



An illustrated transcript from the film series

The Complete Guide to Saving the Earth

For People in a Hurry

AGRICULTURE

Wetlands

Scan to watch film
<https://youtu.be/J8qwBWvEQyl>





If you asked people...

What is the most effective ecosystem for storing CO₂?

...they would probably say...

Rainforests!

...but that's **wrong!**

There's a secret environment that most people never think about, and it stores more than twice the carbon of all forests^[1,2].

RAINFOREST

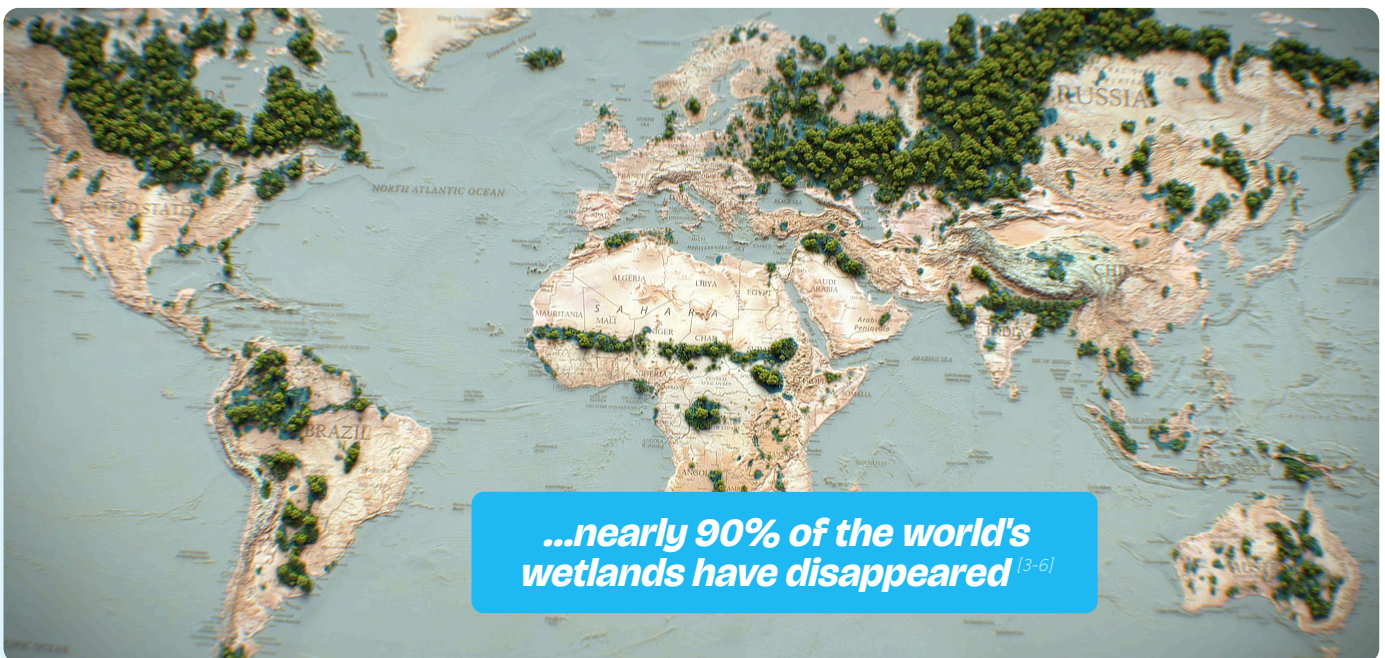


It's the Wetlands!



These forgotten ecosystems are crucial in the fight against climate change, and they offer a lot more than just carbon capture!

Unfortunately, they're under threat—over the last 300 years, nearly 90% of the world's wetlands have disappeared^[3-6]. So, why are they disappearing so quickly? And what makes them so special?



Please note that this resource follows American English spelling conventions



Wetlands are ecosystems flooded by water — they include peatlands, seagrass meadows, lagoons, mangrove forests, and swamps^[7,8,9]. They are home to 40% of the world's species, from aquatic plants to rare birds. However, there are now few of these ecosystems left.

They currently cover around 2% of the Earth's surface^[6,10,11,12], and yet they store more than 20% of all the organic carbon in the world's ecosystems^[13,14,15].

But how do they store so much carbon? Well, wetlands have a trick up their sleeve.

Let's take a closer look and dive into the science.



