CHEMWATCH

Bulletin Board

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JUL. 31, 2020

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ASIA PACIFIC

Thailand revised its pesticide residues monitoring procedures on fresh produce

2020-07-17

On July 15, the Thai FDA issues its revised pesticide residues monitoring measures on fresh produce that will be implemented on August 1, 2020. The revised monitoring measures will supersede any previous measures they officially published on the Thai FDA web site. Thailand Revised Its Pesticide Residues Monitoring Procedures on Fresh Produce The Office of Agricultural Affairs at the U.S. Embassy met with the Thai FDA on July 8 to discuss about the concerns over the new monitoring measures on fresh produce inspection at the port of entry. On July 15, the Thai Food and Drug Administration (FDA) issued the revised guidelines to test imported fresh produce for pesticide residues according to the Notification of the Ministry of Public Health No. 387 Re: Food Containing Pesticide Residues in Food. The revised measures supersede all previous measures officially published on the Thai FDA web site. The enforcement date remains August 1, 2020.

The revised monitoring measures will supersede any previous measures they officially published on the Thai FDA web site.

Below are key areas amended from previous announcements:

- The testing measure for "High Risk" category will be implemented on a random basis instead of on "every shipment" basis;

- The revised pesticides list required to be tested and on Certificate of Analysis for "High Risk" category - no more 134 pesticides required;

- The revised on the pesticides list required to be tested and on Certificate of Analysis for "Very High Risk" category - no more 134 pesticides required.

Clarification on the Guidelines

The guidelines were issued to inform importers and exporters of fresh produce on how the Thai FDA's Import and Export inspection Division will enforce their pesticide residues monitoring program and testing protocol in relation to the Ministry of Public Health Notification No. 387 Re: Pesticide Residues in Foods. (additional reference: Section III Pesticides and Other Contaminants of Thailand: FAIRS Country Report) The Thai Food and Drug Administration (FDA) has had a testing protocol in place for a while but considered it an internal practice. In the past, if any shipment tested positive, the exporter's names will be in the Thai FDA's quarantined list and the Thai FDA notified the importer for legal action (the importer notified

the exporter and paid a fine for the violation) and the following three shipments of the same product by the importer from the same exporter would be held and tested for pesticide residue. The Thai FDA classifies imported produce based on their risk levels into three classifications and from August 1, 2020 onwards, the following key measures will be implemented by the Thai FDA at the port of entry.

Full Report

USDA Global Agricultural Information Network, 17 July 2020

https://agfstorage.blob.core.windows.net/misc/FP_com/2020/07/22/Thai.pdf

22 October 2019

AICIS industrial chemicals regulatory news—new categorisation guidance on specific topics

2020-07-24

We have extra information to help you categorise the introduction of:

- chemicals in cosmetics
- chemicals in flavour or fragrance blends
- chemicals in tattoo inks
- UV chemicals

We have other guides to help you categorise the introduction of polymers and chemicals used for research and development. Note all of these guides are to be read in conjunction with our main Categorisation Guide.

AICIAS industrial chemicals regulatory news, 24 July 2020

https://www.industrialchemicals.gov.au/help-and-guides/extra-resources-help-you-categorise-your-introduction

APVMA tailored guidance for applicants

2020-07-14

We're improving our guidance material, tailoring it to the information you need to lodge the right application, with the right data and supporting evidence to meet APVMA criteria.

We have extra information to help you categorise the introduction of:

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Whether you're registering a new product or making a variation, you'll have access to current and clear guidance for that application type **before** you enter our online services portal.

The following tailored guidance is **available now**. At the end of the process you'll be able to start an application:

New product registrations

- I want to register a new product with an existing active or new combination of approved actives
- I want to register a new product which contains a new active constituent
- I want to register a product that is based on an existing registered reference product
- I want to register a product that is the same as a reference product
- I want to register a product and apply for the concurrent approval of a new source of active

Additional labels for a registered product

- I want an additional marketing name for my existing registered product

Variations to registered products

- I want to vary my product to amend a restraint, contraindication, precaution or side effect statement (vet products only)
- I want to vary my product to alter the shelf life/expiry date, in-use shelf life and/or storage conditions
- I want to vary a re-entry or handling instruction for my product
- I want to vary a withholding period and/or export interval
- I want to vary my product to add a new crop, animal species or situation
- I want to vary the sites of manufacture
- I want to vary a product pack size
- I want to vary the use of a product to include a new use, new application method, or new use instructions within an existing crop or situation (agricultural chemical products only)
- I want to vary my product to make a change to the product formulation**—New**

Timeshift applications

- I want to submit a timeshift application

The tailored guidance materials are an alternative pathway to the existing decision tree, which is still available.

We'll be gradually making more tailored guidance available for other common types of applications.

APVMA, 14 July 2020

https://apvma.gov.au/node/27441

Derogations tracker or eased regulations—Taiwan

2020-07-24

Taiwanese authorities are considering extending the registration deadline for the first batch of 106 priority existing chemicals (Pecs) until at least 2023, due to the impact of the coronavirus Covid-19 pandemic.

Doing so would require a legal amendment to the Regulation on new and existing chemical substances registration.

If approved, the delay will impact the publication deadlines of future batches of Pecs.

Chemical Watch, 24 July 2020

https://chemicalwatch.com/137841/covid-19-deadline-extensions-derogations-and-supply-chain-news

AMERICA

New PFAS rules set to take effect Aug. 3, among nation's strictest

2020-07-23

Starting Aug. 3, Michigan will have some of the strictest rules in the nation limiting chemical contaminants in drinking water supplies.

Rules governing the presence of seven per- and polyfluoroalkyl (PFAS) chemicals in drinking water will be filed with the Secretary of State's Office in the coming days after passing through the Legislature's Joint Committee on Administrative Rules.

Taiwanese authorities are considering extending the registration deadline for the first batch of 106 priority existing chemicals (Pecs) until at least 2023, due to the impact of the coronavirus Covid-19 pandemic.

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The rules governing 2,700 public water supplies exceed federal standards and could mean increased compliance costs for sites that fall short of the standards.

The new rules are likely to land more than 40 new sites onto the state's list of PFAS-contaminated areas, bringing the total to around 140.

Full Article

The Detroit News, 23 July 2020

https://www.detroitnews.com/story/news/local/michigan/2020/07/23/new-pfas-rules-take-effect-aug-3-standards-some-strictest-nation/5493618002/

Mexico's activist government pushes glyphosate ban that threatens food security and farmer welfare

2020-07-22

Biotech giant Bayer is currently in the fight of its life against more than 100,000 lawsuits alleging its flagship weedkiller Roundup (glyphosate) causes cancer. There is no sound scientific evidence to support such allegations, and every relevant research and regulatory authority in the world has concluded the herbicide poses no cancer risk when used appropriately by farmers. But Bayer, fearing for its financial well-being, has opted to settle the bulk of the lawsuits (roughly 95,000) and is working to resolve the remaining cases, though the future of the litigation is uncertain.

This epic legal battle in the US tends to dominate the headlines, but the debate over glyphosate is an international affair. Multiple nations have attempted to institute glyphosate restrictions as a means of limiting the use of herbicide-resistant GMO crops, designed to be utilized with glyphosate. India recently proposed such a policy. And Mexico, building on earlier efforts to restrict GMOs, is moving perilously close to an outright glyphosate ban.

Simply put, Mexico's proposed nationwide glyphosate ban is motivated by extremist ideology and utterly devoid of scientific justification. More importantly, it would be disastrous for Mexican farmers and consumers.

This epic legal battle in the US tends to dominate the headlines, but the debate over glyphosate is an international affair.

Full Article

Agro Pages, 22 July 2020

http://news.agropages.com/News/NewsDetail---36010.htm

Brazil's Mapa approves 21 pesticides technical products

2020-07-21

On 9th July, the Brazilian Ministry of Agriculture (Mapa) published, in the Federal Official Gazette, the registration of 21 pesticide technical products, which are chemicals with a high degree of purity and concentration of active ingredients.

All the registered products are generic, meaning that they utilize active ingredients already registered and in use in the country. As the 21 products are classed as technical products, none will be available for purchase by farmers. The active ingredients that received approval are Dicamba, Bifenthrin, Azoxystrobin, Diquat, Cyproconazole, Mesotrione, Tebuconazole, Thiamethoxam and Imidacloprid.

As the 21 products are classed as technical products, none will be available for purchase by farmers.

The function of a technical product is to be a component in the production of formulated products. Most active ingredients used in the technical products have been approved for use in the United States, Australia and countries in Europe.

The products were analyzed and approved by the Ministry of Agriculture, Ibama and Anvisa, according to scientific criteria and in line with the best international practices.

The original version of this report is from CanalRural.

Agro Pages, 21 July 2020

http://news.agropages.com/News/NewsDetail---35985.htm

Enforcement US

2020-07-24

Customs officers in the Port of Mobile, Alabama, have intercepted more than $120,000 worth of mislabelled and unregistered disinfectant wipes.

Customs and Border Protection (CBP) discovered a container of 843 boxes containing 20,016 bottles of the wipes that bore no approved markings from either the FDA or the EPA. The shipment was refused entry.

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This is the latest in a wave of enforcement actions against counterfeit or unapproved Covid-19 products. Since the pandemic began, the CBP has seized 20,000 FDA-prohibited Covid-19 test kits and 3,000 EPA-prohibited anti-virus lanyards, among other things.

Chemical Watch, 24 July 2020

https://chemicalwatch.com/137841/covid-19-deadline-extensions-derogations-and-supply-chain-news

EUROPE

The UK Health and Safety Executive (HSE) has released guidance for disinfecting larger spaces or rooms

2020-07-24

The UK Health and Safety Executive (HSE) has released guidance for disinfecting larger spaces or rooms using fog, mist, vapour or ultraviolet (UV) systems during the Covid-19 outbreak.

The guidance explains how to choose the right disinfection method and apply it safely.

The guidance explains how to choose the right disinfection method and apply it safely. It also says that any disinfectant has to comply with the biocidal products Regulation (BPR).

The HSE has previously released advice on how to manufacture, supply and use hand sanitiser and surface disinfectant during the crisis; and guidance for a Covid-19 risk assessment that employers can undertake to make sure their workers are protected.

Chemical Watch, 24 July 2020

https://chemicalwatch.com/137841/covid-19-deadline-extensions-derogations-and-supply-chain-news

REACH Update

JUL. 31, 2020

Lack of legal basis forces Echa to drop registration revocation idea

2020-07-24

Agency wanted withdrawals for non-compliance with dossier evaluation decisions.

Echa has been forced to drop a proposal to revoke REACH registration numbers in instances where companies are found to be non-compliant with dossier evaluation decisions. The move followed advice from the European Commission that there is no legal basis to allow it.

Full Article

Chemical Watch, 24 July 2020

https://chemicalwatch.com/137840/lack-of-legal-basis-forces-echa-to-drop-registration-revocation-idea

Echa round-up

2020-07-24

Echa has updated Iuclid to help with substances of concern in products (Scip) database notifications. The web interface is extended and more complete, it says.

In the latest release, the advanced search for datasets and dossiers is fully developed and the selection of article and mixture categories improved.

Users can refer to information already submitted when preparing the notification of a complex article.

There are also new support documents.

The agency has received an SVHC intention from Sweden to identify the following substance as toxic for reproduction: dioctyltin dilaurate, stannane, dioctyl-, bis(coco acyloxy) derivs., and any other stannane, dioctyl-, bis(fatty acyloxy) derivs wherein C12 is the predominant carbon number of the fatty acyloxy moiety.

Chemical Watch, 24 July 2020

https://chemicalwatch.com/137784/echa-round-up

Agency wanted withdrawals for non-compliance with dossier evaluation decisions.

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Janet's Corner

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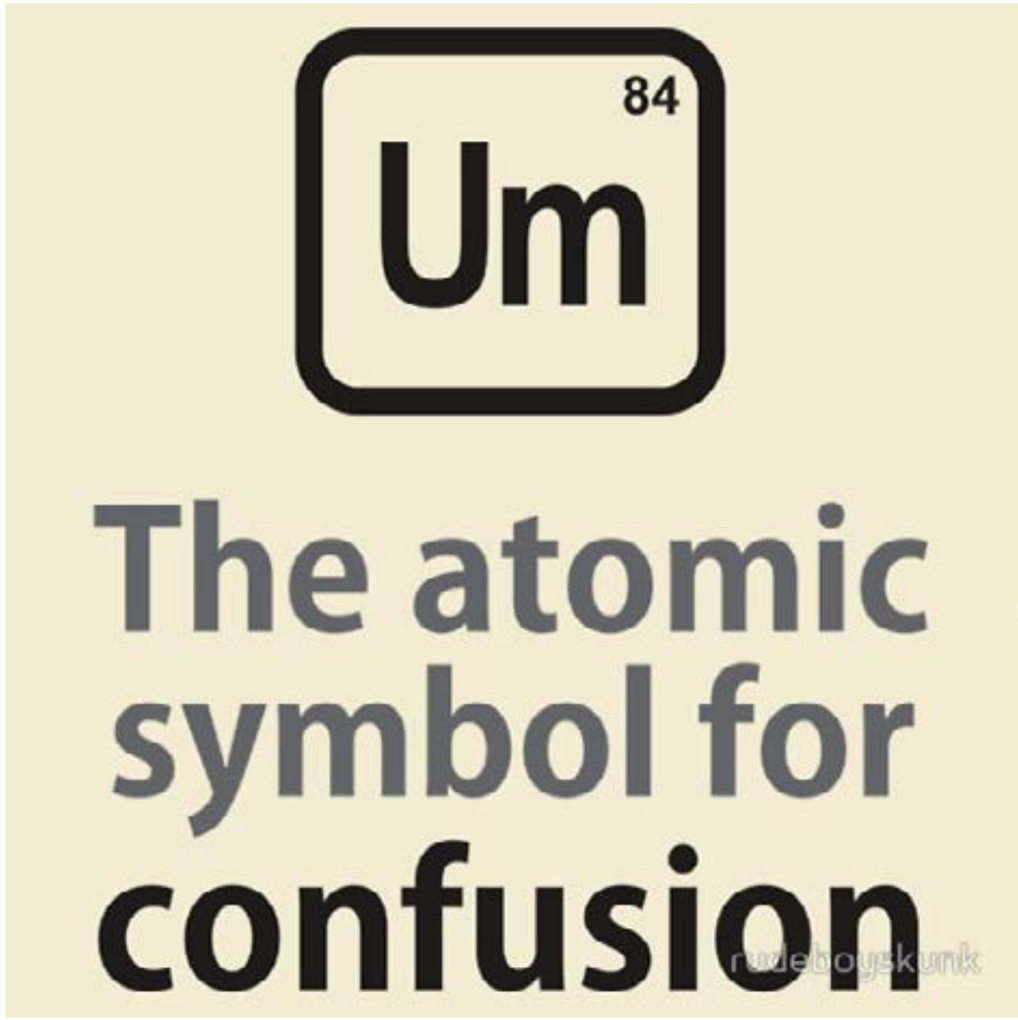
The atomic symbol for confusion

2020-07-31



https://www.chemistryjokes.com/jokes/the-atomic-symbol-for-confusion/

Dichloromethane (DCM)

2020-06-19

Dichloromethane (DCM)—also known as methylene chloride—is a clear colourless liquid. It is highly volatile and has a sweet smell. It has been classified as a Category 3 carcinogen: possibly carcinogenic, but without adequate information to make that assessment. [1,2]

USES [1]

Dichloromethane is used across various industries, primarily as a solvent. It is used a solvent in paints and varnish strippers, and as an extraction solvent in the food and drink industry. For example, the chemical can be used to remove caffeine from tea and coffee. Industrially, it is used in the production of pharmaceuticals, paint strippers and process solvents. The liquid is also used in the transport industry to degrease metal surfaces and parts. In the medical world, dichloromethane is used in cleaners and to extract chemicals from plants or food for medicinal uses.

