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LETTERS

Algae covers the beach in Qingdao, Shandong Province, China.

Edited by Jennifer Sills

China's algal bloom suffocates marine life

Every summer since 2007, algal blooms have grown in China's Yellow Sea (1). This year, covering about 1746 km², the bloom is 2.3 times larger than the country's previous record-holding bloom in 2013 (2). Such massive quantities of algae block sunlight from entering the ocean and deplete oxygen levels, suffocating marine life (3). The algae also pose challenges for tourism and marine transport. The city of Qingdao has deployed 12,686 boats to clean the water, collecting 457,700 tons of algae by 12 July (2). The algae are expected to persist until mid-August (4), at enormous economic and biological cost. Mitigating the damage will require regional collaboration.

The massive algae bloom is the result of a complex interaction between excessive coastal use for aquaculture, climate change, and coastal eutrophication. Booming seaweed aquaculture businesses in neighboring Jiangsu province are alleged to be the primary culprit for algal increases (5), which are then transported to coastal areas such as Qingdao by ocean currents and wind (6). Seaweed aquaculture in Jiangsu has increased by more than an order of magnitude since 2000, resulting in commensurate increases in algae production (7). Compounding the trend, warming ocean temperatures favor the growth and expansion of algae;

increases in extreme weather events, such as storms, destroy the infrastructure that algal matter attaches to, facilitating its spread to the sea. Meanwhile, coastal eutrophication increases nitrate and phosphate levels, intensifying algal blooms (8). Other human uses of the land, including large-scale fisheries, land reclamation, and resource extraction, compete for land in this coastal area, further exacerbating algal production. As increasing eutrophication combines with climate change and human use (9, 10), algae blooms will continue to threaten Yellow Sea marine life in the years to come.

Integrated actions are needed to address future algal blooms. Water quality along the coast should be monitored and pollution controlled to reduce eutrophication. An early warning system for algal blooms should be established, including public engagement throughout the algal control process. Moreover, regional coastal and ocean industrial development should be better coordinated under China's marine functional zoning and ecological red-line policies, which divide marine areas into different types of basic functional areas and legislate to protect them. This supervision helps guide the development of the marine industry and control the expansion of aquaculture, but coastal and ocean industrial development covers different marine functional areas, requiring increased coordination between provinces (11). Finally, an ecological compensation mechanism should be established at the regional level (4). Upstream provinces that are the source of the algal blooms,

such as Jiangsu province, should compensate downstream provinces that bear the ecological and economic costs, such as Shandong province. Alternatively, downstream provinces should compensate upstream provinces for reducing algal flows to below a certain threshold. Controlling China's algal blooms requires regional collaborative governance to better manage the development of the seaweed industry and its environmental impacts.

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REFERENCES AND NOTES

1. Y. Xiao *et al.*, *Mar. Pollut. Bull.* **140**, 330 (2019).
2. F. Yang, Y. Hu, "Qingdao algal bloom reached the highest value in history, experts say it may exist offshore for a long time," *China News* (2021); www.chinanews.com/sh/shipin/cns/2021/07-19/news895145.shtml [in Chinese].
3. S. Dineva, *Environ. Sci. Pollut. Res.* **10.1007/s11356-021-13475-8** (2021).
4. X. Chen, C. Wang, "The algal bloom in Qingdao will last until mid-August, and political consultative committee members call for an 'international chess game' to manage it," *Newspaper of the Chinese People's Political Consultative Conference* (2021); www.rmzxb.com.cn/c/2021-07-07/2898577.shtml?n2m=1 [in Chinese].
5. E. Rees, "Algal blooms fed by climate change, farm pollution and aquaculture," *China Dialogue* (2014); <https://chinadialogue.net/en/climate/7271-algal-blooms-fed-by-climate-change-farm-pollution-and-aquaculture/>.
6. M.-J. Zhou *et al.*, *Estuar. Coast. Shelf Sci.* **163**, 3 (2015).
7. Q. Xing *et al.*, *Remote Sens. Environ.* **231**, 111279 (2019).
8. E. Marris, *Nature* **10.1038/news.2008.998** (2008).
9. G. M. Hallegraeff *et al.*, *Commun. Earth Environ.* **2**, 117 (2021).
10. Y. Wang *et al.*, *Harmful Algae* **10.1016/j.hal.2021.102058** (2021).
11. W. Lu *et al.*, *Mar. Pol.* **62**, 94 (2015).