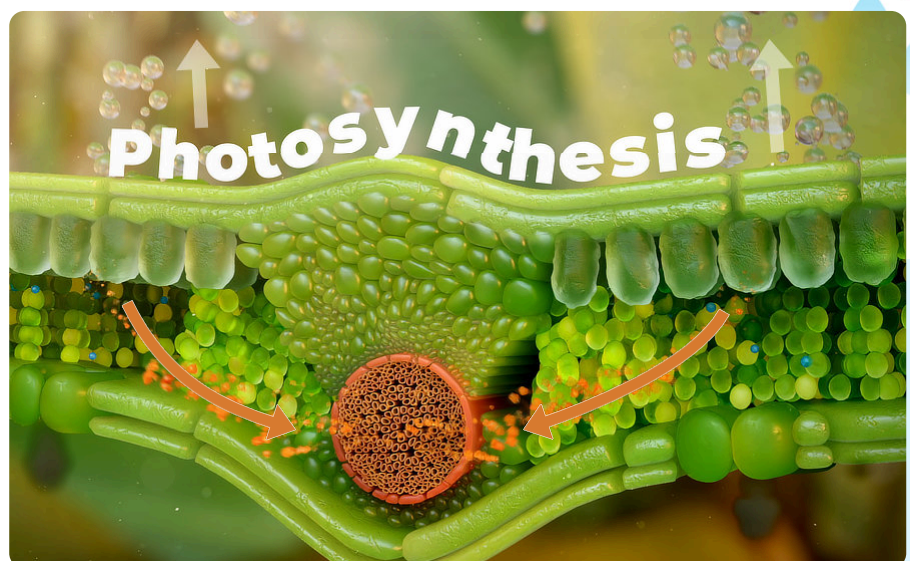
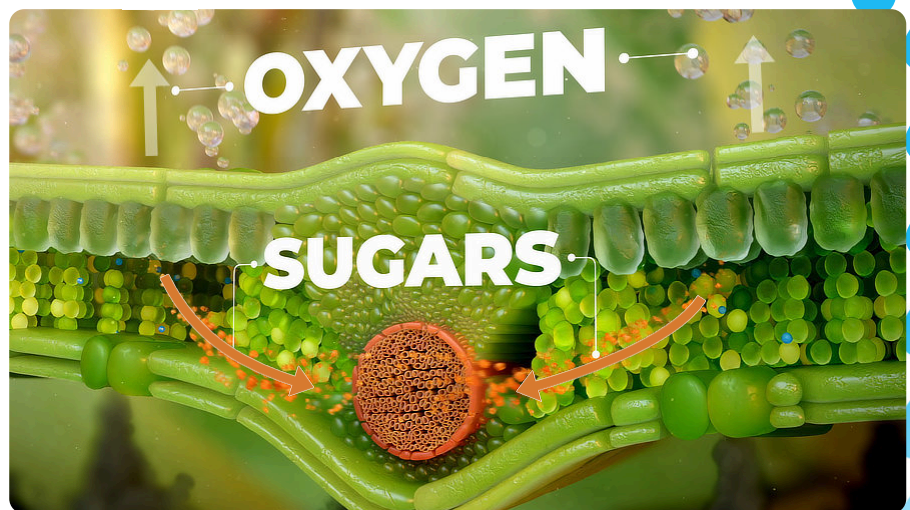
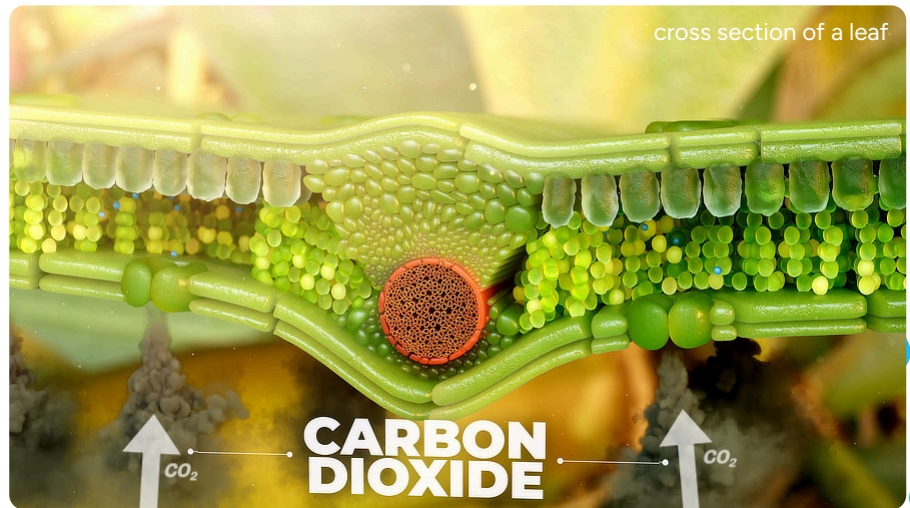
Wetlands cover around 2% of the Earth's surface^[6,10,11,12], and yet they store more than 20% of all the organic carbon in the world's ecosystems.^[13,14,15]



Plants and trees need CO₂ in the same way that they depend on water and sunlight.

Carbon dioxide plays an essential role supporting life on Earth. In fact, plants and trees need CO₂ in the same way that they depend on water and sunlight.