ROUTES OF EXPOSURE [2]

- The primary route of exposure to dichloromethane is via inhalation.
- People can also be exposed to the chemical through ingestion and skin contact.

HEALTH EFFECTS

Dichloromethane poisoning affects a range of systems including the integumentary and nervous systems.

Acute Effects [2]

Severity of symptoms depend on the level and type of exposure.

- Acute exposure to the chemical can result in CNS depression, which can result in headaches, drowsiness, light-headedness, slowed reaction times, irritability, impaired gait, stupor, and slurred speech.
- Prolonged skin contact to the chemical may cause chemical burns.
- Exposure to dichloromethane can cause airway irritation, accumulation of fluid in the lungs, and inflammation of the lungs.
- Exposure can result in nausea, vomiting, bleeding and gastrointestinal ulceration.
- It can also result in sequelae.

Dichloromethane (DCM)—also known as methylene chloride—is a clear colourless liquid.

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Chronic Effects [2,4]

Dichloromethane is toxic to multiple body systems. Long-term exposure to the chemical can result in irritant contact dermatitis, respiratory irritation and gastrointestinal problems. It can also result in long-term neurological issues, including paraesthesia.

SAFETY

First Aid Measures [5]

- Ingestion: DO NOT INDUCE VOMITING. Rinse victim's mouth with water. Immediately contact a medical professional.
- Skin contact: Avoid direct contact with the chemical, and wear protective clothing if necessary. Remove all contaminated clothing, footwear and accessories. Rinse victim with lukewarm water for 15-20 minutes. Immediately contact a healthcare professional.
- Eye contact: Immediately rinse eyes for 15-20 minutes with gently flowing lukewarm water. Hold the victim's eyelids open to ensure they are thoroughly flushed. If pain or irritation persists, contact a medical professional.
- Inhalation: Take victim to the nearest fresh air source and monitor their breathing. Immediately contact a medical professional.
- General: Never administer anything by mouth to an unconscious, exposed person.

Exposure Controls/Personal Protection [5]

- Engineering controls: Emergency eyewash fountains and safety showers should be accessible in the immediate area of the potential exposure. Ensure there is adequate ventilation. Use a local exhaust ventilation to limit the amount of dichloromethane in the air.
- Personal protection: Safety glasses, protective and dustproof clothing, gloves, an apron and an appropriate mask. Follow the PPE guidelines set in your jurisdiction.

REGULATION [6]

United States:

The Occupational Safety and Health Administration (OSHA) has set an 8-hour time weighted average (TWA) concentration limit for dichloromethane of 25ppm.

Australia [7]

Safe Work Australia has set an 8-hour time TWA for dichloromethane of 50ppm.

REFERENCES

1. https://www.chemicalsafetyfacts.org/methylene-chloride/
2. https://www.atsdr.cdc.gov/MMG/MMG.asp?id=230&tid=42#:~:text=Methylene%20chloride%20exposure%20causes%20dose,%2C%20impaired%20gait%2C%20and%20stupor.
3. https://www.sciencedirect.com/science/article/pii/S2211558716300231
4. http://www.inchem.org/documents/pims/chemical/pim343.htm#PartTitle:5.%20%20ROUTES%20OF%20ENTRY
5. https://www.ccohs.ca/oshanswers/chemicals/chem_profiles/methylene.html
6. https://www.cdc.gov/niosh/npg/npgd0414.html
7. http://hcis.safeworkaustralia.gov.au/ExposureStandards/Document?exposureStandardID=401

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EPA scales back requirements for pesticide testing on fish (1)

2020-07-16

The EPA announced Wednesday it will allow pesticide producers to forego certain tests on live fish, which can indicate whether the chemicals accumulate in their bodies and enter the food chain.

A wide range of public health and animal rights advocates support the Environmental Protection Agency's efforts to reduce pesticide testing on animals. But an environmental group is concerned the agency is overlooking a systemic failure to control the chemicals in the environment.

The EPA's goal is to reduce animal testing by 30% over the next five years to "make science-based decisions about pesticide registrations without having to harm animals by testing," agency administrator Andrew Wheeler said in a Wednesday news release.

The EPA previously removed a requirement for companies to submit data obtained by adding pesticides to lab birds' diets, as long as adequate data could be obtained another way.

A draft guidance document on changes in bird testing received support from the Physicians Committee for Responsible Medicine, the Humane Society of the U.S., People for the Ethical Treatment of Animals, and CropLife America. But Brett Hartl, government affairs director for the Center for Biological Diversity, said, "We take issue with Wheeler's statements that this will help them make better decisions about pesticide regulation."

Fish Testing Support

All of the organizations except CropLife said Wednesday they supported the change for fish testing.

In a statement, CropLife managing director of science policy Manojit Basu said the organization supported the EPA's "strategic vision" for developing techniques and approaches to replace or supplement live animal testing.

CropLife America, which represents the pesticide industry, supported the agency's bird testing proposal because it would reduce the time needed for processing pesticide registration applications and the number of animals needed for testing. The organization submitted comments to the agency in November.

But an environmental group is concerned the agency is over-looking a systemic failure to control the chemicals in the environment.

The agency's new guidance reduces the number of scenarios lab tests must use to gauge the effect of pesticides on fish.

Rather than exposing three groups of fish to two different concentrations of pesticides and a control, the EPA is now requiring one concentration and a control, reducing the number of fish needed by one-third, or about 240 animals per year.

Concern Over Changes

Jennifer Sass, senior scientist for the Natural Resources Defense Council, expressed concerns about the changes the EPA has made in pesticide testing requirements.

"They've stripped out science and the public and transparency and reliability in this process," she said.

The EPA requires pesticide producers to register their products and submit test data so the agency can evaluate a pesticide's health and environmental risk assessments. The EPA also evaluates and signs off on pesticide labels to ensure the directions and precautions address potential risks.

Though the center supports the use of fewer animals in testing, the agency's registration process has allowed the use of pesticides that pose risks to human health and the environment, Hartl said.

"The EPA pesticide office rarely sees a pesticide that they don't rubber-stamp its approval of," he said.

The National Centre for the Replacement, Refinement and Reduction of Animals in Research, based in the U.K., suggested to the EPA in 2017 that it reduce the number of animals used in biological chemical concentration testing. The organization said making the change would harmonize U.S. requirements with international ones and reduce unnecessary animal testing.

news.bloomberglaw.com, 16 July 2020

https://www.news.bloomberglaw.com

House reps renew push for PFAS drinking standards

2020-07-16

The currently stalled PFAS Action Act of 2019 could get implemented by adding it to a defense spending law in the upcoming fiscal year's budget.

The PFAS Action Act of 2019 passed the House in a 247-159 vote on Jan. 10, but has sat in the Senate's Committee on Environment and Public Works since then.

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A bipartisan cadre of U.S. House members are renewing a push to regulate chemicals that have contaminated water supplies in Bucks and eastern Montgomery counties and nationwide.

The PFAS Action Act of 2019 passed the House in a 247-159 vote on Jan. 10, but has sat in the Senate's Committee on Environment and Public Works since then.

The act would set sweeping reform for the chemicals that have been linked to multiple health issues, including a deadline for the Environmental Protection Agency to set a national drinking water standard for PFAS.

With no apparent action coming from the upper chamber, Congresswoman Debbie Dingell, D-Michigan, reached out to colleagues to refile the resolution as an amendment to the National Defense Authorization Act later this week.

buckscountycouriertimes.com, 16 July 2020

https://www.buckscountycouriertimes.com

Coral reefs get their genetic revolution

2020-07-17

Scientists have concocted many schemes to save coral reefs from climate change. Assisted migration. Selective breeding. Manipulating the coral microbiome.

Many of these conservation techniques are risky and unproven, but the stakes are high; the United Nations Intergovernmental Panel on Climate Change predicts that with a 2˚C increase in global temperatures, 99 percent of corals will be lost to bleaching.

"We are desperate," Mónica Medina, a coral reef biologist at Penn State University, told EHN.

There's a glimmer of good news. A new study published yesterday in *Science* offers a new roadmap for coral conservation using the tools that have revolutionized our understanding of the human genome. With cutting-edge genetics, it›s now possible to predict which corals will bleach and which ones won›t.

"That's a great asset to conservation efforts," Stephen Palumbi, a coral reef biologist at Stanford University who was not involved with the study, told EHN.

"We are desperate," Mónica Medina, a coral reef biologist at Penn State University, told EHN.

The effort is a fruitful symbiosis between population geneticists and coral biologists.

Coral bleaching is caused by increased ocean temperatures. Marine heatwaves devastate reefs, causing coral polyps to eject the symbiotic algae that live within their tissues. Without their photosynthesizing tenants to make sugars and nutrients, the polyps starve, and the coral becomes a bleached skeleton of its former self.

But some corals can weather the heat, and hold onto their life-sustaining algae—a trait that turns out to be largely heritable.

By propagating branches from these survivors it's possible to selectively breed heat-tolerant individuals, and use them to repopulate reefs.

This strategy has an obvious drawback: we only know which corals are hardy after everything else dies. But if you can screen for that adaptation in a coral's genome, "you don't have to wait for mass bleaching events to reveal these tolerant corals," Zachary Fuller, a population geneticist at Columbia University and lead author of the study, told EHN.

The stony coral *Acropora millepora* breeds with its neighbors, but scatters its infant polyps to the currents, which can carry them for miles. At the height of a mass bleaching event in the Great Barrier Reef in 2017, researchers in Australia collected samples from more than 200 colonies of *A. millepora* in different parts of the reef. It›s the largest population sample in any coral study to date.

Mapping the complete genomes of hundreds of coral colonies would be prohibitively expensive, but Fuller's team used a shortcut that brings down the cost. "They have built the best coral genome that anybody's ever built at the chromosome level," said Palumbi.

Using that genome as a reference, the team skimmed the rest of the samples for random genetic sequences and filled in the gaps.

Of course, corals are doubly complicated creatures. The researchers sequenced the genome of the symbiotic algae, as well.

Drawing on environmental data collected from the reef, and observations of bleaching variation among their samples, the team searched for associations between the corals' genes and heat tolerance.

They found the bleaching response isn't controlled by one gene, as some have hoped, but probably by many. That makes heat tolerance in corals "a lot more akin to say, human diabetes, or even human height, where there are lots of genes involved," said Palumbi.

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Human genetic studies draw on thousands of genomes. So Fuller and his team were excited to find that with only 200 samples, their model could explain roughly 60 percent of the variation in bleaching. With more samples, the picture will only grow sharper.

"Our goal is to start applying these types of approaches into other species that are at risk of climate change," said Fuller.

"It's worked in agriculture, and it's worked in human disease," said Medina. "Working with what nature has already given us" is "a pretty good bet, a safe bet."

It's a steady step forward, but the fanciest genomics won't save the Great Barrier Reef if we can't reign in the warming trend, said Palumbi.

"The reason to be so interested and excited about it, and go for it, is that it gives us the chance to save as much as possible for the next couple of decades while we actually get a grip on carbon dioxide emissions and bring them way down."

ehn.org, 17 July 2020

https://www.ehn.org

Climate change: Summers could become 'too hot for humans'

2020-07-16

Millions of people around the world could be exposed to dangerous levels of heat stress - a dangerous condition which can cause organs to shut down.

Many live in developing countries, and do jobs that expose them to potentially life threatening conditions.

These include being out in the open on farms and building sites or indoors in factories and hospitals.

Global warming will increase the chances of summer conditions that may be "too hot for humans" to work in.

When we caught up with Dr Jimmy Lee, his goggles were steamed up and there was sweat trickling off his neck.

Global warming will increase the chances of summer conditions that may be "too hot for humans" to work in.

An emergency medic, he's labouring in the stifling heat of tropical Singapore to care for patients with Covid-19.

There's no air conditioning - a deliberate choice, to prevent the virus being blown around - and he notices that he and his colleagues become "more irritable, more short with each other".

And his personal protective equipment, essential for avoiding infection, makes things worse by creating a sweltering 'micro-climate' under the multiple layers of plastic.

"It really hits you when you first go in there," Dr Lee says, "and it's really uncomfortable over a whole shift of eight hours - it affects morale."

One danger, he realises, is that overheating can slow down their ability to do something that's vital for medical staff - make quick decisions.

Another is that they may ignore the warning signs of what's called heat stress - such as faintness and nausea - and keep on working till they collapse.

What is heat stress?

It's when the body is unable to cool down properly so its core temperature keeps rising to dangerous levels and key organs can shut down.

It happens when the main technique for getting rid of excess heat - the evaporation of sweat on the skin - can't take place because the air is too humid.

Media captionDr Angie Bone of Public Health England offers some tips and dispels some myths on staying cool

And as Dr Lee and other medics have found, the impermeable layers of personal protection equipment (PPE) - designed to keep the virus out - have the effect of preventing the sweat from evaporating.

According to Dr Rebecca Lucas, who researches physiology at the University of Birmingham, the symptoms can escalate from fainting and disorientation to cramps and failure of the guts and kidneys.

"It can become very serious as you overheat, and in all areas of the body."

How can we spot it?

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A system known as the Wet Bulb Globe Temperature (WBGT) measures not only heat but also humidity and other factors to give a more realistic description of the conditions.

Back in the 1950s, the US military used it to work out guidelines for keeping soldiers safe.

When the WBGT reaches 29C, for example, the recommendation is to suspend exercise for anyone not acclimatised.

Yet that's the level Dr Lee and his colleagues are regularly experiencing at Singapore's Ng Teng Fong General Hospital.

And at the top of the scale - when the WBGT registers 32C - the US says strenuous training should stop because the risk becomes "extreme".

But levels that high have recently been recorded inside hospitals in Chennai in India by Prof Vidhya Venugopal of the Sri Ramachandra University.

She's also found workers in a salt pan enduring a WBGT that climbs during the day to 33C - at which point they have to seek shelter.

And in a steel plant, a ferocious level of 41.7C was recorded, the workers being among the most vulnerable to what she calls "the huge heat".

"If this happens day-in, day-out, people become dehydrated, there are cardiovascular issues, kidney stones, heat exhaustion," Prof Venugopal says.

What impact will climate change have?

As global temperatures rise, more intense humidity is likely as well which means more people will be exposed to more days with that hazardous combination of heat and moisture.

Prof Richard Betts of the UK Met Office has run computer models which suggest that the number of days with a WBGT above 32C are set to increase, depending on whether greenhouse gas emissions are cut.

And he spells out the risks for millions of people already having to work in the challenging combination of extreme heat and high humidity.

"We humans evolved to live in a particular range of temperatures, so it's clear that if we continue to cause temperatures to rise worldwide, sooner or later the hottest parts of the world could start to see conditions that are simply too hot for us."

Another study, published earlier this year, warned that heat stress could affect as many as 1.2bn people around the world by 2100, four times more than now.

What solutions are there?

According to Dr Jimmy Lee, "it's not rocket science".

People need to drink plenty of fluid before they start work, take regular breaks and then drink again when they rest.

His hospital has started laying on "slushie" semi-frozen drinks to help the staff cool down.

But he admits that avoiding heat stress is easier said than done.

For him and his colleagues, going for rests involves the laborious process of changing out of PPE and then back into a new set of equipment.

There's a practical problem as well - "some people do not want to drink so they can avoid having to go to the toilet," he says.

And there's a professional desire to keep working whatever the difficulties so as not to let colleagues and patients down at a time of crisis.

