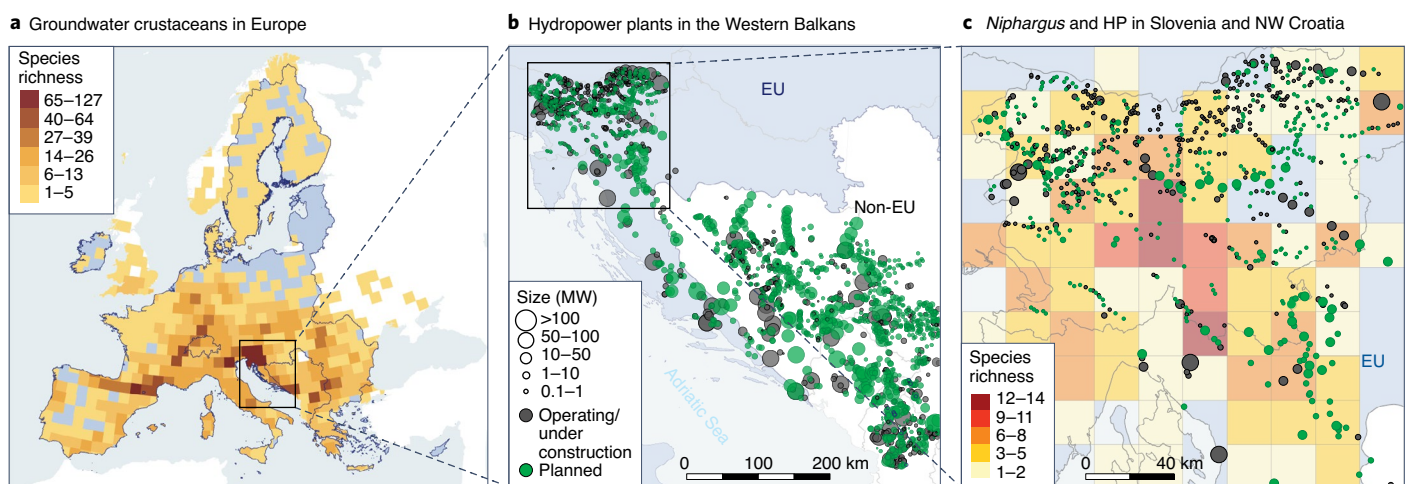


Fig. 1 | Planned hydropower plants threaten subterranean diversity of Western Balkans. **a**, The Western Balkans are a global hotspot of subterranean fauna. Data for all groundwater Crustacea are shown⁷. Background colour of countries of the European Union is blue. **b**, Map of existing and planned hydropower plants in the Western Balkans⁵, showing the capacity in megawatts of each plant. **c**, The planned construction of hydropower plants in EU member states falls in some exceptionally species-rich areas. The map shows distribution of molecular taxonomic units of the amphipod genus *Niphargus*, genetically defined categories that are good proxies of species¹⁴, mapped onto a 20 km × 20 km grid and overlaid with georeferenced information on extant and planned hydropower plants (HP)⁴. Symbols for the hydropower layer in **c** are same as in **b**.

communities, with documented cases of local extinctions.

We evaluated the threats of planned hydropower plants on groundwater fauna for countries in the Western Balkans both inside and outside the EU (Fig. 1). The extent of planned hydropower plants is striking and reveals plans for intense damming on virtually all rivers. Many of the planned hydropower plants are small, producing little electric energy, yet we expect they would have large negative impacts on aquatic and groundwater fauna⁵. The existing plans also include a series of large hydropower plants in different lowlands (poljes). These poljes would become extensively interconnected underground¹³, such that damage and habitat loss will go well beyond the immediate surroundings of the dammed area.

We also overlaid the planned hydropower plants with data on the distribution and diversity of the subterranean amphipod *Niphargus*¹⁴ in the northern half of that region. *Niphargus* is the most speciose genus of freshwater amphipods and adequately represents local community and groundwater diversity patterns in Europe⁸. Our overlay (Fig. 1) shows that, in Slovenia and Croatia, construction works are planned in ‘hotspots within the hotspot’: regions with these country’s highest biodiversity (using *Niphargus* as a proxy). The situation in the countries outside the EU is equally worrying.

This massive dam construction must be addressed under the EGD. If the ecosystems and ecosystem services of Balkan rivers are not rapidly protected and conserved, much of Europe’s surface and subterranean biodiversity will be irreversibly lost. With the planned constructions of dams, many species are likely doomed before being even formally described, matching the fate of

many species in tropical forests. Protecting Europe’s own hotspots and local endemics deserves highest priority even if it falls outside the EU. If the EU is truly “ready to show the ambition to reverse biodiversity loss [and] lead the world by example and action”², we call for changes in policy decisions in EU and non-EU countries to protect waters in the Balkans, above and below ground. Mechanisms to support such biodiversity-rich countries are included in the EGD and the BS2030 through financial stimulus for nature conservation and penalties for ecosystem degradation in both EU member and non-member countries^{1,2}. So far, however, implementation of these policies has been inadequate².

The EU has failed in its efforts to halt biodiversity loss within the Biodiversity Strategy 2020¹⁵. This will only change when the above- and below-ground components of biodiversity are taken seriously into account both within and outside the EU. From that perspective, biodiversity of the Western Balkans has been forgotten twice: in its subterranean component of biodiversity and in the countries outside the EU. The EU’s commitment to protect the continent’s own biodiversity is being put to the test. □

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Competing interests

The authors declare no competing interests.