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Eastern Europe's fraught waterway plans

In December 2020, the Ukrainian parliament passed the Inland Water Transport Act, paving the way for the construction of the E40 international waterway, Europe's longest water route (1). The proposed 2000-km waterway would connect the Baltic Sea port in Gdansk, Poland, with the Black Sea port of Kherson, Ukraine, likely within a decade. The waterway would include parts of the Vistula, Wieprz, Bug, Pina, Pripyat, and Dnieper rivers (2, 3), posing a threat to the wetlands of Polesia, an ecosystem that has been referred to as Europe's Amazon (4). The Ukrainian government supports this project as a symbol of geopolitical connection to Europe during the country's conflict with Russia (3) and will likely fund the first part of the construction in its 2022 or 2023 budget, but thorough ecological assessments should take place before the project moves forward (2, 3).

The proposed E40 would require construction in protected areas such as Polesie State Radioecological Reserve in Belarus and Mizhrichynsky Landscape Park and Chernobyl General Zoological Reserve (part of the Chernobyl Radioecological Reserve) in Ukraine. In April, the Ukrainian government removed the E40 from the updated draft 2030 Chernobyl Exclusion Zone Development Strategy (5), allowing construction work on nearby river bottoms that otherwise would have been forbidden. The planned waterway would pass within 2 km of the former Chernobyl nuclear plant (5, 6). Now that an exception has been made for its construction, the project will likely bring radionuclides that were emitted during the Chernobyl disaster from river bottoms to the surface (5, 6).

Poland also strongly supports the planned construction (6, 7), despite the risks the project poses to the country's protected areas, including 12 Natura 2000 areas, 1 national park, 4 landscape parks, and 24 nature reserves (2). In addition, the E40 would deprive the 772-km Bug river—the last and the longest unregulated river in Europe (2, 3, 6, 7)—of its ability to perform ecosystem services, threatening the drinking water supply for Warsaw's 1.8 million inhabitants by compromising the river's role in treating contaminated water flowing to Poland from Ukraine (3, 6, 7).

The E40 waterway is a serious threat to vulnerable species, such as the aquatic warbler (*Acrocephalus paludicola*) (8), and ecosystems that survived the communist period in Eastern Europe (2). In Ukraine

and Poland, there is a strong political will to implement the project (1, 6), but areas of global and regional environmental importance should not be put under pressure for political reasons. Scientists must work to prevent the coming habitat destruction by appealing to the governments of these countries to postpone construction until the environmental consequences are better understood.

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REFERENCES AND NOTES

1. O. Shevchenko, "Ukraina przyjęła ustawę istotną dla odbudowy drogi wodnej E40" (2021); www.ecpp.org.pl/ukraina-przyjela-ustawe-istotna-dla-odbudowy-drogi-wodnej-e40 [in Polish].
2. G. Grzywaczewski, I. Kitowski, *Oryx* **53**, 4 (2019).
3. I. Kitowski, M. Oskierko, *Przegląd Geopolit.* **30** (2019) [in Polish].
4. P. Weston, "The race to save Polesia, Europe's secret Amazon," *The Guardian* (2020).
5. Save Polesia, "E40 waterway removed from Ukrainian Exclusion Zone Strategy" (2021); <https://savepolesia.org/e40-waterway-removed-from-ukrainian-exclusion-zone-strategy>.
6. P. Nowak, "Droga wodna E40 ma połączyć Bałtyk z Morzem Czarnym. Eksperti ostrzegają: To grozi katastrofą" (2020); <https://kurierlubelski.pl/droga-wodna-e40-ma-polaczyc-baltyk-z-morzem-czarnym-eksperti-ostrzegaja-to-grozi-katastrofa/ar/c8-14940338> [in Polish].
7. Polish Society for the Protection of Birds, "Kosztowna droga wodna E40—ekspertyza ekonomiczna" (2020); <https://otop.org.pl/2020/11/kosztowna-droga-wodna-e40-ekspertyza-ekonomiczna> [in Polish].
8. G. Grzywaczewski, I. Kitowski, *Science* **365**, 134 (2019).