People who are highly motivated can actually be at the greatest risk of heat injury, says Dr Jason Lee, an associate professor in physiology at the National University of Singapore.

He's a leading member of a group specialising in the dangers of excessive heat, the Global Heat Health Information Network, which has drawn up guidelines to help medics cope with Covid-19.

It's spearheaded by the World Health Organization (WHO), the World Meteorological Organization (WMO) and the US weather and climate agency Noaa.

Dr Lee says that as well as measures like rest and fluids - and shade for outdoor workers - a key strategy for resisting heat stress is to be fit.

"By keeping yourself aerobically fit, you're also increasing your heat tolerance, and there are so many other benefits too."

And he sees the challenge for medics, sweating inside their PPE as they deal with Covid-19, as "almost like a full dress rehearsal" for future rises in temperature.

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"This climate change will be a bigger monster and we really need a coordinated effort across nations to prepare for what is to come.

"If not," he says, "there'll be a price to be paid."

bbc.com, 16 July 2020

https://www.bbc.com

Up to 100 gallons of turbine oil spilled into Columbia River from faulty Bonneville Dam turbine

2020-07-16

Up to 100 gallons of turbine oil spilled from the Bonneville Dam into the Columbia River over the last week, according to an environmental advocacy group.

Between July 6 and 14, between 70 and 100 gallons of oil spilled into the river from a faulty turbine, Columbia Riverkeeper said in a statement. The turbine thought to be the source of the spill was shut down, and an investigation is ongoing, said Lauren Goldberg, legal and program director for the group.

The dam is operated by the U.S. Army Corps of Engineers.

As water spills through the dam, it flows through turbines, which contain spinning blades that create hydropower. The dam is operated by the U.S. Army Corps of Engineers.

"Oil spills from dams must stop. Shockingly, the Army Corps faces no penalties for fouling the Columbia River with toxic oil," Goldberg said in a statement. "Toxic pollution threatens people, fish, and wildlife that rely on clean water."

The Corps said its staff did their best to remedy the spill as soon as they realized it was happening.

"Dam operators immediately begin spill cleanup and remediation procedures while technicians work to identify and repair the source of the issue; all of this takes place in very short order," Kevin Brice, deputy district engineer for the Corps, said in a statement. "After an oil spill, we review our processes and procedures to address areas for improvement, training opportunities, and reporting needs."

In 2014, the Corps settled a lawsuit with Columbia Riverkeeper that required the agency to apply for pollution permits, which allow for limited and regulated discharge of pollutants into waterways, from the

Environmental Protection Agency for numerous dams on the Snake and Columbia rivers. The settlement also stipulated that the Corps look into the use of non-toxic oils and notify Columbia Riverkeeper when spills take place.

Goldberg said the Corps should move to safer materials immediately and the Environmental Protection Agency needs to step up enforcement.

"The Bonneville Dam oil spill, and many others, demonstrate the Army Corps must switch to non-toxic oils and protect salmon and people that rely on clean water," she said. "The U.S. Environmental Protection Agency — which has the authority to hold the Corps accountable — has ignored toxic oil pollution from federal dams for decades. It's time to stop playing politics and protect clean water."

Mark MacIntyre, a spokesman for the Environmental Protection Agency, said the Corps notified them about the leak and said that no oil sheen was visible on the river when the spill was discovered. Given the volume of water flowing through the dam, the Corps was unable to recover any of the oil, he said.

"EPA has been working cooperatively with the Corps for over a decade performing inspections, conducting enforcement, reviewing safety plans, and holding trainings and workshops, all aimed at reducing the number and severity of such releases," MacIntyre said in a statement. "We remain committed to working with the Corps and doing whatever it takes to protect the Columbia from future releases."

The Corps did not respond to a request for comment.

oregonlive.com, 16 July 2020

https://www.oregonlive.com

A fifth of Brazilian soy in Europe is result of deforestation

2020-07-17

Large quantities of the soy and beef imported to Europe from Brazil have been "contaminated" by deforestation, research shows.

The findings suggest much more needs to be done to protect Brazilian land as pending trade agreements are likely to increase sales to European consumers.

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Just 2% of properties in the regions of Brazil studied were responsible for 62% of the illegal deforestation…

About a fifth of the soy exported to the EU from Brazil's Amazon and Cerrado regions, mostly for animal feed, and at least 17% of the beef, may be coming from land that has been deforested, according to the study published in the journal Science.

Just 2% of properties in the regions of Brazil studied were responsible for 62% of the illegal deforestation, the researchers established, through a close examination of land use and deforestation, but these tend to be in some of the areas most associated with soy and beef production for export.

The researchers compiled a new comprehensive set of land-use and deforestation maps, from sources including the national online environmental registry and cattle transport permits, to distinguish between legal and illegal deforestation linked to the production of soy and beef.

They said the government of Brazil could do more to ensure its agricultural supply chain was transparent, and to enforce clear policies on deforestation. "It is not enough to claim to be the world's most sustainable agriculture while a share of the sector fails to comply with the country's own environmental laws, and supports the government's undoing of past environmental achievements," said the researchers.

They said their work showed it was possible to use existing systems to "implement a national and public monitoring system that enforces environmental compliance at the property level to substantially reduce deforestation in the country's major agriculture supply chains".

The Guardian's own investigations have also established clear links between deforestation and animal feed, and the sale of products to consumers in the UK.

The study comes at a key moment, as the EU is finalising a trade deal with the Mercosur group of Latin American countries, including Brazil, that could increase trade in agricultural commodities. Austria has already raised concerns over fires in the Amazon as a reason to reject the agreement.

Environmental campaigners are urgently seeking safeguards to ensure any increase in trade does not encourage deforestation, which has increased in Brazil under the government of Jair Bolsonaro, who has been accused of presiding over the destruction of the Amazon and other key regions. The UK is also pursuing trade deals in the region as part of its post-Brexit trade strategy.

There are already signs that trade in key commodities may be stepping up. Earlier this month, a shipment of soy believed to be the biggest ever imported to the EU arrived in Amsterdam. The conservation charity WWF calculated the soy came from land equivalent to 80,000 football fields, and said that although much of the soy may have come from land cleared many years ago, it was impossible to be sure that soy shipments to Europe and the UK were not linked to recent deforestation or habitat destruction.

Campaigners are concerned at the lack of any law in the UK that requires importers to guarantee their products are free from deforestation. WWF said that meant people could be unwittingly consuming products that contribute to the destruction of nature.

In the UK, only about 27% of soy is officially certified as not being associated with deforestation or destruction of other natural habitats, but two-thirds of the soy imported comes from countries with high deforestation rates.

The Brazilian government's response to deforestation - an ongoing military operation – has been criticised as being largely ineffective. Despite two helicopters and 97 agents, its first message in May reportedly failed to fine anyone, arrest anyone or seize anything.

Meanwhile, corporate interests are becoming increasingly concerned. In June, foreign investors managing trillions of dollars in assets warned the Brazilian government that escalating deforestation and the "dismantling" of policies to protect the environment and indigenous communities were "creating widespread uncertainty about the conditions for investing".

Environmentalists say fines for deforestation are often ignored and rarely enforced, and that the government has hobbled environment agency work since it came to power. They also say the Brazilian government does not take the climate emergency seriously.

The Brazilian environment minister, Ricardo Salles, has called the climate crisis a "secondary issue", while the foreign minister, Ernesto Araújo, has described it as Marxist plot.

Mike Barrett, executive director of science and conservation at WWF-UK, said: "Without knowing it, we're eating meat and dairy products from animals fed on soy grown on deforested land in Brazil. We need to stop importing habitat destruction."

He called on the UK government to use the environment bill now passing through parliament to insert a requirement for companies and financial

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institutions to guarantee their supply chains and investments were free from the taint of deforestation.

A spokesperson for Brazil's government said: "Illegal deforestation is a crime and fighting it is a priority for Brazil. The [science paper] acknowledges that the vast majority of Brazilian agriculture output is sustainable and deforestation-free. Trade restrictions would not contribute to solve the problem and would rather harm hardworking families."

theguardian.com, 17 July 2020

https://www.theguardian.com

The secret power of the tequila plant that could help feed the world

2020-07-15

CLOSE to the town of Ayr in Queensland, Australia, there is a field of unusual crops. The plants are a silvery shade of teal, with long fleshy leaves splaying out in all directions like thin, serrated knives. When Daniel Tan walks among them, the tallest stand two heads taller than him. There are thousands of these blue agaves here. Best known as the raw ingredient needed to make the fiery spirit tequila, they are more commonly found in Mexico than on Australia's Pacific coast. Yet for Tan, a researcher at the University of Sydney, they are part of an impending global revolution.

We certainly need one. Plants provide us with food, fuel, building materials and natural beauty, all while locking away untold volumes of carbon dioxide that would otherwise crank up the planet's thermostat. But as Earth's population and temperature continue to rise, we will need more from our green allies. Our food requirements alone will be eye-watering. In 30 years, we may need to produce about 50 per cent more food to feed nearly 10 billion people – just as global warming is predicted to slash the yield of many major grain crops.

Researchers like Tan are looking to a radical solution, involving plants' not-so-secret weapon: photosynthesis. We ultimately depend on this process, by which plants store energy from sunlight for everything that nourishes us. So it might seem odd to say it is scandalously inefficient. But it is – for most species. By understanding the secrets of plants such as agave with supercharged versions of photosynthesis, the hope is we can create a greener, cleaner, more secure future for us all.

In 30 years, we may need to produce about 50 per cent more food to feed nearly 10 billion people – just as global warming is predicted to slash the yield of many major grain crops.

Photosynthesis captures the power of sunlight to convert CO_2 and water into sugars, which plants then use to fuel their growth. It is a wondrous thing. Yet despite the fact that evolution has had at least 2 billion years to perfect it, we have to content ourselves with the wonder that it is done at all, not that it is done well. The maximum conversion efficiency of solar energy to biomass in most plants is a disappointing 4.6 per cent.

This is true for the C3 version of photosynthesis, the metabolic process used by almost 90 per cent of plants, including wheat, rice and soya beans. The inefficiency comes down to an enzyme called rubisco. This piece of biochemical machinery picks up CO_2 molecules and combines them with another compound to form a molecule containing three carbon atoms, as a first step in the production of sugar. The trouble is that 40 per cent of the time, rubisco slips and picks up oxygen instead, wasting energy. The problem gets worse when plants close their leaf pores, or stomata, to prevent water loss. Oxygen builds up inside the leaf and rubisco is even more likely to mistakenly grab it.

None of this mattered when rubisco evolved more than 3 billion years ago, when Earth's atmosphere was rich in CO_2 and almost free of oxygen. But as oxygen has become more abundant – ironically largely as a result of plants photosynthesising – it has become a roadblock to better photosynthesis.

Over the past 100 million years, some plants have found a workaround, evolving a process known as C4 photosynthesis. This splits the metabolic pathway involved in normal photosynthesis between two parts of their anatomy. First, they capture CO_2 molecules in spongy cells called mesophylls beneath a leaf's waxy protective layer, where they produce a four-carbon molecule. This molecule is then transported through special channels to cells clustered around leaf veins, where it is broken down to release CO_2 again. Only here does rubisco come in, and with higher concentrations of CO_2 present, it has fewer chances to grab oxygen. C4 plants also have enlarged chloroplasts, the parts of the cell where photosynthesis is conducted, which gives them an extra boost.

The benefits of these adaptations are stark. Although only about 4 per cent of plant species use C4 photosynthesis, they are responsible for about 23 per cent of the biomass produced on land. C4 crops include major sources of food such as maize and sugar cane, and pasture grasses that feed many of the animals we consume.

The warming planet is adding fuel to the idea that we could make more of these potent photosynthesis machines, for example by using genetic engineering to prod C3 plants into using the C4 pathway. Even if global

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warming is contained at 2°C this century, that could lower yields of C3 crops such as wheat, rice, maize and soya beans by between 6 and 15 per cent.

The C4 rice project is an international effort that kicked off in 2008 to transform the staple food of half the world's population into a C4 crop. Rice lacks the special leaf structure of C4 plants, so its anatomy requires resculpting through the insertion of 20 or 30 new genes. "This is the biggest project in synthetic biology and genome engineering that's around at the moment," says Robert Furbank at the Australian National University in Canberra.

Rice dreams

It initially took the team seven years to transplant six genes. But new techniques allowing multiple genes to be transferred at once moved the work along apace, and in 2017, the team announced it had created a proto-C4 rice species complete with those crucial intercellular channels and beefed-up chloroplasts.

Jane Langdale at the University of Oxford, coordinates the project. She expects C4 rice plants to be in field trials by 2030. "We may not get a perfect C4 rice, but we will get varieties that are better yielding," she says. Meanwhile the International Rice Research Institute, which helped initiate the project, has grown rice plants under atmospheres with a higher than usual CO_2 concentration in order to simulate what C4 rice would be like. Calculations based on these experiments suggest it would have a yield up to 50 per cent higher than the conventional crop.

But ambitious though the C4 rice project is, it won't be enough. As the climate changes, we don't just need crops that produce food more efficiently, we need them to do it under more taxing conditions. "Water is going to be the rate-limiting factor for agriculture in the context of our global climate crisis," says John Cushman at the University of Nevada in the US. Drought is predicted to ravage many semi-arid regions over the coming century, with 45 per cent of land expected to have droughts that are more frequent, more intense and longer lasting. Turbocharged rice will be no use to anyone if it is simply too dry for it to grow.

There is, however, another trick up nature's sleeve. About 7 per cent of plant species use a third kind of photosynthesis called crassulacean acid metabolism (CAM). Those silvery agave with the serrated leaves in Queensland are one; others include pineapple, aloe vera and vanilla.

Like C4 photosynthesis, CAM pre-concentrates CO_2 to improve the performance of rubisco. But while C4 plants physically separate photosynthesis, CAM plants split it into time intervals. Unlike most vegetation, CAM plants open their stomata only in the cool of night to capture CO_2. When the sun comes up, the stomata close to prevent water loss and the plants use stored CO_2 to photosynthesise. Thanks to these adaptations, CAM plants only need about 20 per cent as much water as the least thirsty C3 and C4 crops.

Agave and its ilk have long been used for food (see "Sugar 'n' nice"). But they are increasingly being grown in new places and for unusual purposes. The point of Tan's plantation is to test whether agave can be used to produce biofuel. Already used, for example, to supplement petrol in many parts of the world, biofuels are increasingly seen as a viable alternative to liquid fossil fuels, but are also controversial due to the land, water and other resources needed to grow them.

Tan and his colleagues recently published the first comprehensive life cycle assessment of agave bioethanol, examining greenhouse gas emissions, water consumption and environmental pollution. They found that it has a 60 per cent lower impact on global warming compared with ethanol derived from maize, and 30 per cent lower than that from sugar cane. It requires neither irrigation nor pesticides, because agave has no native pests in Australia.

Agave isn't the only CAM crop with potential. Cushman leads a project growing the prickly pear cactus for food, animal feed, bioethanol and biogas. Native to the Americas, this cactus can thrive anywhere where the temperature remains mostly above freezing. This means a fifth of land that is unsuitable for other crops could be used to grow it. Field trials in Nevada have shown that a hectare of cactus produces as much as 44 tonnes of biomass each year, a similar productivity to maize and sugar cane.

Even if you don't use the CAM plants for anything in particular, they are worth having around. Brazil and Tunisia have both planted prickly pears across areas equivalent to that of the Grand Canyon. Originally grown to feed cattle, scientists at the International Center for Agricultural Research in the Dry Areas in Tunisia observed that hedges comprising the cactus prevent erosion and boost the soil's nitrogen content. In South Africa, which has seen extreme droughts over the past few years, some farmers are growing another CAM crop called spekboom to revive their parched land.

