

LETTERS

Edited by Jennifer Sills

Greenland: Build an economy on sand

As A. Torres *et al.* explain in their Perspective “A looming tragedy of the sand commons” (8 September, p. 970), sand scarcity is an emerging global issue. Future urbanization and massive infrastructure improvements will further intensify our need for sand, and scarcity is expected to increase sand demand (1) and market prices (2). Torres *et al.* stress that we need innovative solutions to prevent the negative sociopolitical, economic, and environmental effects of the sand crisis. Given recent advances in the understanding of fluvial deposits along the coast of Greenland, river sediments from the world’s northern regions could provide an answer.

Greenland’s ice sheet produces about 8% of suspended sediments transported from rivers and glaciers to the global ocean (3). Greenland’s high meltwater runoff drives rapid growth of delta area, extending them into the sea (4). Every melt season, sand and gravel are deposited into hundreds of Greenland deltas. Rivers feeding the deltas are located in regions completely free of any anthropogenic sources of upstream entrapment, such as dams (5). Especially in southern Greenland, these deltas constitute prime locations for dredging sand, gravel, and slurry for further processing. With continued warming, acceleration of melt

and ice sheet flow may increase sediment delivery from Greenland to the ocean, as well as the extent of the deltas (4).

Developing commercial opportunities in Greenland would diversify Greenlandic industry, allowing Greenland to become independent from Danish subsidies (6), which account for roughly one-third of the Greenlandic gross domestic product (GDP). Along with current efforts to develop glacial rock flour into a source of nutrients for depleted soils (6), we propose that sand extraction along selected fluvial outlets could serve as a new industry in Greenland while addressing the global need for sand. If Greenland is to benefit from sand extraction, we must raise awareness about the resource both locally and globally, the Greenlandic people must learn best practices to extract the sand (6), and the industry must guarantee that extraction methods minimize potential negative impacts on the local environment.

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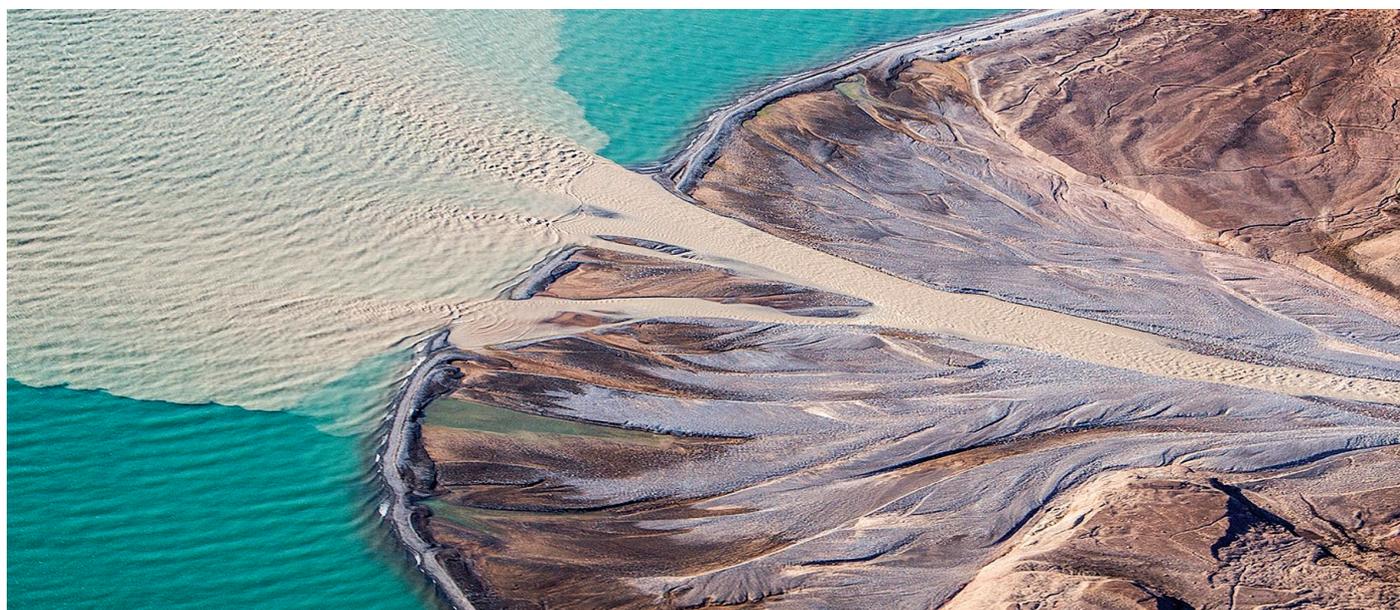
10.1126/science.aar3388

Bluefin tuna science remains vague

The International Commission for the Conservation of Atlantic Tunas (ICCAT) spent the past 8 years and more than US\$15 million to improve scientists’ understanding of Atlantic bluefin and their management (1). Unfortunately, this year’s long-awaited stock assessment produced more questions than answers.

ICCAT’s model for the eastern bluefin stock’s assessment is unreliable because small tweaks to the input data result in substantial differences in quota advice. For example, adding just one year of data increased the model’s recommended quotas by 70% (2). Adding data from a single fishery (i.e., one abundance index) increased the estimated sustainable quotas by 126%. Depending on the assumptions made about future productivity, the model results range from estimates indicating that the stock is recovered to estimates indicating that it is not recovered.