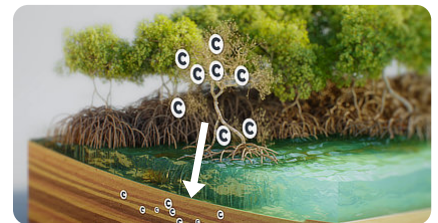
They absorb carbon dioxide and water from the atmosphere through tiny pores and turn it into **sugars** and **oxygen** in a process called **photosynthesis**^[16-19]. Then they use these sugars as fuel to grow stronger, and since they don't need all the oxygen, they give it away for free!





Usually in a cultivated field or a forest, some of the CO_2 gets stored as carbon in the soil^[20,21,22]. But when plants and trees die, they decompose and release a lot of the carbon they hold back into the atmosphere^[23,24,25].

Wetlands play by a different set of rules: The CO_2 is snatched up just like before, but when the plants and trees die, the water slows down their decomposition^[26,27,28].

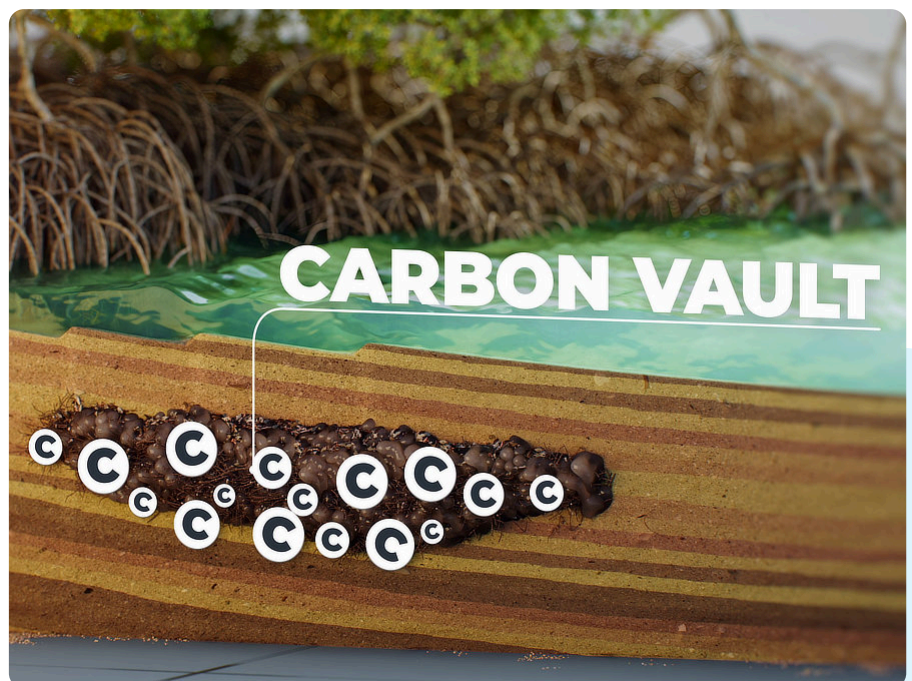


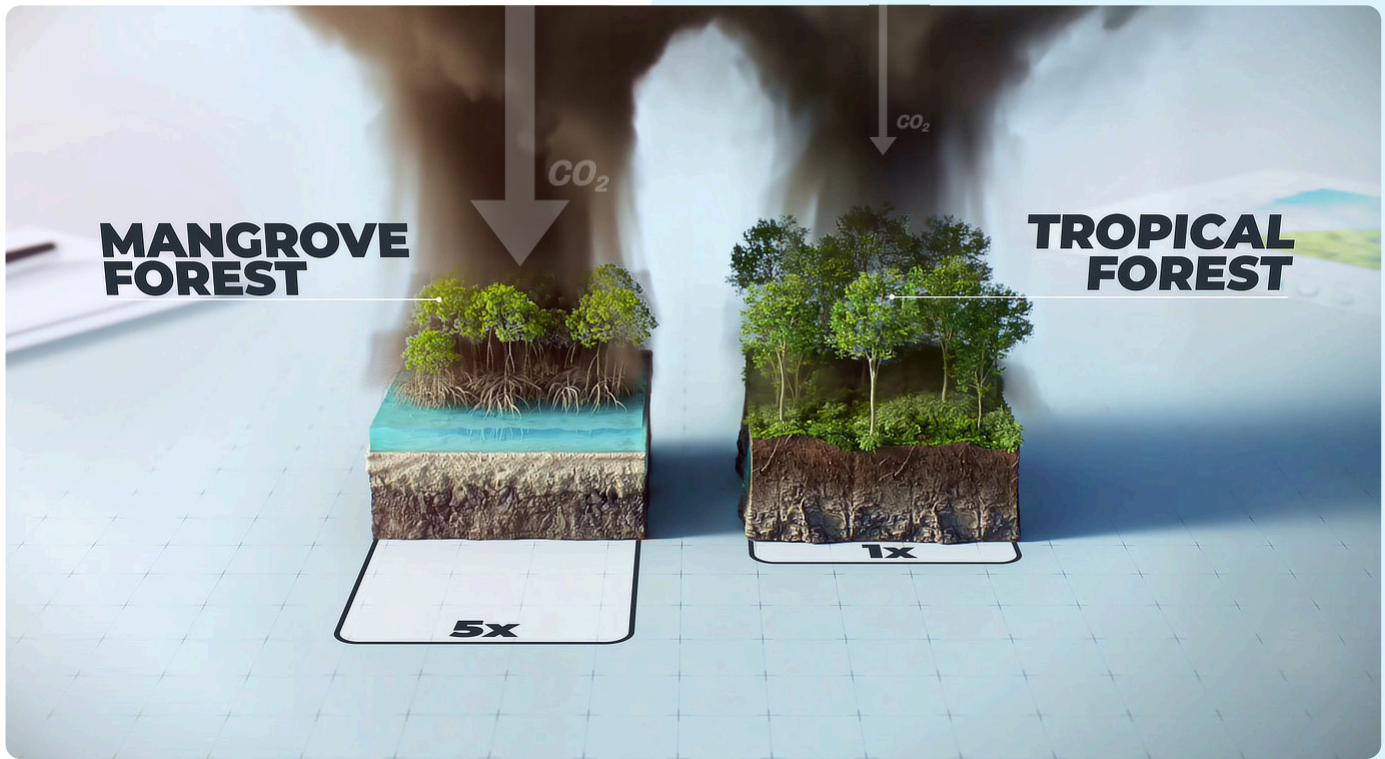
Layers of sediment stop CO_2 from escaping.

Over time, layers of sediment begin to form, piling up over the dead plant matter and creating a natural **carbon vault**.

Each new layer further traps the carbon, stopping it from escaping back into the atmosphere. These layers aren't just temporary storage either—they hold onto that carbon for hundreds and even thousands of years!^[29-32]

This puts wetlands in the major league of carbon sinks.