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CAM plants are often thought to be slow to grow, but they don't necessarily deserve this reputation. Annual crops like maize and soya beans grow fast, but only for one season, typically four to six months. Most CAM plants are perennials that grow continuously for years. "If you take seasonality out of the equation, some cultivated CAM species are just as productive," says Cushman.

Pollination problems

That isn't the full story, however. Some CAM crops, including agave, flower and produce seeds only once towards the end of their lives. And their lives are long; one species of agave is known as the "century plant", though in truth it lives about 30 years. To be commercially successful, agave must be propagated not by germinating seeds, but by cloning.

This creates several problems, including a world shortage of tequila in 2018 (see "Tequila sunset?"). A more serious issue is that the pollinators that feed on agave flower nectar – in Mexico this is largely bats – are threatened with extinction. The cloned crops, being so genetically similar, are also vulnerable to pests and disease. Prickly pears are at risk of infection by a stunting disease called "macho". We don't know its cause.

Cushman's team is sequencing the DNA of prickly pear plants afflicted by macho to investigate the disease and prevent it from spreading. And several sustainable tequila projects have been established that allow a portion of the agave plantation to go untouched, so that the plants flower and can be pollinated naturally. It is estimated that if 5 per cent of the agave planted on a hectare of land is allowed to flower, that will provide enough food for about 90 bats each night.

Some are wondering if we can go further, with an effort akin to the C4 rice project that aims to combine the traits of C3 and CAM crops into the ultimate supercrop. Over the past five years, scientists have sequenced the genomes of several CAM plants. But there is a long road ahead. While we broadly understand how the CAM photosynthesis pathway operates, important details such as how regulatory enzymes fluctuate over time remain unclear.

For the moment, Cushman and his team are piecing together an understanding of CAM genetics with a view to developing a prototype CAM soya bean. He thinks we could have one in about five years, so it may be a while before we see them in the fields. In the meantime, more

and more of Earth's semi-arid land looks set to be planted with crops like agave. Its tall, teal leaves are going to become a lot more familiar.

newscientist.com, 15 July 2020

https://www.newscientist.com

New genes control plant height, could lead to flood-proof crops

2020-07-16

Stature matters to plants. Short crops can carry more grain without bending under their own weight—a key trait that helped power the Green Revolution in the 1960s. But tall plants are better at surviving long floods. Now, researchers have found two genes that together help control the height of rice plants: one that accelerates the elongation of the stem and another that acts as a brake. If the system is similar in other plants, scientists say it could be useful in the breeding of many kinds of crops.

"This could be one more great tool in the toolbox," says Julia Bailey-Serres, a rice biologist at the University of California, Riverside, who was not involved in the new research.

In the mid–20th century, plant breeders typically selected for wheat and rice varieties with short stems; these plants devoted more resources to grain and were less likely to fall over in heavy wind or rain. Biologists later discovered that these varieties, at certain times in their development, produce less of a hormone called gibberellic acid (GA) or can't respond to its signals to elongate their stems. Side effects of those mutations can include young plants that sometimes emerge from the ground too soon in drought-prone regions.

Top of Form

Plant molecular geneticist Motoyuki Ashikari of Nagoya University and colleagues have been studying rice varieties that survive long, deep floods by growing taller—and quickly, if need be, up to 25 centimeters per day. So-called "deep-water rice" is grown in delta areas, mainly in Southeast Asia where slow seasonal floods can reach 1 meter or deeper. Previous work had shown that when plants are submerged, ethylene gas accumulates in their tissues and triggers GA production. Ashikari and his colleagues wanted to know how GA coaxes stems to grow in deep-water varieties of rice.

Now, researchers have found two genes that together help control the height of rice plants: one that accelerates the elongation of the stem and another that acts as a brake.

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The team compared the DNA of one species of deep-water rice with another rice variety that can only grow in shallow water. They soon located the two genes, which they dubbed *ACE1* (accelerator of internode elongation) and *DEC1* (decelerator of internode elongation). Greenhouse experiments showed what the genes did: In deep-water rice, *ACE1* turns on when plants are covered in water, stimulating cell division in their stems and helping them grow, the researchers report this week in *Nature*. But a typical shallow-water variety, which has a mutation in *ACE1*, did not lengthen its stem when flooded.

In other experiments, the team showed that *DEC1* suppresses stem growth. *DEC1* was active in the shallow-water variety, and it stayed active when those plants were flooded, essentially keeping the brakes on stem growth. In contrast, when deep-water rice was exposed to flooding, the brakes were lifted: *DEC1*stopped expressing, further allowing for stem growth.

If plant breeders or molecular biologists can control those two genes, they might be able to adjust plant height without having to modify GA levels—perhaps even in crops other than rice—says Laura Dixon, a plant biologist at the University of Leeds. That means GA would continue to influence other parts of the plant normally. The two new genes could act like a simple "dimmer switch" for plant height, says Susan McCouch, a rice biologist at Cornell University, who was also not involved in the research.

The two genes also exist in sugarcane, barley, and the well-studied grass *Brachypodium distachyon*. They might occur widely in other agriculturally important grasses, Ashikari believes. Another important crop, corn, has an equivalent to *ACE1*, but it has a gene that only partially resembles *DEC1*. Still, the range of species with the two genes makes the new discovery "supersignificant," McCouch says.

The genes might help rice breeders improve low-yield varieties that can already cope with seasonal flooding—or engineer new ones from productive shorter varieties. If this approach works in other plants, it could even help engineer flood-proof crops for areas experiencing more frequent flooding because of climate change, including the U.S. Midwest, Bailey-Serras says. Such efforts would depend entirely on whether the genes in the target crops are responsive, but, "It would make a heck of a lot of difference to the farmer."

Bottom of Form

sciencemag.org, 16 July 2020

https://www.sciencemag.org

The pandemic could actually strengthen the U.S. food system

2020-07-17

OMAR FLORES HOLDS up what appears to be a fluorescent green baseball sprouting a forest of leafy trees. Then he pulls a knife from the braided sheath at his belt and expertly cuts the vegetable into flat rounds.

The newest customer to visit G. Flores Produce on the sandy eastern Virginia peninsula known as the Northern Neck, Tom McDougall, chews the raw, crunchy kohlrabi with an expression of reverence. The plant, an exotic-looking German cousin of the cauliflower and cabbage, would fetch a good price in the cities of Washington, D.C., and Northern Virginia.

"Here's this thing that looks like an alien—and it turns out to grow particularly well in the mid-Atlantic?" McDougall says. It's also a bright green representative of the vast array of easily-grown, nutritious cultivars left out by an American food system built around just a few species—a symbol of the food system that was and might be again.

McDougall is at G. Flores to buy several thousand dollars of kohlrabi, kale, and golden beets for 4P Foods, a company he founded in 2014. 4P sells produce from operations like G. Flores to chefs, groceries, and consumers who want to buy food grown in the mid-Atlantic region but don't have the time, contacts, or resources to find it themselves.

COVID-19 spread chaos across U.S. agricultural supply chains in the spring and is widely expected to do so again this year as the number of cases and deaths continues to rise. As that first wave of disruptions happened, 4P rapidly scaled up its direct-to-consumer business, even as the schools and restaurants that once made up half of its revenues shuttered. 4P's subscription revenues from January to June, year-over-year, have jumped almost 400 percent, with general revenues up 225 percent over the same timeframe. 4P now employs six times more people than before the pandemic.

But McDougall, like many in an emerging coalition of Mid-Atlantic farmers and wholesalers, is dreaming even bigger. COVID-19, he believes, could

4P now employs six times more people than before the pandemic.

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enable something he and fellow "food nerds" have long dreamed of: a thriving regional alliance of farmers, wholesalers, and customers.

If they succeed, McDougall argues, operations like 4P won't be the only beneficiaries. "Wouldn't it be amazing if we came out of the other end of [COVID-19] with a more equitable, distributed, and resilient food system?"

Shock to the system

The travails that COVID-19 brought to U.S. agriculture started in early March, when thousands of farms set up to supply the restaurant and food service industries had to rapidly pivot to selling to a populace now cooking most of its meals at home.

This, says John Newton, an economist with the Farm Bureau Federation, has led to a dramatic, even traumatic, change, as farms across the United States have seen their business models and painstakingly negotiated contracts evaporate overnight.

The U.S. food supply chain isn't linear; it's more like a matrix of crop growers, processors, and distributors, over half of which are geared toward providing raw materials to commercial kitchens, rather than homes. Entire plants are "fabricated just to make products for the restaurant business," Newton says, "whether it's French fries or large quantities of packaged bacon."

COVID-19 caught farmers and processors in the various food-service supply chains in a pincer attack. As it forced the closure of schools, offices, and restaurants, slashing badly needed sales, the virus also sickened thousands of workers throughout the few and massive U.S. processing factories—like the Smithfield pork plant in Sioux Falls, South Dakota—that serve the conventional food system.

This two-pronged crisis forced large commodity farms devoted to, say, the production of onions for restaurant onion rings or milk for school lunches, to dump produce and milk by the truckload, and slaughter pigs and chickens by the hundreds of thousands.

These coronavirus closures also hit smaller operations like G. Flores, many of which have survived the runaway consolidation of farms, processors, and markets over the last several decades by selling to farmer's markets and farm-to-table restaurants—niche venues where sales were, at best, extremely restricted in the pandemic.

But the Flores family was well positioned for change. After immigrating from outside Guadalajara in central Mexico, George Flores, Omar's father, spent years as a picker, following the long harvest season in a great loop along the East Coast—from cucumbers in the Carolinas to apples in the Hudson Valley. That experience showed him diversity in both product and markets, his son says, which became key to the farm's long-term economic survival—as was the ability to sell directly to customers.

On a blistering June day, we rattle through the Flores' vast fields, past rows of multifarious potatoes, melons, beans, squash, greens, and tomatoes, as the smell of Thai and lemon basil and dozens of other herbs wafts into the ATV.

Now 32, Omar Flores has grown up with a command of hedging and diversification that would humble an index trader: You can always plow back under crops you can't sell, he says, but when there's a rush on peppers, you'd best be sure you have some.

That strategy was why, when a friend from the Fredericksburg Farmers Market passed Flores's name on to McDougall, they were ready.

"That kale and kohlrabi didn't have a buyer yet," Omar Flores says, but his father had picked cultivars that wouldn't go "woody" if left unpicked for a long time. Like over a hundred other species on the Flores farm, they had sat waiting for chance—in this case, a pandemic—to bring them a customer.

Regional agriculture advocates argue that the same diversity that protects a 50-acre farm like G. Flores can also fortify the larger food system.

In western Virginia, outside the Shenandoah Valley town of Edinburg, COVID-19 has brought Jordan and Laura Green their best year yet. Before the pandemic, they had shifted from farmers' markets to online sales, shipping their grass-fed beef and pasture-raised chicken to customers, or selling it at their sprawling farm, which is about nine times the size of the Flores's.

Like the Flores family—and unlike a conventional meat farm in the Smithfield or Tyson supply chain—the Greens follow a strategy of diversification to smooth out the bumps in the market. They think cultivating a wide array of direct customers, able to buy through a wide variety of different means—at their farm stand or online—means more reliable income than if they just sold wholesale to a few restaurants. "If you

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put 50 percent of your business in any one thing and it changes," Jordan Green says, "you're done."

So though the pandemic cost them all of their restaurant customers—about 5 percent of their operation—direct-to-consumer sales went up by a factor of 10. "We've been able to grow the business more in three months than what we projected in five years," he says.

Though it is far too soon for systematic data, reports from farmers, CSA alliances, regional food researchers, and wholesalers across the country suggest a boom is under way for direct-to-consumer operations, as long as they're close enough to cities to take advantage of dense urban markets, says Nelson of the Farm Bureau Federation. A sweeping study on the impacts of COVID on agricultural markets by a task force of land grant universities like the University of Georgia and Ohio State University, meanwhile, has concluded chiefly that more study is needed.

Still, the anecdotal surge in sales holds for both relatively large operations like the Greens', and also for small ones like all-women produce farm Owl's Nest—on five acres just outside of Washington D.C. That farm sold out its subscription boxes a month earlier than usual. And by a month into the pandemic, owner Liz Whitehurst says she had 150 people on a waiting list for 100 slots.

A retail spike like this is "unheard of," says Kathleen Finlay, the president of Glynwood, a teaching farm and organizing hub in the Hudson Valley, where direct-to-retail farms have seen "unprecedented" demand, with CSA shares selling out within weeks of sales opening.

For some direct-to-retail farms, the boom has meant a chance—even a necessity—of sharing the wealth. Jordan and Laura Green saw "four months of inventory evaporate in six weeks." To fill orders, the Greens became wholesalers themselves. They now buy from farms in Indiana and New Jersey that meet their brand's ethical and ecological standards, and that have their own processing operations—saving the Greens the effort of buying hundreds of new calves—but who had lost their own restaurant and institutional customers in the lockdown.

To meet the COVID-19 surge, Jordan Green says, "deals that usually would have taken months happened in a week."

That nimbleness, says Finlay, is characteristic of the sustainable agriculture movement. "It's way less efficient, but way more decentralized, which

makes it more agile than these very ingrained [conventional] networks with just a few nodes."

Local- and regional-food proponents like Finlay and McDougall believe that their system is more resilient and adaptable. However, that's still unproven, says Gidon Eshel, a professor of environmental physics at Bard College and Harvard who is preparing a paper on resilience in regional food.

It is intuitive, Eshel says, "that the predominance of just a few players and regions is dangerous, because it's susceptible to various perturbations," and that distributing production across many regions should lead to more resilience—and better public health.

Just last year, disastrous flooding across the upper Midwest gutted one of the world's principal corn-and soy baskets; only the glut of product left unsold because of the trade war with China staved off price spikes. And when it comes to food contamination, single sources of distribution can spread a single mistake over a huge geographic area; in 2012, for example, a listeria outbreak at a Colorado packing farm led to 33 deaths across 28 states.

Still, Eshel says, with Earth's population headed toward 10 billion, providing a healthy and nutritious diet for all is one that will be hard to solve with only local and regional agriculture. "How do we achieve the necessary volume of production, with the maximum efficiency possible," Eshel says, "while causing the least amount of damage? That is strongly pushing us toward favoring large-scale commercial agriculture."

Those big commercial farms serve a valid need, says Kate Clancy, a food systems consultant and visiting scholar at the Center for a Livable Future at Johns Hopkins University. The Northeast, for example, has been a net food importer for a century, and even vastly expanded regional agriculture will likely not be enough for it to feed itself.

But Clancy thinks that America's mid-sized farms are essential to long-term food-security because of their flexibility. Those farms, however, are too big to effectively sell to farmer's markets or individuals, yet too small to compete with the biggest commodity operations.

Operating regionally, they deal with a bewildering array of government rules, and a lack of organizations, governmental or otherwise, to encourage them. In the D.C. "foodshed," for example, there is no single

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entity that farmers and consumers can turn to that addresses the region's shared needs.

"We need policy that crosses state boundaries, and most food systems in the U.S. have not been able to go there yet," Clancy says. For example, under federal law, the Greens would have to hire a USDA inspector if they processed any more chickens than the 20,000 they do currently, as well as to sell in D.C., even though it is far closer than most of the rest of Virginia.

This is ultimately what McDougall and his allies are trying to solve: the mission, ultimately, that brought him to the Flores farm on that hot June day.

In the weeks after the lockdowns, when it became clear that businesses like 4P Foods were thriving, McDougall and a group of Mid-Atlantic food activists and entrepreneurs founded MAFRAC, the Mid-Atlantic Food Resilience and Access Coalition. The group matches producers like the Greens or Flores' with buyers to create community feeding networks. So far, MAFRAC has awarded grants of up to $15,000 to dozens of organizations, which has helped keep money in farmers' pockets, taken strain off food banks, and gotten fresh food into the hands of people who need it.