For ICCAT’s western stock assessment, the biggest challenge was the inability to determine what constitutes a healthy stock level, due to uncertainty that remains about some biological questions, such as the relation between the number of adults and the number of young fish produced (2). The assessment does, however, conclude that the stock size is as low as 45% of the 1974 level and just 18% of what it was in 1950 (2). The science is also clear that abundance is expected to decline, even without increased fishing (3). Furthermore, westward migration of eastern bluefin has



Greenland’s rivers deliver sediment from melting ice to the ocean.

PHOTO: NIKOLAJ KROGH-LARSEN

increased in recent years (4), to the extent that estimated increases in the western stock size could be entirely the result of fishermen catching (and scientists counting) eastern fish in western areas.

Instead of providing precautionary advice in light of this severe uncertainty, ICCAT's scientific body told policy-makers that substantial increases in quotas are sustainable over the short term, even though these quotas are projected to cause declines in both stocks (4). As chair of IUCN's Tuna and Billfish Specialist Group, I would instead recommend that when policy-makers meet in Morocco in November that they set quotas at levels that would allow both stocks—neither of which is considered recovered—to grow.

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Romanian ecosystems need EU protection

The Jiu River, located in Romania's Jiu Gorge National Park, is the last free-flowing big montane river in the Romanian Carpathians (1). The Hidroelectrica Company has proposed the creation of two redundant dams on the Jiu (1). The project threatens one of the last large wilderness areas in Europe, including Natura 2000 protected areas (2). These plans are proceeding despite the fact that the Water Framework Directive, instilled by the European Union, states that the degradation of the ecological integrity of the river is prohibited (3). The river provides essential ecological functions, from microbial contributions (4) to the biogeochemical cycles (4) to thriving animal populations, including the European otter (*Lutra lutra*), listed by the IUCN as Near Threatened (5).

The dams would breach at least five EU environmental protection directives (3), including the Habitats Directive, yet the European Commission has taken no action to intervene. Biodiversity studies,

and the funding to support them, are rare in Romania, but preliminary investigations suggest that the region has high levels of previously unrecognized biodiversity, as well as being home to endangered and endemic plant and animal species [such as the Romanian loach (*Sabanajewia romanica*)] (6). Environmental impact studies, funded by the European Regional Development Fund, concluded that dam and diversion activities should be forbidden because of their potential to negatively affect priority riparian habitat (such as alluvial forests), degrade aquatic habitat, and lead to possible extinction of the otter population (7). These results were ignored by Romanian environmental authorities.

Romanian rivers are under enormous pressure from hydropower developments, sand and gravel mining, and regulation works, and endemic species have already been brought to extinction (8). There is substantial value, both in terms of biodiversity and ecosystem services, to protecting the last free-flowing rivers in the region. Tragically, Romanian authorities fail to recognize this value, Romanian conservation laws are arbitrary, and EU-wide environmental laws such as the Habitats Directive are failing to provide much-needed overriding protections. In developing countries with many societal challenges, like Romania, the need to protect nature is overshadowed by other problems. Consequently, environmental legislation is often imposed from outside rather than the initiative of national policy-makers. In such cases, external influence can protect threatened and broadly important landscapes. For EU member countries, especially those that are developing, a willingness on the part of the EU to enforce its environmental laws is essential. We call on the European Commission to do so in this case and others that may arise in countries where environmental laws are developing, but landscapes cannot wait.

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10.1126/science.aar2216

TECHNICAL COMMENT ABSTRACTS

Comment on "The extent of forest in dryland biomes"

Daniel M. Griffith, Caroline E. R. Lehmann, Caroline A. E. Strömberg, Catherine L. Parr, R. Toby Pennington, Mahesh Sankaran, Jayashree Ratnam, Christopher J. Still, Rebecca L. Powell, Niall P. Hanan, Jesse B. Nippert, Colin P. Osborne, Stephen P. Good, T. Michael Anderson, Ricardo M. Holdo, Joseph W. Veldman, Giselda Durigan, Kyle W. Tomlinson, William A. Hoffmann, Sally Archibald, William J. Bond

Bastin *et al.* (Reports, 12 May 2017, p. 635) infer forest as more globally extensive than previously estimated using tree cover data. However, their forest definition does not reflect ecosystem function or biotic composition. These structural and climatic definitions inflate forest estimates across the tropics and undermine conservation goals, leading to inappropriate management policies and practices in tropical grassy ecosystems.

Full text: dx.doi.org/10.1126/science.aao1309

Response to Comment on "The extent of forest in dryland biomes"

J.-F. Bastin, D. Mollicone, A. Grainger, B. Sparrow, N. Picard, A. Lowe, R. Castro
Griffith *et al.* do not question the quality of our analysis, but they question our results with respect to the definition of forest we employed. In our response, we explain why the differences we report result from a difference of technique and not of definition, and how anyone can adapt—as we did—our data set to any forest definition and tree cover threshold of interest.

Full text: dx.doi.org/10.1126/science.aao2079

ERRATA

Erratum for the Review "Quantum simulations with ultracold atoms in optical lattices" by C. Gross and I. Bloch, *Science* **357**, eaap9526 (2017). Published online 22 September 2017; 10.1126/science.aap9526

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