In fact, a mangrove forest can store up to five times more carbon than tropical forests^[32,33]—but this can only happen if these areas are protected. Currently, 88% of the wetlands around the world are unprotected and at risk of being destroyed^[34,35].





Humans pose the biggest danger because these ecosystems are often drained for building new infrastructure, like farms^[5,36,37].

Demolishing these ecosystems is dangerous for four main reasons:^[38]

Reason 1: Wetlands are crucial habitats for 40% of Earth's species^[39,40,41]. By destroying this biodiversity, the health of the planet is put at great risk.

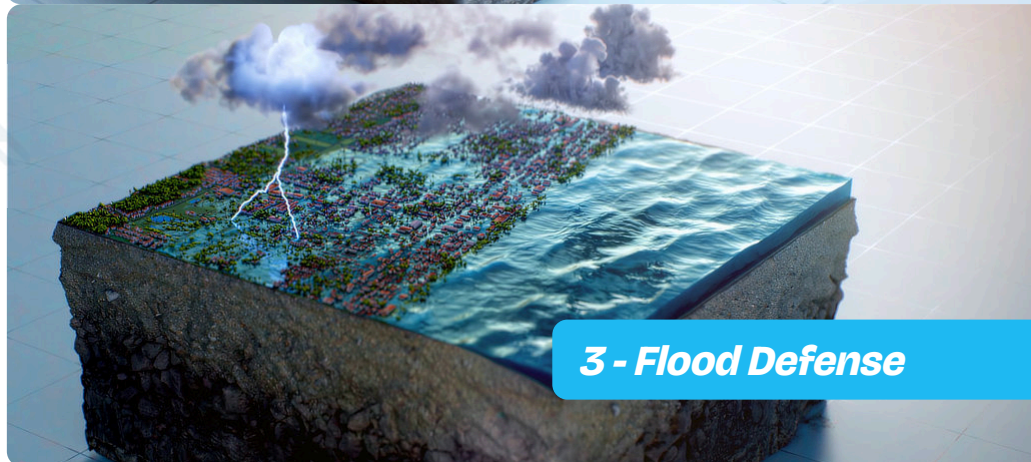
Reason 2: Wetlands act as natural and sustainable water filters^[42,43,44]. Without them, there would be less clean drinking water, and it could become more expensive to make it safe to drink^[45,46,47].

Reason 3: These areas protect local communities against sea level rise and storms^[48,49,50]. If you lose them, you also lose a natural flood barrier and layer of protection.

And most importantly,

Reason 4: Although wetlands can store carbon for thousands of years, if they are destroyed, they not only lose their vital role in capturing CO₂ for future generations, but they also release those thousands of years of stored carbon back into the atmosphere. This makes things far worse for the planet^[29-34,51].