But that short-term crisis response, McDougall believes, has a long-term payoff: a new matrix of business and personal relationships around which regional agriculture can grow and ultimately advocate for its own interests—a network not of marginal do-gooders but of serious businesses. Every transaction pulsing through these new connections helps create a world in which it is easier for customers to eat food grown in their region.

"Our hope is that after the pandemic, people won't forget what is happening right now—and will stay involved to change the system," McDougall says.

nationalgeographic.com, 17 July 2020

https://www.nationalgeographic.com

Inconsistent mask regulations in parks risk lives

2020-07-16

Visiting a national park this summer? The National Park Service is not requiring visitors or staff to wear face masks. But that doesn't mean you won't be asked to wear one. Confused? That's only part of the problem.

"But the park doesn't have the authority to require visitors or staff to wear masks, so we're just asking people nicely."

"Since the park re-opened, Montana has seen one of the biggest increases of COVID-19 cases [per capita] in any state," says a ranger at Glacier National Park, who asked to remain anonymous. "But the park doesn't have the authority to require visitors or staff to wear masks, so we're just asking people nicely."

Glacier and some other national parks closed to visitors in late March, following often conflicting guidance from the federal government that encouraged visitation and waiving entrance fees into the third week of that month. The park partially re-opened on June 8, joining what the park service says are "two-thirds" of its 419 units currently open. But, in line with anti-mask sentiments across the Trump administration, the public health plan implemented by the NPS does not make masks mandatory for park staff or visitors.

Mask wearing is currently believed to be one of the most effective tools in preventing the explosive spread of COVID-19 across the country. According to a University of Washington report, masks are currently only worn in public by 20 to 60 percent of Americans, a practice that currently has our country on track for over 200,000 total COVID-19-related deaths by November 1. But the report determines that if 95 percent of Americans were to adopt mask wearing, close to 60,000 of those deaths could be avoided.

Unfortunately, mask wearing has been heavily politicized, with President Trump notably refusing to wear one in public, barring one recent press briefing. And policies mandating their use in public places have been left up to state and local governments, and even private companies, in lieu of federal leadership on the issue.

This dynamic is playing out in miniature within our national parks, causing a uniquely problematic situation. National parks are owned by the federal government, but exist inside the boundaries of states and counties, which leaves the question of whose guidelines the parks need to follow.

Take Big South Fork National River and Recreation Area, which spans the Kentucky-Tennessee border, for example. Mask wearing in public places is mandated in Kentucky, but not in the park (the NPS confirmed there are no mandated rules about masks for any park), even the parts of it within that state's boundaries. (Masks are not required in Tennessee.) Every day, people who work at or visit the park are moving between state-managed areas that require masks and NPS-governed areas.

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And to make those conflicting layers of management and regulation more confusing, facilities inside parks, like lodges, restaurants, and visitor centers, are run by third-party vendors, not the NPS. Those private companies are free to make their own calls about the safety of their employees, visitors, and even NPS employees working at or passing through the facilities they manage.

One of the two biggest NPS vendors, Xanterra, which manages visitor centers, restaurants, and lodges in places like Zion and Yellowstone, implemented a mandatory mask policy across all facilities early this month. Anyone working in or passing through Xanterra properties are required to wear masks indoors and also in outdoor spaces where social distancing guidelines may be difficult to follow (think crowded overlooks and queues outside popular attractions). But the other big vendor, Delaware North, which manages facilities in sites like the Grand Canyon and Shenandoah, only requires masks to be worn by its public-facing employees. The visitors it serves, along with any NPS staff, are able to go mask-free. (A spokesperson for Delaware North clarifies that the company is following state and local ordinance, and may also require masks in common areas at some properties not subject to government-mandated orders.)

I spoke with Rick Hoeninghausen, Xanterra's Director of Sales and Marketing at its Yellowstone National Park properties. He says that he cares about the safety of his colleagues and customers, so he sees a mask policy as a no-brainer. It's complemented by daily temperature checks for all their staff, modified employee housing that gives each their own room, and other policies that he says the company plans to update as knowledge of the virus evolves. "We're using the best possible practices to keep everyone safe," says Hoeninghausen. "To the best of my knowledge, we've had no complaints."

But Xanterra's employees and guests won't be as safe once they leave the company's properties. Even within a single national park like Yellowstone, hotels and other facilities may be managed by a number of operators. A visitor may stay at a mask-free hotel outside the park, eat lunch at a Xanterra restaurant, and take a tour operated by a third company, then ask a park ranger for directions along the way, and all the while be unaware that they're moving between different areas of responsibility, different rules, and different levels of safety.

The anonymous ranger in Glacier expresses frustration that the Park Service, and its bosses at the Department of the Interior, are abdicating

responsibility for the safety of its workers and visitors. "They're greatly increasing the odds that the park will have to entirely close again," they say. "People will lose their jobs, others will die, and many businesses will go under."

I asked NPS to justify its policies. "Cloth face coverings have been distributed and secured for all employees," says a spokesperson. "DOI employees are encouraged to conduct daily self-monitoring for symptoms of COVID-19 and to not report to the workplace if they exhibit any symptoms or are feeling unwell."

"While we strongly encourage social distancing and the use of face coverings when social distancing cannot be maintained, the NPS will not take actions against individuals who do not wear cloth face coverings or adhere to the guidance," says the NPS spokesperson when asked for further clarification on its mask policies. The park service has operated without a Senate-confirmed director since the beginning of the Trump administration.

"There has been free testing for staff, but it takes more than two weeks to get the results," says the Glacier ranger, who interacts with visitors and colleagues daily. "What's the point?"

Without mandatory masks, without effective testing, and with a disease that may be spread by asymptomatic carriers, NPS's abdication of duty moves this issue out of the realm of a miniature reflection of a national problem and into being a national problem on its own. National parks draw visitors from around the country and the world to travel long distances to some of our nation's most rural, isolated areas. If COVID-19 is spreading between visitors or staff, it may foster the disease's spread around the country and to those small communities that exist outside of the parks. Montana's now record-high spike in cases began in early June, at the same time that Glacier and Yellowstone re-opened. On Wednesday afternoon, Governor Bullock issued a mandatory mask order for Montana.

I talked to a friend yesterday who had just driven up from Los Angeles to bring his kids to Yellowstone for the first time. "Everyone I saw was wearing a mask," he said when he texted me a picture of his kids posing in masks with a masked park ranger. Over that ranger's shoulder, just a few feet away, was another visitor wearing no mask at all.

outsideonline.com, 16 July 2020

https://www.outsideonline.com

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How many hot dogs can a person *really* scarf down in 10 minutes?

2020-07-14

On the Fourth of July, as they have done for years, renowned competitive eaters descended on New York City to compete in the Nathan's Famous Hot Dog Eating Contest. The event was a bit different this year, of course, because of the coronavirus pandemic. Only 10 people competed, and there was no live audience. But Joey "Jaws" Chestnut still managed to set a world record, scarfing down 75 hot dogs (buns included) in 10 minutes.

Surprisingly—and perhaps a bit horrifyingly—he could have eaten a few more. In a new study, a researcher calculates that a human could theoretically devour 83 hot dogs in 10 minutes—a rate of consumption similar to that of a grizzly bear chowing down on animal flesh.

James Smoliga came up with the idea for the study while reading about research on track and field performance. Scientists have tried to estimate human limits for athletic events such as the marathon or 100-yard dash using data from past record holders, says Smoliga, a physiologist at High Point University. While reading a paper on the limits of human running speed, he thought, "I bet the hot dog competition is similar to this."

Smoliga turned to a mathematical model created by Mark Denny, a biologist at Stanford University. Denny used the model to estimate **the maximum possible running speeds of dogs, horses, and humans**. By finding a mathematical function that fits data points from past world records in a certain event (in this case, hot dog eating) over time, Denny says, one can then predict performance limits in that event.

Thankfully for Smoliga, competitive eating enthusiasts have diligently documented their feats over the years. Combining those self-collected data points with information from the Nathan's Famous website, he pulled together 39 years of data, ending in 2019. (Though the contest began in 1972, consistent competition times of 10 to 12 minutes began in the early '80s.)

The winning number of hot dogs has ballooned, Smoliga found, from 10 in 1980 to a gargantuan 74 in 2018–the previous record, also held by Chestnut. "We haven't gotten twice as fast in the 100 meters or twice as fast in the marathon over 100 years," Smoliga says. "It doesn't compare to anything else that we've seen in sports."

The winning number of hot dogs has ballooned, Smoliga found, from 10 in 1980 to a gargantuan 74 in 2018–the previous record, also held by Chestnut.

These skyrocketing numbers are likely due to competitors stepping up their training, he says, by practicing downing large amounts of food or water in a limited time. The goal is to train the stomach to relax and rapidly stretch, allowing these professional eaters to "take in this enormous volume that most people can't," says David Metz, a gastroenterologist at the University of Pennsylvania Perelman School of Medicine.

In 2007, Metz documented **this impressive (or appalling) stomach expansion in a competitive eater**. In one test, a competitive eater guzzled 4.5 liters of water in just 2 minutes, whereas a person with no competitive eating experience drank less than 2 liters.

While shaving off one-tenth of a second in the 100-meter dash depends on complex processes in the cardiovascular, muscular, and skeletal systems, stretching one's stomach is simpler, Smoliga says. (He compares it to using progressively larger earrings to slowly expand earlobes, though the stomach can more easily contract back to its normal size.) That could explain the rapid increase in winning hot dog counts in a relatively short time.

And there's still room for improvement, Smoliga found. According to his calculations, **a human being should be able to swallow up to 83 hot dogs in 10 minutes**, he reports today in *Biology Letters*.

Denny cautions, however, that math alone isn't enough because equations do not account for physiological factors. In particular, Metz adds, research is slim on the physiology of competitive eaters, so there are still many unknowns, including the maximum capacity of the human stomach.

And he cautions the public not to try to find out for themselves. An amateur eater could suffer serious health consequences trying to ingest a humongous volume, he warns, potentially choking or rupturing their stomach. Simply put, he says, "They shouldn't try this at home."

sciencemag.org, 14 July 2020

https://www.sciencemag.org

How changing the way you sit could add years to your life

2020-07-15

ANOTHER blistering afternoon in northern Tanzania, another high-stakes game of musical chairs. Stumbling back into camp to escape the sun, desperate for a seat, we glanced at each other and then at the single

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unoccupied camp chair. In the other, grinning, sat Onawasi, a respected elder with a mischievous bent. He seemed to be enjoying this.

We were spending our summer with the Hadza community, one of the last populations of hunter-gatherers on the planet. Hadza men and women manage to avoid heart disease and other diseases of the more industrialised world, and we wanted to understand why. Our small research team had come in two Land Cruisers loaded with tech to measure every movement made and calorie burned as Hadza men and women scoured the landscape every day for wild game, honey, tubers and berries.

After a long morning, we felt drained by the inescapable heat and humidity. All we wanted to do was sit. Onawasi seemed to feel the same way. He had spent the morning hunting, and certainly deserved the chair more than we did. But this was getting out of hand. Our precious camp chairs that we took into the bush despite their weight were Hadza magnets. Every visitor to our little research area seemed drawn to them like moths to a porch light.

We knew we had a lot to learn from the Hadza about staying physically active. It turns out they also had something important to teach us about resting. Together, over the next 10 years, we would come to understand why chairs are so irresistible, and why they seem to make us ill.

Together, over the next 10 years, we would come to understand why chairs are so irresistible, and why they seem to make us ill.

In a simpler time, before Brexit, Donald Trump was US president or covid-19, way back in 2012, the world was alerted to a new and insidious danger, an invisible pandemic. I-Min Lee, an epidemiologist at Harvard University, analysed mortality data from heart disease, diabetes and cancer and found a common culprit: sitting. In a landmark paper in *The Lancet*, Lee and her colleagues concluded that prolonged periods of inactivity killed more than 5 million people every year globally, making the health risks "similar to… smoking and obesity". In the media, sitting became the new smoking. Even more alarming for those of us who spend our lives in front of a screen, exercise doesn't fully undo the dangers of sitting. Long hours spent in a chair or on the sofa steal years from our lives, even if we hit the gym religiously. Sitting is different, and maybe worse, than just a lack of exercise.

Priests and public health workers have warned us against the sin of sloth for millennia. But the familiarity of the public health advice to get moving obscures a curious evolutionary puzzle. Why is inactivity bad for us even if we exercise? How could evolution produce an organism that responds so poorly to rest? As Charles Darwin articulated so clearly more than 150 years ago, natural selection favours strategies that direct an organism's

resources towards survival and reproduction. Any effort that doesn't ultimately pay off in reproductive success is wasted. Natural selection, the amoral accountant, pays attention only to the number of offspring produced. It would seem to follow that our bodies should be well-adapted to rest whenever possible, sparing resources for future use.

Countless other species seem to be on board with this philosophy. In the ocean, some predators will rest for more than a day waiting for prey to float by. Numerous reptiles and amphibians slip into dormancy to wait out periods of tough weather or limited food. Bears, bats and a handful of other mammals spend their winters in hibernation, showing no ill effects when they wake up in the spring. Even our evolutionary cousins, the great apes, spend hours every day sitting and lying about like hungover spring breakers on the beach.

The perils of inactivity

And despite people's assumption that hunter-gatherers are more active than people in more industrialised societies, we also know from our own experiences with the Hadza community and scientific accounts of other populations that they spend lots of time sitting and resting, too. There aren't a lot of standing desks in Hadzaland. In the heat of the day, when they are back at camp after a foray, men and women invariably find a shady place to sit while they tend the fire, prepare food and socialise. But unlike with people in the more industrialised world, sitting doesn't make them sick. What was their secret? How had we managed to screw up something as simple as sitting?

The first clues that sitting for long stretches caused disease in the industrialised world came from a ground-breaking study of London transport workers published in 1953. Epidemiologist Jerry Morris noticed that bus drivers sat for most of the day while conductors stood and climbed the stairs of the iconic double-deckers. Morris and his colleagues followed about 31,000 men in these roles over two years and found that drivers were about 30 per cent more likely than conductors to develop coronary heart disease, and to do so at a younger age and with worse outcomes. Later research comparing postal workers who delivered the mail with their sedentary office mates showed similar results.

Summarising the findings, Morris focused on the importance of physical activity in preventing heart disease, helping to kick off the modern exercise movement. But beginning in the 1990s, researchers started to wonder whether sitting itself could be leading to problems. Indeed, studies began to show that people had an elevated risk of heart disease

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and of dying at an earlier age when they reported sitting for long periods while, for example, watching television.

This line of thinking was bolstered by data from attempts to mimic the effects of space travel on the body. As the space race heated up in the 1950s, NASA became concerned with how a lack of gravity might affect astronaut health. The agency began a series of bed-rest studies, where volunteers would lie down for long periods, sometimes more than two months. Their bones thinned and muscles weakened, but there were other, unexpected effects, too. Subjects had higher levels of fats called triglycerides in their blood and other risk factors for cardiovascular disease.

As the evidence for the dangers of inactivity grew, a hypothesis began to develop for why it was so harmful. When we stand and walk, we engage the muscles of our legs and core to hold us upright. Chairs and beds allow us to turn those muscles off, sagging like wet dishcloths into the contours of the cushions. Perhaps muscle activity was the key.