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Australia threatens to weaken forest laws

Victoria is one of Australia's most forested jurisdictions. The state supports 7.2 million ha of forest, of which 1.8 million ha are broadly allocated for logging (1). The native forests of Victoria are critical for water production, carbon storage, and biodiversity conservation (2). Victoria has taken steps to protect its natural forests by committing to phasing out all native forest logging across the state by 2030 and to substantially reducing current levels of cutting starting in 2024 (3). However, Victoria is now updating its forest code (4). Instead of strengthening much-needed protections, the state is considering changes that would weaken current regulations and put its forests in renewed jeopardy.

Motivated by rapidly dwindling timber supplies (5), policy-makers in Victoria have planned changes that will permit environmentally harmful practices that are currently prohibited. For example, logging

is illegal within water catchments where terrain exceeds 30 degrees in slope (6, 7) to limit erosion, conserve aquatic ecosystems, and ensure water quality for human consumption. Under the revised laws, these slope restrictions will be relaxed.

The current policy to protect forest on steep slopes, although scientifically sound, has been poorly enforced. Recent terrain analysis indicates that 75% of 204 logged sites (called cutblocks) in one Victorian water catchment were on areas steeper than 30 degrees; logging of these areas therefore breached current laws (8). A ministerial review (9) and legal cases have found that logging frequently breached codes of practice (10).

Australia has been pilloried for its record on climate inaction (11), biodiversity loss, and under-spending on species conservation (12). Weakened forest laws will further accelerate biodiversity decline. Victoria's government must resist industry pressure to degrade environmental laws and weaken codes of forest practice and instead focus on strengthening enforcement of current laws.

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REFERENCES AND NOTES

1. Commissioner for Environmental Sustainability Victoria, "State of the Forests 2018" (Government of Victoria, Melbourne, Australia, 2018); www.ces.vic.gov.au/reports/state-forests-2018.
2. H. Keith *et al.*, *Nat. Ecol. Evol.* **1**, 1683 (2017).
3. Government of Victoria, "Timber harvesting regulation" (2021); www.vic.gov.au/timber-harvesting.
4. Victoria Department of Environment, Land, Water and Planning, "2021 proposed variation of the Code of Practice for Timber Production" (2021); <https://engage.vic.gov.au/code-practice-timber-production>.
5. Jaclyn Symes, "Review to protect Victoria's forests, jobs and timber industry" (2020); www.jaclynsymes.com.au/media-releases/review-to-protect-victorias-forests-jobs-and-timber-industry/.
6. Victoria Department of Environment and Primary Industries "Code of Practice for Timber Production 2014" (2014); www.forestsandreserves.vic.gov.au/_data/assets/pdf_file/0016/29311/Code-of-Practice-for-Timber-Production-2014.pdf.
7. Office of the Conservation Regulator, "Regulating timber harvesting on steep slopes" (Office of the Conservation Regulator, Melbourne, Australia, 2021).
8. C. Taylor, D. B. Lindenmayer, *Environ. Sci. Pol.* **120**, 204 (2021).
9. J. Brockington, N. Finnegan, P. Rozen, "Independent review of timber harvesting regulation: Panel report to the Secretary of the Department of Environment, Land, Water and Planning" (Victorian Government Library Service, Melbourne, Australia, 2018).
10. M. Jagot, J. E. Griffiths, R. M. Derrington, *FCAFC 92 Cost Order* (Federal Court of Australia, Melbourne, Australia, 2021).
11. M. Mazengarb, "Australia ranked dead last in world for climate action in latest UN report," *Renew Economy* (2021); <https://reneweconomy.com.au/australia-ranked-dead-last-in-world-for-climate-action-in-latest-un-report/>.
12. A. Waldron *et al.*, *Nature* **551**, 364 (2017).

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