Scientists estimate that the current destruction of wetlands unleashes over a billion metric tons of CO₂ every year^[52-56], which is more than the annual emissions of the global aviation industry^[57,58].

**1 - Wildlife****2 - Filtration****3 - Flood Defense****4 - Carbon Storage**



Fortunately, humans are beginning to take action.

In Australia, the government is teaming up with local and Indigenous communities to map, monitor, and restore wetlands^[59,60,61].

UN initiatives and global efforts like the *Ramsar Convention* mean countries all over the world are joining forces to keep these vital ecosystems thriving, as well as introducing smart legislation and policies to make sure urban growth is in harmony with nature^[62,63,64].



Wetlands need protection! After all, they aren't just bustling biodiversity hubs—they're secret weapons in the fight against climate change!





More Ways to Save the Earth

Earth 2050 has identified 42 solutions to get the planet to net zero carbon by the year 2050

Why Solar Power Is the Future of Our Planet



<https://youtu.be/8lCC9k-cKFQ>

Could humans power the entire planet from a desert?

We explore this idea and other options, from rooftops to agri-voltaics to floating arrays. We show how solar power actually works, and explore new materials like perovskite that turn windows into solar panels.

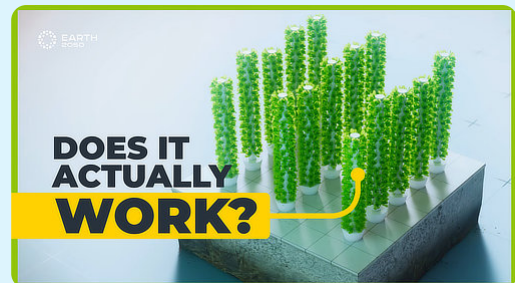


Solar is now the cheapest source of energy in human history, but there are still some problems to overcome...

Is Vertical Farming the Future of Food?

Growing food upward, not outward, saving space and water, and keeping food local.

We show how crops grow without soil using hydroponics and aeroponics. They're lit by LEDs and guided by automation. We look at where urban sites could shine. Then we outline today's limits; energy, crop choice, skills and high costs, and the pathways that could help, like using renewables and waste heat. Big harvest, small footprint, great choice for space exploration!



<https://youtu.be/kITR8FhkPIY>

The Secret Energy Source in Every Atom



<https://youtu.be/R8UGarcy7CY>

Few topics split the room like nuclear energy.

We explain how fission makes electricity without burning fuel, why steady output can help alongside renewables, and what history tells us about accidents and waste.



We also look at costs and timelines, long-term waste storage, and where newer designs like SMRs could show up next, from nuclear-powered container ships to data centers.

VISIT OUR WEBSITE [EARTH2050.COM](https://Earth2050.com)



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FURTHER VIDEOS (NON-AFFILIATED)

Overview

[What are wetlands? | WWT](#)
[Wetlands - Mangroves, Marshes and Bogs - Biomes#9 | Geodiode](#)
[Peatlands 101 | The Nature Conservancy](#)

How it Works

[Wetlands: A Powerful Carbon Sink | Ducks Unlimited Canada](#)
[Blue Carbon, Explained | WWT](#)
[What on Earth is Blue Carbon? | Conservation International](#)

Importance of Wetlands

[Why Wetlands are Nature's Super-Systems | WWT](#)
[World Wetlands Day 2022: Importance of wetlands at the time of climate change. | Down to Earth](#)
[Why Are Wetlands Important | Wetland | The Planet Voice](#)
[Peatlands Critical In Climate Change Fight | National Geographic](#)
[What is peatland and can it save the planet? | RSPB](#)
[From wasteland to wetland. Why our coastal wetlands are vital for birds and people | RSPB](#)
[Coastal Wetlands Are a Critical Ecosystem for a Healthy Climate | Pew](#)
[Importance of Mangrove Forests | Mangrove Action Project](#)
[Mangroves: how they help the ocean | The Economist](#)

Methane from Wetlands

[Wetlands and Methane | Wetlands Int'l](#)
[Methane Emissions from Wetlands | NASA Goddard](#)



FURTHER READING

Summary Information

[What Are Wetlands? | Wetlands International Europe](#)
[Wetlands | Ecosystems and their services | Biodiversity Information System for Europe](#)
[Wetland habitats | WWT](#)
[What Is a Wetland? Plus 8 Key Wetland Facts | World Wildlife Fund](#)

How It Works

[Photosynthesis | Definition, Formula, Process, Diagram, Reactants, Products, & Facts | Britannica](#)
[Water Keeps Plant Matter From Releasing Carbon | AskNature](#)
[Coastal 'Blue Carbon': An Important Tool for Combating Climate Change | The Pew Charitable Trusts](#)
[Coastal Blue Carbon | NOAA](#)