Normally, medical researchers like to test their ideas in rodents, but convincing a rat to sit in a chair and watch television didn't seem a viable option. Undaunted, Marc Hamilton at the University of Missouri and his colleagues suspended rats' hind limbs off the floor by tying their tails to a swivel on the roof of the cage. With no need to support the body, the rats' hind limb muscles switched off and stopped burning fuel. This in turn led to reduced levels of an enzyme needed to provide fuel to working muscles: lipoprotein lipase. This enzyme acts like a triglyceride vacuum cleaner, breaking the molecules into fatty acids that can be burned in the muscles, and thus removing them from the bloodstream.

In Hamilton's rats, triglycerides built up in the blood because the muscles didn't need them and didn't produce the lipoprotein lipase to break them apart. The translation to humans seemed obvious: prolonged sitting allows us to switch our muscles off and causes triglycerides to climb.

Studies in humans have provided support for this mechanism. In several controlled trials, people forced to sit for long periods developed elevated triglyceride levels. Importantly, if the sitting time is broken up with light activity, even a bit of slow walking, triglyceride levels are greatly reduced. In fact, people asked to reduce sitting by spending more time walking and standing over a four-day period saw a 32 per cent drop in triglyceride levels. Sitting for long, uninterrupted periods also alters the walls of blood vessels in ways that make them stiffer and more prone to coronary heart disease, but breaking up sitting with light activity restores vessel function.

Perhaps societies like the Hadza avoided the dangers of inactivity by resting less each day, or perhaps they broke up their sitting time with more frequent bouts of standing or walking. That idea certainly had intuitive appeal: it was hard to imagine a Hadza man or woman logging as many hours on their butt each day as a typical US citizen. But our experiences with Onawasi and the irresistible attraction of a nice chair hinted at another, deeper explanation. Perhaps chairs, those sirens calling out to us, were the problem.

Material evolution is a curious phenomenon. Innovations tend to build on one another, as simple solutions give way to more sophisticated designs. Nonetheless, simple and elegant ideas often stay undiscovered for millennia. The ancient Britons who built Stonehenge were wise enough to track the sun and clever enough to move 20-tonne boulders, but never imagined the wheel. Chairs are another surprisingly recent invention. They first appear in the archaeological record less than 5000 years ago, well after the emergence of farming, towns and metallurgy. Our Palaeolithic hunter-gatherer ancestors never had them.

Even today, the Hadza don't use chairs. A Hadza man or woman can manufacture an impressive array of things, from powerful bows and arrows to breezy, weatherproof houses, and summon fire on demand. But they don't make furniture. The closest thing you will find in a typical Hadza household are animal skins for sleeping on the ground.

Without chairs or other furniture, how do we rest? Anthropologist Gordon Hewes was interested in this topic, having spent time teaching in Tokyo in the mid-1950s where seiza-style kneeling was often used as a rest posture in formal settings. Hewes amassed a worldwide compendium of nearly 1000 human postures. In societies with little furniture, Hewes found that resting often involved squatting or kneeling on the ground.

These postures are an ancient part of the human repertoire. Deep squatting flexes the foot upward, pressing the talus, a small bone in the ankle, into the end of the shin bone, or tibia. If it is done often enough, these postures leave a mark on the tibia, called a squatting facet. Palaeoanthropologists have found these facets on fossils of human ancestors going back to Homo erectus, nearly 2 million years ago.

Resting squats

In the Hadza community, we noticed that people of all ages spent much of their resting time in a deep squat, heels on the ground, bottoms resting on the back of the ankles. If you don't grow up doing it, you have

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probably lost the flexibility to squat that deeply (go on, give it a try). Even if it is second nature, as it is for the Hadza, the posture would seem to require more muscle activity than lolling about in a chair. Here, then, was a third hypothesis for how the Hadza avoid the perils of inactivity: rather than sitting less or breaking up their sitting into shorter bouts, perhaps the secret was in the way they sit.

Armed with these insights, we headed back to Hadzaland a few years later with an array of small, wearable sensors to record muscle activity and body position. We used the sensors to track the resting behaviours of 28 Hadza men and women for a week, calculating both the average number of hours spent inactive each day and the frequency with which they broke up long periods of sitting to stand up or walk around. We also conducted a set of controlled studies to measure muscle activity in various resting postures, including squatting and sitting in a chair.

The results surprised us. Hadza men and women spent nearly 10 hours every day resting, almost identical to the numbers for people in the US, Netherlands and Australia. The number of breaks was similar across populations as well. Hadza adults switched from resting to active postures like standing or walking roughly 50 times per day, on par with data from Europeans.

Still, Hadza blood profiles and blood pressures showed they were remarkably healthy, with low levels of triglycerides and other markers of heart disease. The Hadza were much healthier than their desk-bound counterparts in industrialised countries, but not because they rested less or got up to stretch their legs more often.

Instead, the big difference we found was in muscle activity during rest. Squatting forces you to keep the body balanced over the feet, requiring between five and 10 times as much muscle activity in the legs as sitting in a chair or on the ground, and sometimes even more muscle activity than we would expect from light activity. Sure enough, when we tallied the resting postures used around camp, we found that Hadza men and women were squatting and kneeling nearly one-third of this time. Putting the evidence together, we think that the use of "active resting" postures, like squatting and kneeling, might maintain enough muscle activity to prevent triglyceride build up and avoid disease. If our ancestors also used these more active rest postures, then the negative health effects of sitting make perfect sense: our physiology never experienced long periods of quiet muscles, so our bodies never evolved a protective response.

In the end, how could we blame Onawasi, or anyone, for wanting to sit in our camp chairs? We wanted them for the same reasons: chairs are an indulgence, allowing us to rest our tired muscles. The allure of a good chair has held our collective attention ever since they sprang into our material world. But chairs, once invented, let us rest in ways that are comparatively new to the human body. That novelty is both the draw and the danger.

Should we abandon our chairs? Unless you have been squatting since childhood, forcing yourself to do it may cause pain and discomfort. And Hadza men and women also spend much of their rest time in postures like sitting and lying down that entail low muscle activity, so maybe we don't have to avoid sitting altogether. But, our work suggests that you can improve your cardiovascular health by sitting less, and by breaking up your sitting into shorter bouts to increase muscle activity throughout the day. As our Hadza friends showed us, it is likely that quiet muscles are the enemy. So, while we are sheltering in place, working from home or watching more TV than ever before, let's try to break up the couch time into smaller bits. Get up, move around and if you are limber and feeling adventurous when you turn on Netflix, trying squatting just like the Hadza, in an active resting posture. Your heart will thank you.

newscientist.com, 15 July 2020

https://www.newscientist.com

COIVD-19 has resurrected single-use plastics—are they back to stay?

2020-07-14

COVID-19 is changing how the U.S. disposes of waste. It is also threatening hard-fought victories that restricted or eliminated single-use disposable items, especially plastic, in cities and towns across the nation.

Our research group is analyzing how the pandemic has altered waste management strategies. Plastic-Free July, an annual campaign launched in 2011, is a good time to assess what has happened to single-use disposable plastics under COVID-19, and whether efforts to curb their use can get back on track.

From plans to pandemic

Over several decades leading up to 2020, many U.S. cities and states worked to reduce waste from single-use disposable objects such as straws, utensils, coffee cups, beverage bottles and plastic bags. Policies varied but

In just a few weeks, plastic bags returned to grocery stores in states that had recently banned them.

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included bans on Styrofoam, plastic bags and straws, along with taxes and fees on bottles and cups.

Social norms around plastic waste have evolved quickly in the past several years. Pre-COVID-19, "Bring your own" tote bags, mugs and other foodware had become part of daily life for many consumers. Innovative startups targeting reusable foodware niches include Vessel, which partners with cafes, enabling customers to rent stainless steel to-go mugs, and DishCraft, which picks up dirty dishes from dine-in restaurants and to-go food outlets, cleans them with high-tech equipment and returns them ready for reuse.

Just before COVID-19 lockdowns began in March 2020, the New Jersey senate adopted a bill that would have made the state the first to ban all single-use bags made of either paper or plastic. And U.S. Sen. Tom Udall of New Mexico and U.S. Rep. Alan Lowenthal of California introduced the Break Free from Plastic Pollution Act – the first federal measure limiting use of single-use disposable items.

COVID-19 shutdowns drastically changed all of this. In just a few weeks, plastic bags returned to grocery stores in states that had recently banned them. Even before lockdowns were official, restaurants and cafes started refusing personal reusables such as coffee mugs, reverting to plastic cups and lids, wrapped straws and condiment packets.

By late June, cities and states had temporarily suspended almost 50 single-use item reduction policies across the U.S. – mainly bans plastic bag bans. The pandemic also spurred demand for single-use personal protective equipment, such as masks and plastic gloves. These items soon began appearing in municipal solid waste streams and discarded on streets.

The plastic pandemic

With legislation restricting disposables suspended, many food vendors and grocery stores have shifted entirely to disposable bags, plates and cutlery. This switch has raised their operating costs and cut further into their already-low margins.

Grocery stores have sharply increased plastic bag usage. Households are generating up to 50% more waste by volume than they did pre-COVID-19. Anecdotal reports indicate that these waste streams contain more single-use disposable items.

The recycling industry has weighed in on the impacts of more single-use bags and higher residential waste volumes. Waste industry workers, who

have been uniformly declared essential, work in closed spaces with many other people, so even if surface transmission of coronavirus is not a serious risk, the pandemic has increased person-to-person transmission risks in the waste industry.

Hygiene: A red herring

The main rationale that states, cities and vendors have offered to justify switching from reusables back to disposables is hygiene. Plastic packaging, the argument goes, protects public health by keeping contents safe and sealed. Also, discarding items immediately after use protects consumers from infection.

This narrative handily dovetails with the plastics industry's ongoing effort to slow or derail bans and restrictions. The industry has loudly supported turning the clock back toward single-use disposable products.

In a March 2020 letter to the U.S. Department of Health and Human Services, the Plastics Industry Association argued that single-use items were the "most sanitary" option for consumers. Industry representatives are actively lobbying against the Break Free From Plastics Act.

However, studies show that these products are not necessarily safer than reusable alternatives with respect to COVID-19. The virus survives as long on plastic as it does on other surfaces such as stainless steel. What's more, studies currently cited by the plastics industry focus on other contaminants such as E.coli and listeria bacteria, not on coronaviruses.

Viewed more holistically, plastics generate pollutants upstream when their raw materials are extracted and plastic goods are manufactured and transported. After disposal – typically via landfills or incineration – they release pollutants that can seriously affect environmental and human health, including hazardous and endocrine disrupting chemicals.

All of these impacts are especially harmful to minority and marginalized populations, who are already more vulnerable to COVID-19. In our view, plastic goods are far from being the most hygienic or beneficial to public health, especially over the long term.

Building resilience

Crises like the COVID-19 pandemic make it hard to see the bigger picture. No longer having to remember reusable tote bags or coffee mugs can be a relief. But the quick return of single-use disposable products shows that

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recent restrictions are precarious, and that industries don't cede profitable markets without a fight.

Waste reduction advocates, such as Upstream Solutions and #BreakFreeFromPlastic, are working to gather data, educate the public and prevent decision-making about plastics that is based on perception rather than scientific reasoning. On June 22, 115 health experts worldwide released a statement arguing that reusables are safe even under pandemic conditions.

Some governments are taking notice. In late June, California reinstated its statewide ban on single-use plastic bags and requirement for plastic bags to contain 40% recycled materials. Massachusetts quickly followed suit, lifting a temporary ban on reusable bags.

For the longer term, it is unclear how COVID-19 disruptions will affect consumerism and waste disposal practices. In our view, one important takeaway is that while mindful consumers are part of the solution to the plastics crisis, individuals cannot and should not carry the full burden.

We believe that at the local and federal levels, policymakers need to build cross-jurisdictional alliances, recognizing shared interests with the waste management industry and emerging businesses like Vessel and Dishcraft. To make progress on reducing plastic waste, advocates need to reinforce measures in place before the next crisis hits.

theconversation.com, 14 July 2020

https://www.theconversation.com

Should banks be forced to price in climate change?

2020-07-14

Since the 2008 financial crisis, regulators each year have required big banks to prove they could keep lending through new calamities. The rules, so far, have focused on purely economic disasters: Do they have enough capital to keep their doors open when markets collapse, or if unemployment explodes?

But there's another kind of risk that didn't burst onto the radar during that crisis but could trigger just as much of an economic disaster: climate change.

With increasingly severe storms, floods and fires, many forecasters envision a crisis that pivots from the physical to the economic. Imagine back-to-

But there's another kind of risk that didn't burst onto the radar during that crisis but could trigger just as much of an economic disaster: climate change.

back wildfires and floods devastating huge swaths of California, or an epic drought coupled with tornadoes in Oklahoma during an oil price dip. The growing fear is that widespread damage to property serving as collateral for loans and to assets underpinning other investments could cause devastating financial blowback to banks, not to mention insurers on the hook for the damage.

And as governments try to ratchet down carbon output, it could also threaten banks through their exposure to fossil fuel investments. Some see the global economy's potential next "Minsky moment"—a reference to the economist Hyman Minsky, who warned of speculative business cycles that end in destabilizing crisis.

What to do about the problem is emerging as a high-level conversation among global bankers, their regulators and an increasingly influential coalition of Wall Street watchdogs and environmental advocates who are winning over a growing number of U.S. lawmakers.

Should banks be subject to a stress test for climate—and if yes, what would it look like?

Stress tests are just one of the tools advocates want regulators to deploy to avert a disaster. But already the conversation is split between different approaches. One prevailing idea is to require more corporate disclosure of climate change risks. Others see the potential need for stricter regulatory intervention — such as an overhaul of bank capital rules — to nudge financial institutions toward a greener economy.

"I'm not looking at this as a social policy," said Sarah Bloom Raskin, a former Federal Reserve governor and deputy Treasury secretary who is widely seen as a contender for Fed chairman or Treasury secretary for the next Democratic president. "I'm looking at this as economic resilience and financial institution resilience. I see it as integral to how we actually manage risk."

The financial fallout from climate change falls into two potential buckets. The first category is the so-called physical risks, the danger that collateral such as real estate underlying bank loans is susceptible to natural disasters, exposing lenders to financial risks — in particular if they aren't diversified.

The second category is less extreme and dramatic, but may have bigger long-term consequences. Those are the transition risks — the costs

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incurred as the world, as expected, reduces its carbon footprint to mitigate global warming.

The concern is that it could trigger its own kind of shock — making financial institutions' oil and gas investments worthless as carbon-producing energy sources become "stranded" and unburnable.

According to the Rainforest Action Network, 35 of the world's biggest banks provided $735.6 billion in financing to fossil fuel companies in 2019. One calculation from February by Financial Times Lex Research Editor Alan Livsey put a $900 billion price tag on the value of fossil fuel assets that would be lost if governments tried to limit the increase in temperatures to 1.5 degrees Celsius above pre-industrial levels. Other estimates have put the degree of economic risk in the trillions of dollars.

Many economists have long suspected that climate risks are an underanalyzed, underappreciated threat to the world economy. In a study released in May, then International Monetary Fund found that global stock markets aren't reflecting the physical dangers of natural disasters. IMF officials said that a first step should be more transparency: "granular, firm-specific information" on climate change exposure, wrote the IMF's Felix Suntheim and Jérôme Vandenbussche, would help lenders, insurers and investors better understand the liabilities. The IMF said climate change stress testing and scenario analysis for financial firms "can play a potentially important role in providing a better sense of the size of the exposures at a highly granular level."

The development and enforcement of the recommendations would fall to national regulators, including central banks. Some have already started to move in this direction.

Before Bank of England Governor Mark Carney stepped down in March, he pioneered an effort to begin stress testing banks for climate factors. (He's since been appointed United Nations special envoy for climate action and finance.) The Bank of England, European Central Bank and Bank of Japan are among the more than 60 central banks and regulators that have formed the so-called Network for Greening the Financial System to collaborate on the issue. In June, the group released a set of climate scenarios as a starting point for analyzing the risks and a guide for regulators with practical advice on how they should proceed.