Threats

[Threats to wetlands | WWT](#)
[Protect Coastal Wetlands | Project Drawdown](#)
[Threats to Wetlands | EPA](#)

Reason 1: Biodiversity

[Wetlands and Biodiversity Factsheet | Ramsar](#)

Reason 2: Water Filtration

[Wetland Functions and Values: Surface and Ground Water Protection | Department of Environmental Conservation](#)

Reason 3: Flood Protection

[When traditional flood defences are no longer enough: wetlands and flood prevention | WWT](#)

Reason 4: Carbon Release

[Climate change and wetlands | WWT](#)

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- [1] [Wetlands: The key to coping with climate change | Ramsar](#)
- [2] [Peatlands store twice as much carbon as all the world's forests | UNEP](#)
- [3] [How much wetland has the world lost? Long-term and recent trends in global wetland area | CSIRO PUBLISHING | Marine and Freshwater Research](#)
- [4] [Global conservation priorities for wetlands and setting post-2025 targets | Communications Earth & Environment](#)
- [5] [Threats to wetlands | WWT](#)



- [6] [Global Extent and Distribution of Wetlands: Trends and Issues | CSIRO PUBLISHING | Marine and Freshwater Research](#)
- [7] [What Are Wetlands? | Wetlands International Europe](#)
- [8] [Wetlands | Biodiversity | European Environment Agency & European Commission](#)
- [9] [Wetlands as nature-based solutions for water management in different environments | Current Opinion in Environmental Science & Health](#)
- [10] [Wetlands are the Lifeblood of our Planet and They Need a Transfusion | MedWet](#) (See Reference Notes*)
- [11] [World Wetlands Day | United Nations](#)
- [12] [Mitsch, Gosselink: Wetlands, 4th Edition | Wiley](#) (cited in [14])
- [13] [Carbon sequestration | Philosophical Transactions of the Royal Society B](#)
- [14] [Carbon storage in US wetlands | Nature Communications](#)
- [15] [Recovering wetland biogeomorphic feedbacks to restore the world's biotic carbon hotspots | Science](#)
- [16] [Plant Physiology and Development | University of California | CABI](#)
- [17] [How Is Carbon Dioxide Absorbed During Photosynthesis? | Sciencing](#)
- [18] [The Carbon Cycle | Earth Observatory | NASA](#)
- [19] [Photosynthesis | Definition, Formula, Process, Diagram, Reactants, Products, & Facts | Britannica](#)
- [20] [Soil Carbon Storage | Nature Education](#)
- [21] [Soil Carbon Sequestration, Offsetting and Credits | Biochar](#)
- [22] [Carbon Sequestration in Soils | ESA](#)
- [23] [Resolving the intricate role of climate in litter decomposition | Nature Ecology & Evolution](#)
- [24] [SOIL: The Hidden Part of the Climate Cycle | European Commission](#)
- [25] [DOE Explains...the Carbon Cycle | US Department of Energy](#)
- [26] [Trends of litter decomposition and soil organic matter stocks across forested swamp environments of the southeastern US | PLOS One](#)
- [27] [Water Keeps Plant Matter From Releasing Carbon – Biological Strategy | AskNature](#)
- [28] [Wetland Soils - an overview | ScienceDirect Topics](#)
- [29] [Carbon Sequestration in Wetlands | MN Board of Water And Soil Resources](#)
- [30] [Wetlands for Carbon Storage | WWT](#)
- [31] [What is Blue Carbon? | The Blue Carbon Initiative](#)
- [32] [Coastal Blue Carbon | NOAA](#)
- [33] [Mangroves among the most carbon-rich forests in the tropics | Nature Geoscience Letters | US Department of Agriculture \(In: Future Mangrove Carbon Storage Under Climate Change and Deforestation | Frontiers in Marine Science\)](#)
- [34] [Protect Coastal Wetlands | Project Drawdown®](#) (See Reference Notes*)
- [35] [Global Assessment of Inland Wetland Conservation Status | Bioscience](#)
- [36] [Wetlands and agriculture: impacts of farming practices and pathways to sustainability | Ramsar Convention on Wetlands](#)
- [37] [Agricultural use of wetlands: opportunities and limitations | Annals of Botany](#)
- [38] [What are wetlands, and why are they so critical for life on Earth? | National Geographic](#)
- [39] [Wetlands and Biodiversity | Ramsar Convention on Wetlands](#)
- [40] [Why wetlands? | WWT](#)
- [41] [Ensuring the Global Biodiversity Framework prioritises measures to safeguard wetlands and wetland biodiversity | Wetlands International](#)
- [42] [Nature's Wealth | International Institute for Sustainable Development](#)
- [43] [Wetlands: Water Living Filters? | Repositório Digital de Publicações Científicas](#)
- [44] [Water Purifying Capacity of Natural Riverine Wetlands in Relation to Their Ecological Quality | Frontiers in Environmental Science](#)