In the U.S., bank regulation falls to the Federal Reserve, Federal Deposit Insurance Corp., the Office of the Comptroller of the Currency and state agencies. Among them, the New York Department of Financial Services

is the only U.S. representative in the Network for Greening the Financial System.

Federal Reserve Chairman Jerome Powell, first nominated by President Barack Obama to serve at the the Fed in 2011 and then confirmed as chair under President Donald Trump in 2018, said in January that a systemwide risk to financial stability from climate change is "certainly possible" over the longer term. He indicated that the central bank would take a cautious approach.

"We are in the very early stages, as are other central banks, in understanding just what that means," he said. "And there's quite a lot of work going on around the world at other central banks and at the Fed, too, to think that through."

He signaled that the Fed should play a limited role in the broader policy response to climate: "Society's overall response to climate change needs to be decided by elected officials and not by the Fed."

Now, environmental activists, financial reformers and a growing number of influential Democratic policymakers are calling on the Fed and other U.S. regulators to act more aggressively.

One of them is Raskin, a former Obama Fed and Treasury official who has emerged as one of the leading voices on the issue. She said her two former agencies "have to get caught up with the rest of the world." Raskin, who is allied with progressives and is seen as a potential top economic appointee in a potential Biden administration, giving her views extra weight.

"The other central banks are all on this," Raskin said. "They completely understand that climate change is a potential exogenous shock that needs to be prepared for."

Raskin takes a broad view of how the government should get involved. She argues that a Treasury official should be tasked with bringing together financial regulatory agencies to articulate what the problems look like from the position of the firms they oversee. Raskin served a similar role coordinating the Obama administration's response to cybersecurity threats in the financial industry.

"There needs to be a concerted effort first of all within each regulatory agency but then cohesively around what are the real risks," she said. "You can come up with a list of priorities. Maybe that will involve a climate stress test. Maybe it will involve better disclosures around a firm's market valuation that have to do with what their exposure to carbon-based assets

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is. Maybe firms just need to have plans regarding transitioning away from carbon-based assets."

At the modest end, policymakers around the world have called on corporations to step up disclosures of risks they face from global warming. Beyond that, Democratic lawmakers and activists want the Fed to formally include climate in its bank stress test calculations, forcing lenders to be transparent about their assets at risk. At the more ambitious end, some European and U.K. officials have discussed adjusting rules governing bank capital — the financial buffer to protect against losses — to incentivize "green" investments while penalizing more environmentally harmful "brown" activities. Advocates in the U.S. have said it's also an idea worth exploring.

Underlying the proposals is a belief that the tools could also hasten the transition to a greener economy — a goal that supporters do not hide. That has banks distressed about whether they'll become a tool for climate change policy.

In the U.S., stress testing by the Fed has a direct impact on how banks must manage their balance sheets, and bank representatives argue the risks of climate change extend far beyond their current financial exposure.

Tinkering with how much capital they have to hold based on what's more environmentally friendly is even more horrific to lenders who say it's as a way for governments to use bank deposits instead of taxpayer money to fund climate policy decisions.

"Capital requirements, including risk-weighted requirements and stress tests, should be based on actual financial risk and not co-opted as a subsidy or penalty to serve other public policy goals, however worthy," said Greg Baer, who represents the largest U.S. lenders as president and CEO of the Bank Policy Institute. "Climate change policy should be effectuated through fiscal policy and direct regulation, while financial regulation should remain focused on protecting taxpayers and reducing systemic risk."

The issue has become a political sweet spot for Democrats who want to talk about greening the economy and policing Wall Street excess.

"The failure of our regulators to accurately and thoroughly account for that risk is growing more serious by the day," said Sen. Brian Schatz, a Hawaii Democrat on the Senate Banking Committee who has drafted climate

stress test legislation. "They don't have to have an opinion about climate change as a public policy matter. But risk is risk."

In the U.S., where lobbies exert large influence on the agencies that regulate them, what happens will likely need to involve the banks themselves.

While the finance industry is uneasy with the idea of climate stress tests and changes to capital rules, it's started to show some willingness to put potential threats under a microscope as political pressure has grown. JPMorgan Chase and Bank of America are among the supporters of the Task Force on Climate-Related Financial Disclosures, a G-20-organized group chaired by Michael Bloomberg that is developing voluntary climate-related financial disclosures.

With a range of rules and regulations looming, some of the industry's biggest players are calling for greater international coordination on what the next steps will be.

"Our members have been on the record and very consistent in saying, these risks need to be identified, they need to be managed," said Andrés Portilla, head of regulatory affairs at the Institute of International Finance, which represents global banks and insurers.

But there are limits. "Whether the regulatory approach needs to be a prescriptive one, or one that leads to capital charges, then it's a different question," Portilla added.

With U.S. regulators focused on the emergency response to the pandemic, nothing major is likely to happen in the near future, and Trump's appointees have not signaled that it's a priority. So climate-related financial risk is shaping up to be another issue on the ballot in November — whether voters are tracking it or not.

The debate that's just beginning to ramp up will likely leave a mark on the economic policies of the Democratic Party, including presumptive Democratic nominee Joe Biden's presidential agenda.

"A lot of what we have tried to do and are going to continue to try to do is set the stage for action under a future administration," said Gregg Gelzinis, senior policy analyst for economic policy at the Center for American Progress. "The first time we progressives think about this issue and think about some of the policy details shouldn't be the first day controlling the levers of power."

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Graham Steele, a former senior aide to Senate Banking Committee Democrats, who now oversees the Corporations and Society Initiative at the Stanford Graduate School of Business, has written a paper that reads like a road map for the next administration, outlining the potential risks and the options available to regulators.

"All these ways in which climate scientists talk about how risk in one region can lead to a tipping point that impacts a different region is deeply analogous to how we think about things like fire sales and run risks," he said. "It felt sometimes they were using literally the exact same terminology we use when we think about financial regulation."

It will be a litmus test on the left for Biden's executive appointments, if he wins in November. Elected Democrats including Schatz are already calling on Biden and his advisers to act.

"What I'm hopeful of — and have certainly had conversations about this with all the presidential candidates including now our nominee — is this is not just a question of do they prioritize these issues," said Rep. Sean Casten (D-Ill.), who is sponsoring bills on climate stress tests and climate risk disclosure for corporations. "But do they structure their administration in a way that ensures there's a single point of control to make sure we factor all these things in."

politico.com, 14 July 2020

https://www.politico.com

Why are US coronavirus deaths going down as covid-19 cases soar?

2020-07-14

Coronavirus deaths are falling in the US even as cases skyrocket. In the UK, a lower proportion of people hospitalised with covid19 are dying. This has led to suggestions that the risk of dying if you are infected with the virus is falling, but the truth may be more complicated.

"At this point, I don't think we have conclusive evidence that the death rate is going down," says Tessa Bold at Stockholm University in Sweden.

Having plateaued at around 20,000 in May, the number of daily confirmed cases in the US began rising in June and has now exceeded 60,000. However, the number of deaths in the US reported as being due to covid-19 has fallen from more than 3000 a day in mid-April to well under 1000.

Another reason why deaths aren't tracking case numbers in the US could be the lag between people testing positive for the coronavirus and dying.

There are several possible explanations for this. For starters, it could be a result of better treatments, including use of the steroid dexamethasone.

Another reason why deaths aren't tracking case numbers in the US could be the lag between people testing positive for the coronavirus and dying. Those who die usually do so around two weeks after developing symptoms and their deaths typically aren't reported for another week. More widespread testing, no longer limited to those with serious symptoms, could mean that cases of coronavirus are being detected even earlier, increasing this lag.

It could also be that most new cases are in younger people, whose risk of dying from the virus is far lower. The median age of those testing positive in the US is falling, suggesting that while older people continue to shelter and avoid infection, younger people are being infected as they return to work and socialising.

"As this group begins to mingle with older relatives, we may see a spike in cases for the older," says Richard Grewelle at Stanford University in California.

Plenty of mingling will have occurred over the Independence Day weekend, which could lead to a spike in deaths in late July, he says. "We'll see if my prediction holds true."

The situation in England points to a similar trend in the UK. An analysis of government data by Jason Oke at the University of Oxford and his colleagues suggests there has been a steady and steep decline in the proportion of people hospitalised with covid-19 dying. "It's encouraging," says Oke. "We are either getting better at treating this or it's becoming less severe."

But there might be other explanations, he cautions. It could just be an artefact of the data due to survivors staying in hospital longer. Another possibility is that hospitals are admitting less severe cases now they have the resources.

To know for sure if the odds of dying are falling, we really need to know how many of those who are infected succumb and if this is changing – that is, if the infection fatality rate (IFR) is declining.

Early estimates put the IFR across populations at between 0.6 and 1 per cent. Some thought this would turn out to be an overestimate, but recent estimates are similar. A statistical analysis by Grewelle and his colleague Giulio De Leo, for instance, suggests that the global IFR so far is 1 per cent.

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Bold's team has estimated IFRs for different countries around the world based on death rates in France, and also came up with relatively high numbers. For instance, Brazil, one of the world's hardest-hit countries, should have an IFR of around 0.4 per cent given the ages of its inhabitants and their general health. Adjusting for the quality of healthcare, however, pushes the predicted IFR up to 0.8 per cent.

This matches research by Fernando Barros at the Catholic University of Pelotas in Brazil. He has tried to directly measure the nation's IFR by doing antibody tests on more than 25,000 people. His team puts it at 1 per cent.

So far, though, there are no estimates of how IFRs are changing over time. "We have only one estimate, and not two or more points in time, so we are not in the position of studying trends," says Barros

newscientist.com, 14 July 2020

https://www.newscientist.com

Simple addition to crops could help soak up 2 billion tonnes of CO2 each year

2020-07-18

Drastically reducing the amount of carbon dioxide (CO2) we're pumping into the atmosphere is the best way of tackling our climate crisis, but soaking up CO2 could make a huge difference as well – and scientists have found one way to significantly boost the amount of CO2 that crops are able to absorb.

The trick is adding crushed rock dust, which triggers a reaction known as enhanced rock weathering (ERW): minerals in the tiny bits of rock chemically bind with the CO2 naturally picked up by rainwater as it falls on the ground.

The bicarbonate end product then washes away to be locked into the soil or, ultimately, the ocean.

Rock weathering happens naturally, but it speeds up when smaller rock particles are used so that it only takes months.

The simple addition to crops would be enough to remove 2 billion tonnes of CO2 every year if it was deployed worldwide, the scientists calculated.

That's about as much CO2 as the aviation and shipping industries pump into the atmosphere every year.

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"Carbon dioxide drawdown strategies that can scale up and are compatible with existing land uses are urgently required to combat climate change, alongside deep and sustained emissions cuts," says David Beerling, the director of the Leverhulme Centre for Climate Change Mitigation at the University of Sheffield in the UK.

"Spreading rock dust on agricultural land is a straightforward, practical CO2 drawdown approach with the potential to boost soil health and food production."

The analysis involved creating extensive gridded maps of the world's farmland and the weather systems that they experience. Costs, engineering challenges, and CO2 removal potential were broken down by country.

Even the quality of the local soil and the energy required to transport rock dust to each location was factored in as well, as there's little point removing CO2 from the atmosphere if we're going to be emitting even more in the effort to get the necessary materials to farmers in the first place.

The 2 billion tonne figure they came up with is something the researchers think we could get to by 2050, with everyone pulling together. While the approach is not without its challenges, it does have certain factors in its favour – not least that farmers already do something like it.

"The practice of spreading crushed rock to improve soil pH is commonplace in many agricultural regions worldwide," says Steven Banwart, director of the Global Food and Environment Institute at the University of Leeds in the UK.

"The technology and infrastructure already exist to adapt these practices to utilise basalt rock dust. This offers a potentially rapid transition in agricultural practices to help capture CO2 at large scale."

The technique has a number of bonuses. It can help stop the deterioration of topsoil, it reduces the acidity of rainwater (and also the acidity of the oceans), and we could use stockpiles of silicate rock dust left over from the mining industry as well as construction byproducts for the job.

Scientists have been exploring this idea for a number of years, but this is the first detailed report on the potential global cost and effect of ERW. The nations with the highest CO2 output, including the US and India, could suck up the most carbon dioxide the researchers say, because of their extensive agricultural industries and climates.

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All that said, this would still be a huge challenge: efforts would need to be carefully coordinated across the world's farms, any efforts would need to be well funded, and, unfortunately, adding rock dust to crops isn't going to be nearly enough to save us on its own.

What's more, this detailed model now needs real-world testing to back it up and check for any potential and unwanted side effects.

Still, we need options like this now more than ever.

"We have passed the safe level of greenhouse gases," says climatologist James Hansen, from Columbia University.

"Cutting fossil fuel emissions is crucial, but we must also extract atmospheric CO2 with safe, secure and scalable carbon dioxide removal strategies to bend the global CO2 curve and limit future climate change."

The research has been published in *Nature*.

sciencealert.com, 18 July 2020

https://www.sciencealert.com

Is it safe to strike up a band in a time of coronavirus?

2020-07-17

As U.S. schools and colleges debate how to reopen amid the novel coronavirus pandemic, band directors and musicians are wondering when—or whether—music can be played safely. A new study finds that although musical instruments do generate airborne particles that could carry SARS-CoV-2, the risks for performers and audience may be manageable.

There is almost no research on whether musical instruments produce the airborne particles—or aerosols—that can transmit the novel coronavirus. So it's impossible to know whether keeping 2 meters away is enough to stay safe from a trumpet at full blast.

Without data, schools were already cutting band rehearsals "out of fear," said Mark Spede, president of the College Band Directors National Association. Given the potential threat to music education and the livelihoods of musicians around the globe, Spede's group and the National Federation of High School State Associations raised about $275,000 from more than 100 arts groups to study the safety of performing during the pandemic.

For instance, the trumpet and clarinet, which run straighter from the mouthpiece to the instrument opening, had higher concentrations of aerosols.

Researchers at the University of Colorado (CU), Boulder, had five student musicians—a soprano singer and clarinet, flute, French horn, and trumpet players—enter a clean room one at a time. The room was normally used for indoor air pollution research, and it was outfitted with tight seals, and multiple high-efficiency particulate air (HEPA) filters remove almost all particles from the air.

The participants performed a short solo piece with a wide range of high and low notes and different styles of playing, including a smooth chorale and a staccato march. The players angled their instruments' openings toward a series of tubes that feed into a trio of particle monitors that detected aerosols of different sizes. An imaging system also captured the airflow around the musicians to visualize where the particles moved.

The initial results—which were released online this week without peer review—showed for the first time that the instruments can produce aerosols in the range of sizes that can carry the COVID-19 virus. These aerosols can also stay airborne for long periods of time, and different instruments produced different amounts. For instance, the trumpet and clarinet, which run straighter from the mouthpiece to the instrument opening, had higher concentrations of aerosols.

To reduce the spread of aerosols, the researchers tested instrument covers, such as a cloth covering for the opening or a sack covering an entire clarinet; both effectively reduced aerosols, in some cases by half, without deadening their sound.

Another team at the University of Maryland, College Park, used computer models to examine whether an infected musician might spread the virus in different conditions. The modeling confirmed the importance of distancing to avoid infected plumes. It also suggested that conventional ventilation systems, where air supply and exhaust are both on the ceiling, are less effective than those in which the exhaust is on the floor.

The results add to recent work on airflow from instruments. A study in May had Vienna Philharmonic wind and string musicians play after inhaling a mist that is illuminated by headlights when exhaled. Another study, conducted this spring in Germany, tracked air flow from wind instruments. Both found that instruments produced less airflow than singing (although flutes produced more than other wind instruments).