- [45] [Pollution busting wetlands | WWT](#)
- [46] [Wetland Functions and Values: Surface and Ground Water Protection | Department of Environmental Conservation | State of Vermont](#)
- [47] [Green Recovery Report 2023/24 | Severn Trent Water](#)
- [48] [Restoration and management of coastal wetlands | Climate Adapt | European Environment Agency](#)
- [49] [Valuing natural habitats for enhancing coastal resilience: Wetlands reduce property damage from storm surge and sea level rise | PLOS One](#)
- [50] [Coastal marshes provide valuable protection for coastal communities from storm-induced wave, flood, and structural loss in a changing climate | Scientific Reports](#)
- [51] [Wetlands In a Changing Climate: Science, Policy and Management | Wetlands – Journal of the Society of Wetland Scientists](#)
- [52] [Conversion of coastal wetlands, riparian woodlands, and peatlands increases greenhouse gas emissions: A global meta-analysis | Global Change Biology](#) (See Reference Notes*)
- [53] [Land use and land cover changes in coastal and inland wetlands cause soil carbon and nitrogen loss | Global Ecology and Biogeography](#)
- [54] [The role of peatlands in climate regulation \(Chapter 4\) | Peatland Restoration and Ecosystem Services](#)
- [55] [Estimating Global “Blue Carbon” Emissions from Conversion and Degradation of Vegetated Coastal Ecosystems | PLOS One](#) (Press release: [Wetlands: Destroyed coastal ecosystems emit a massive amount of carbon | Nicholas Institute for Energy, Environment & Sustainability](#))
- [56] [Annual emissions of carbon from land use, land-use change, and forestry from 1850 to 2020 | Earth System Science Data](#)
- [57] [Emissions Gap Report 2024 | UNEP](#)
- [58] [Aviation | IEA](#)
- [59] [Wetlands and Indigenous values | Department of Climate Change, Energy, the Environment and Water | Australian Government](#)
- [60] [The Wetlands Policy of the Commonwealth Government of Australia | Ramsar Convention on Wetlands](#)
- [61] [Indigenous wetland monitoring \(info sheet\) | Resilient Landscapes – National Environmental Science Programme | The University of Western Australia](#)
- [62] [The List of Wetlands of International Importance | Ramsar Convention on Wetlands](#)
- [63] [The Ramsar Convention Manual, 6th edition | Ramsar Convention on Wetlands](#) (see [Home page | The Convention on Wetlands, Ramsar](#) for more)
- [64] [Wetlands: the unsung heroes of the planet | UNEP](#)

*REFERENCE NOTES

[6,10,11,12] Clarification of source estimates on global wetland coverage:

[6] indicates that wetlands cover 12.1×10^6 km². This is approximately **2.3%** of the Earth’s surface.

[10] states wetlands cover 1.5-3% of the Earth’s surface globally. It is a press release, written by Giuseppe Dodaro, the Wetland Restoration Expert at MedWet (The Mediterranean Wetlands Initiative), on the publication of the Restoring Mediterranean Wetlands Policy Playbook (2022) [^], to which MedWet contributes. While the figure of 1.5-3% is not mentioned specifically in this report, it is widely quoted in adjacent press releases by other organisations that contributed to the report.



[11] indicates that wetlands cover 6% of Earth's land surface. Since land accounts for 29% of Earth's total surface^B, 6% of land area = **1.74%** of total area. [12] stated wetlands account for 5-8% of Earth's land surface, as cited in [14], reinforcing figures from [10] and [11].

^A [Restoring Mediterranean Wetlands Policy – Playbook 2023 | Wetland Based Solutions Initiative](#)

^B [1.1 Overview of the Oceans – Introduction to Oceanography | Roger Williams University](#)

[34,35] Information on wetland protection:

[34] indicates coastal wetlands alone cover 54.6 million hectares, which is approximately 1% of earth's surface. This source also states that of the 54.6 million hectares of coastal wetlands, 11.48 million hectares are protected (8.04 million hectares of strict and non-strict protection categories + 3.44 million hectares Indigenous People's Lands (IPLs)). Subsequently, this means approximately 79% of coastal wetlands are unprotected. Inland wetlands have not been included in this estimate.

[35] indicates that 89% of inland wetlands are unprotected (i.e. excluding coastal). [35] also states that 92.8% of continental wetland area is inland and only 7.2% is coastal. Combining this with information from [34] noted above, it follows: (79% of 7.2%) + (89% of 92.8%) = **88%** total wetlands are unprotected.

[52-56] Estimate of global emissions from destruction of wetlands:

Wetland ecosystems are globally significant reservoirs of carbon, but their degradation and destruction due to land-use change and other anthropogenic activities have substantial implications for greenhouse gas emissions. The statement, "Scientists estimate that, combined, the emissions released from the destruction of wetlands equate to over 1 billion metric tons of carbon dioxide every year," is derived from a synthesis of multiple sources and studies. Below is a breakdown and clarification of the scientific findings supporting this statement:

[52] Meta-analysis Estimate: A global meta-analysis conducted by Lishan Tan et al. (2019) reported an annual emission of at least 0.96 ± 0.22 gigatons (Gt) of CO₂-equivalent (CO₂e) from land-use and land-cover change (LULCC) across all wetlands. This figure incorporates the cumulative impacts of CO₂, methane (CH₄), and nitrous oxide (N₂O), adjusted by their relative warming impacts. Methane is likely to have a significant negative effect on CO₂e, while N₂O is likely to have a significant positive effect. [53] expands on this paper through further analysis of soil nitrogen and carbon dynamics.

Natural wetlands are known to be significant sources of methane, and their conversion to other land uses often leads to an overall reduction in CH₄ emissions due to the drainage and aeration of soils, which allows aerobic decomposition and stops methanogenesis. Given methane's potent warming impact, this might sound good for the climate - but Wetlands contribute to natural cycles and levels of atmospheric methane. Climate change threatens to disrupt this process, whereby a warmer climate is increasing rates of anaerobic decomposition and methanogenesis worldwide, even to the point of outpacing methane produced by global use of fossil fuels (see additional links below). Therefore, wetlands may be considered a double-edged sword in the face of global warming and habitat destruction. Regardless, destruction of wetlands unleashes substantial carbon dioxide (CO₂) and nitrous oxide (N₂O) emissions, resulting from the unfettered decomposition of organic matter and the application of fertilizers in new agricultural settings, which far outweigh any reductions in methane emissions.

[54] Degraded Peatlands: Joosten et al. (2016) estimated that the oxidation of degraded peatlands alone contributes approximately 1.15 Gt of CO₂ annually, excluding emissions from peat fires. When fires are included, this figure rises to approximately 2 Gt CO₂.

[55] Coastal Wetlands: Pendleton et al. (2012) estimated emissions from the destruction of coastal wetlands to be around 450 million tons (0.45 Gt) of CO₂ per year. However, other sources suggest this figure could be as high as 1.02 Gt CO₂, depending on assumptions about the scale and nature of degradation.

[56] Comprehensive Modeling: A more recent study published in *Earth System Science Data* (2023) estimated that gross emissions from LULCC in wetlands, modeled across multiple wetland types, amount to 0.75 Pg of carbon per year. This equates to approximately 2.75 Gt CO₂ annually when converted from carbon to CO₂ using a factor of 3.67. This estimate is inclusive of peat oxidation and decomposition but may or may not fully account for peat burning, as detailed in the study's methodology.



Regional Contributions: For the tropics, [56] uses data from Randerson et al. (2013) and (2018) on emissions from burning peatlands and Hooijer et al. (2010) on draining of peatlands, extrapolated to the present. Outside of the tropics (Northern Hemisphere), they use estimates of carbon emissions from Qui et al. (2021) (full references in paper). Hooijer et al. (2010) and other studies on Southeast Asia have highlighted that tropical peatland degradation, particularly in Indonesia and Malaysia, is a disproportionately large source of wetland emissions, accounting for significant portions of both global peat oxidation and fire-related emissions.

Scientific Context and Considerations:

- The variation in reported figures arises from differences in methodologies (e.g. meta-analyses, model-based estimates, empirical measurements), definitions of wetland types, and the specific greenhouse gases included.
- Wetland degradation, including peat drainage and oxidation, is considered functional destruction of wetlands due to the irreversible or permanent loss of carbon storage and sequestration capacity, even without complete land conversion or clearance. Additional impacts include soil loss, compaction, nutrient depletion, water table mismanagement and pollution.
- The synthesis of these data sources supports the statement that emissions from wetland destruction exceed 1 Gt CO₂ annually, particularly when considering the combined effects of peatland degradation, peat fires, and coastal wetland conversion.
- Uncertainties remain in exact figures due to regional disparities in data availability, varying assumptions in global models, and the variable inclusion/exclusion of certain emissions processes (e.g. methane from anaerobic decomposition).

Additional Links – Methane Emissions:

[Recent intensification of wetland methane feedback | Nature Climate Change](#) (In: 'Exceptional' surge in methane emissions from wetlands worries scientists | Carbon Brief)

[Rapid shift in methane carbon isotopes suggests microbial emissions drove record high atmospheric methane growth in 2020–2022 | PNAS](#)

[Large Methane Emission Fluxes Observed From Tropical Wetlands in Zambia | Global Biogeochemical Cycles](#) (Press release: [Tropical Wetlands Emit More Methane Than Previously Thought | Eos](#))

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