Bernhard Richter, an otolaryngology specialist and co-director of the Freiburg Institute for Musicians' Medicine, who led the German study, says his team's initial results could inform safety recommendations. And he says

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the new aerosol work will offer even more sophisticated data. "We don't know enough about aerosols … and the critical issue of how they are spreading."

The researchers behind the aerosol study will now gather data from additional instruments, singers, dancers, and actors. Those could give a fuller picture of potential risks of performance and improve computer modeling on the effectiveness of distancing and air circulation, says Shelly Miller, an engineering professor at CU who helped run the study.

Based on the initial findings, the organizations that funded the study recommend that indoor rehearsal rooms and performance venues use HEPA filters and increase circulation, and that musicians use instrument covers. They also recommend 2 meters of distancing and that performers face the same direction, which could limit band or orchestra size.

Miller says she hopes further data recommendations will let the band play on. "It's heartbreaking to halt these activities because we don't know if they're hazardous or not."

sciencemag.org, 17 July 2020

https://www.sciencemag.org

Dogs may use Earth's magnetic field to take shortcuts

2020-07-17

Dogs are renowned for their world-class noses, but a new study suggests they may have an additional—albeit hidden—sensory talent: a magnetic compass. The sense appears to allow them to use Earth's magnetic field to calculate shortcuts in unfamiliar terrain.

The finding is a first in dogs, says Catherine Lohmann, a biologist at the University of North Carolina, Chapel Hill, who studies "magnetoreception" and navigation in turtles. She notes that dogs' navigational abilities have been studied much less compared with migratory animals such as birds. "It's an insight into how [dogs] build up their picture of space," adds Richard Holland, a biologist at Bangor University who studies bird navigation.

There were already hints that dogs—like many animals, and maybe even humans—can perceive Earth's magnetic field. In 2013, Hynek Burda, a sensory ecologist at the Czech University of Life Sciences Prague who has worked on magnetic reception for 3 decades, and colleagues showed dogs tend to orient themselves north-south while urinating or defecating.

There were already hints that dogs—like many animals, and maybe even humans—can perceive Earth's magnetic field.

Because this behavior is involved in marking and recognizing territory, Burda reasoned the alignment helps dogs figure out the location relative to other spots. But stationary alignment isn't the same thing as navigation.

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In the new study, Burda's graduate student, Kateřina Benediktová, initially put video cameras and GPS trackers on four dogs and took them on trips into the forest. The dogs would scamper off to chase the scent of an animal for 400 meters on average. The GPS tracks showed two types of behavior during their return trips to their owner (see map, below). In one, dubbed tracking, a dog would retrace its original route, presumably following the same scent. In the other behavior, called scouting, the dog would return along a completely new route, bushwhacking without any backtracking.

When Benediktová showed the data to Burda, her Ph.D. adviser, he noticed a curious feature: In the middle of a scouting run, the dog would stop and run for about 20 meters along a north-south axis (see video, below) before it began to navigate back. Those short runs looked like an alignment along the magnetic field, but Benediktová didn't have enough data to be sure.

So Benediktová and Burda scaled up the project, setting loose 27 dogs on several hundred trips over 3 years. Colleagues in the department of game management and wildlife biology, where almost everyone has a hunting dog, pitched in.

The researchers took a close look at 223 scouting run cases, in which the dogs roamed an average of 1.1 kilometers on their return. In 170 of these trips, the dogs stopped before they turned back and ran for about 20 meters along a north-south axis. When the animals did this, they tended to get back to the owner via a more direct route than when they didn't, the authors report in *eLife*. "I'm really quite impressed with the data," Lohmann says.

During the walks in the forest, the team tried to avoid giving the dog other navigational clues. Whenever possible, a dog was taken to a part of a forest it had never been to, so that it couldn't rely on familiar landmarks. A dog also couldn't navigate back by looking for its owner, who hid after the dog first headed off to roam. Scent didn't seem to play a role either, because the wind was rarely blowing from the owner toward the dog when it was coming back.

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Burda thinks the dogs run along a north-south axis to figure out which way they are. "It's the most plausible explanation," he says. Lohmann says the implication is that dogs can remember their previous heading and use the reference to the magnetic compass to figure out the most direct route home. "I'm intrigued," she says.

Adam Miklósi, who specializes in dog behavior at Eötvös Loránd University, says designing magnetoreception experiments is complicated because it is hard to make an animal rely only on that sense. "The problem is that in order to 100% prove the magnetic sense, or any sense, you have to exclude all the others."

Burda and Benediktová are taking a different approach. In one new experiment, they will put magnets on the dogs' collars to disturb the local magnetic field and see whether it hinders their ability to navigate. The idea harkens back to a controversial experiment published in 1980 in *Science*, in which magnets stuck in blindfolds seemed to disrupt an intuitive magnetic homing sense in humans.

Miklósi says it would not be surprising to find that dogs can use the magnetic field to navigate—it seems to be an ancient ability—and it might be present in any mammal that traverses large territories. Lohmann agrees. "You would expect this to be something that a lot of animals can do to return home after hunting," she says, "and it's neat to see it in a dog."

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sciencemag.org, 17 July 2020

https://www.sciencemag.org

The link between Parkinson's Disease and toxic chemicals

2020-07-20

Michael Richard Clifford, a 66-year-old retired astronaut living in Cary, N.C., learned before his third spaceflight that he had Parkinson's disease. He was only 44 and in excellent health at the time, and had no family history of this disabling neurological disorder.

What he did have was years of exposure to numerous toxic chemicals, several of which have since been shown in animal studies to cause the kind of brain damage and symptoms that afflict people with Parkinson's.

Sometimes, though, the links are so strong and the evidence so compelling that there can be little doubt that one causes the other.

As a youngster, Mr. Clifford said, he worked in a gas station using degreasers to clean car engines. He also worked on a farm where he used pesticides and in fields where DDT was sprayed. Then, as an aviator, he cleaned engines readying them for test flights. But at none of these jobs was he protected from exposure to hazardous chemicals that are readily inhaled or absorbed through the skin.

Now Mr. Clifford, a lifelong nonsmoker, believes that his close contact with these various substances explains why he developed Parkinson's disease at such a young age. Several of the chemicals have strong links to Parkinson's, and a growing body of evidence suggests that exposure to them may very well account for the dramatic rise in the diagnosis of Parkinson's in recent decades.

To be sure, the medical literature is replete with associations between people's habits and exposures and their subsequent risk of developing various ailments, from allergies to heart disease and cancer. Such linkages do not — and cannot by themselves — prove cause and effect. Sometimes, though, the links are so strong and the evidence so compelling that there can be little doubt that one causes the other.

The link of cigarette smoking to lung cancer is a classic example. Despite tobacco industry claims that there was no definitive proof, the accumulation of evidence, both experimental and epidemiological, eventually made it impossible to deny that years of smoking can cause cancer even long after a person has quit.

The criteria that supported a cause-and-effect relationship between smoking and lung cancer included strength and consistency of the association; whether the link made biological sense; whether it applied especially or specifically to those exposed to the putative agent; and whether it was supported by experimental evidence.

Likewise, based on extensive evidence presented by four experts in a new book, "Ending Parkinson's Disease," it seems shortsighted to deny a causative link between some cases of Parkinson's disease and prior exposure to various toxic chemicals.

The book was written by Dr. Ray Dorsey, neurologist at the University of Rochester; Todd Sherer, neuroscientist at the Michael J. Fox Foundation for Parkinson's Research; Dr. Michael S. Okun, neurologist at the University of Florida; and Dr. Bastiaan R. Bloem, neurologist at Radboud University Nijmegen Medical Center in the Netherlands.

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The authors called the increasing prominence of Parkinson's "a man-made pandemic." Its prevalence has closely tracked the growth of industrialization and has increased dramatically with the use of pesticides, industrial solvents and degreasing agents in countries throughout the world.

"Over the last 25 years," the authors noted, "the prevalence rates for Parkinson's, adjusted for age, increased by 22 percent for the world, by 30 percent for India, and by 116 percent for China."

Furthermore, they added, men, who are more likely to work in occupations that expose them to industrial products linked to the disease, have a 40 percent greater risk than women of developing it.

But no one is being spared a potential risk. Among other exposures, a solvent called trichloroethylene, or TCE, linked to Parkinson's, is so widespread in the American environment that nearly everyone has been exposed to it. It contaminates up to 30 percent of the country's drinking water and, because it evaporates readily, it can enter homes undetected through the air.

Yet a proposed ban on the use of TCE was postponed indefinitely in 2017 by the Environmental Protection Agency, as has a ban on the nerve toxin chlorpyrifos, an insecticide linked to Parkinson's that is widely used on crops and golf courses.

Another prominent toxin, the pesticide paraquat, can increase the risk of Parkinson's by 150 percent. It has been banned by 32 countries, including China, but not by the United States, where use on agricultural fields has doubled during the last decade, the authors noted. Both TCE and paraquat were banned years ago in the Netherlands, and the incidence of Parkinson's there has since declined.

As with smoking, which doesn't cause cancer in all smokers, most cases of Parkinson's are likely to reflect an interaction between environmental exposures and genetic predisposition. But also as with cancer and smoking, criteria that strongly suggest a cause-and-effect relationship apply as well to chemical exposure and the development of Parkinson's disease. In fact, a pioneering study in California by Dr. Caroline Tanner and Dr. William Langston of more than 17,000 twin brothers, both fraternal and identical, suggested that environmental factors outranked genetics as a cause of Parkinson's.

Thirty years ago, researchers at Emory University showed that rats developed classic features of Parkinson's when given rotenone, then a popular household insecticide that is still used by fisheries to eliminate invasive species. When the researchers examined the rats' brains, they found a loss of nerve cells that produce dopamine, the same damage that afflicts people with Parkinson's.

Dr. Langston and Dr. Tanner later showed that farmers who used rotenone and paraquat, among other pesticides, were more than twice as likely to develop Parkinson's as those who did not use these chemicals. In laboratory studies, the Parkinson-associated chemicals have been shown to injure nerve cells.

Although Parkinson's is most likely to afflict older people, its rise has far exceeded the aging of the population. In just 25 years, from 1990 to 2015, the number of people afflicted globally more than doubled, from 2.6 million to 6.3 million, and is projected to reach 12.9 million by 2040.

The disease is progressive, characterized by tremors, stiffness, slow movements, difficulty walking and balance problems. It can also cause loss of smell, constipation, sleep disorders and depression. While there are medications that can alleviate symptoms, there is as yet no cure. People can live with gradually worsening symptoms for decades, resulting in a huge burden on caregivers.

And the economic burden of Parkinson's is huge, said Dr. Tanner, now a neurologist and environmental health scientist at the University of California, San Francisco. In 2017, it resulted in about $25 billion in direct medical costs and another $26 billion in indirect costs, she said.

In addition to preventing exposure to toxic chemicals, Dr. Tanner said that regular exercise and a healthy diet can reduce the risk of Parkinson's even in people who were occupationally exposed to nerve toxins.

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Newly identified cell type may help predict, treat rheumatoid arthritis flares

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When Dana Orange's patients experience flare-ups of rheumatoid arthritis (RA), they can be devastating. One woman's pain is so great that she can't bend her elbow to brush her teeth. Another is unable to support the weight of her purse. Still another takes 30 minutes to roll out of bed and 90 minutes more bath and dress.

One woman's pain is so great that she can't bend her elbow to brush her teeth.

But the worst part, says Orange, a rheumatologist at the Rockefeller University, is that these attacks are wholly unpredictable. A new study may change that. Orange and her colleagues found that in the weeks before an RA attack, a newly identified cell type builds up in the blood, possibly triggering inflammation in the joints. If researchers can target those cells for diagnosis or therapy, they could predict or even prevent the flares.

The new findings are "intriguing," because they may help clinicians and patients more effectively manage the ebbs and flows of the disease, says Dirk Elewaut, a rheumatologist at Ghent University who was not involved in the study.

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RA is an autoimmune disease that causes debilitating pain and irreversible joint damage, among other symptoms. It affects an estimated 1.3 million people in the United States, with women more than twice as likely as men to develop the disease. Anti-inflammatory and immunosuppressant medications can help keep the disease in check, but the drugs' effectiveness can wane over time, and up to one-third of patients on these drugs can experience flare-ups.

To better understand how the condition changes from day to day, Orange and colleagues decided to track fragments of messenger RNA in the blood of five patients with uncontrolled RA. They wanted to see whether—prior to a flare-up—there were any consistent changes in the kinds of RNA circulating in the bloodstream.

But ideal tracking would require patients to come to the lab at least weekly for blood draws, the team thought. That was unrealistic to ask of patients, so they had the five volunteers collect their own blood at home once per week (or multiple times if they were experiencing flare-ups) via pinprick—similar to the method some people with diabetes use to monitor their disease. The researchers also developed a new buffering solution which, when mixed with blood samples, would preserve RNA for at least 24 hours, allowing patients to mail their blood samples to the team's lab.

Collectively, the blood draws continued for more than 200 weeks—a time of "blood, sweat, and tears," says Robert Darnell, a neuro-oncologist at the Rockefeller University and senior author on the study. When the team finally reviewed the samples, researchers analyzed which types of RNA

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were abundant in each patient before, during, and after reported flares. They then matched those data to known signatures associated with cells causing inflammation to re-create patterns of immune activity.

That's when they found a "major unexpected [RNA] signature," Darnell says. Its source: mesenchymal cells, which develop into the body's connective tissues and fill spaces between joints. This mesenchymal RNA consistently appeared in the weeks before flares in each patient, in tandem with RNA associated with inflammation. This led the team to dub these distinctive cells preinflammatory mesenchymal (PRIME) cells.

To validate their findings, the researchers then took samples from 19 additional patients with active RA and found that PRIME cells were present at much higher levels than in healthy controls, the team reports this week in *The New England Journal of Medicine*. Although this finding doesn't mean PRIME cells cause the attacks, Darnell says, the patterns suggest they are integral to flare-ups of joint inflammation.

The researchers also found RNA signatures associated with immature white blood cells that peaked in the days prior to PRIME cell activity. White blood cells are responsible for initiating cascades of immune activity—recruiting other inflammatory cells in order to do so—and dysfunctional white blood cells have been implicated in multiple autoimmune diseases. Taken together, the finding suggests PRIME cells could be mobilized by abnormal immune system activity, Darnell says.

Prior research has found that similar inflammation-causing connective tissue cells cause the disease in the joints of mice, but this is the first time such cells have been found in the human bloodstream. That makes this study "important," as it could direct researchers' attention to ways in which these cells could be manipulated to rein in the disease, says Robert Winchester, a rheumatologic pathologist at Columbia University. However, the study is just a first step, Elewaut cautions. Knowing for certain how PRIME cells influence flare-ups will require "a much larger set" of experiments.

Other experts are excited by the new buffering solution. Stanley Cohen, a rheumatologist at the University of Texas Southwestern Medical Center who was not involved in the study, says it could help researchers monitor disease activity in patients with other autoimmune conditions that wax and wane, including lupus and ankylosing spondylitis. "One could easily imagine cut-and-pasting this entire protocol" to other diseases, Darnell says. Those include COVID-19—because severe cases feature a storm of immune cells, clotting factors, and other inflammatory signals in the

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blood. Darnell has already begun to adapt the method for monitoring COVID-19 in patients quarantining at home.

Darnell says the findings could help researchers "take the Benjamin Franklin approach to preventing fires: an ounce of prevention, rather than a pound of cure." Orange sees a more concrete benefit for her patients. If the PRIME cells help diagnosis and treatment, "you could, at the bare minimum, plan your life, and perhaps even stop the flares from coming."

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