

# Bulletin Board

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### ASIA PACIFIC

#### Japan GHS classifications updated

2020-03-25

On 17 March 2020, the Japanese National Institute of Technology and Evaluation's (NITE) GHS Classification Results were updated. The following substance (already classified) had its classification updated:

Phosphoric acid

Yordas Group, 25 March 2020

<https://www.yordasgroup.com/hive/news>

22 October 2019

#### South Korea revises Toxic Chemical Substances List

2020-03-25

In March 2020, the South Korea Toxic Chemical Substances List was updated in accordance with a revision published in the official gazette, adding the following substances to the list:

1-(5-Ethyl-5-methyl-1-cyclohexen-1-yl)-4-penten-1-one

1,1'-[(1,1,5,5-Tetramethyl-3,3-diphenyl-1,5-trisiloxanediyl)di-3,1-propanediyl] 2-methyl-2-propenoate

1-Butyl-3-dodecyl-1H-imidazolium salt with 1,1,1-trifluoro-N-[(trifluoromethyl)sulfonyl]methanesulfonamide (1:1)

4-(2,6,6-Trimethyl-1-cyclohexen-1-yl)-3-buten-2-ol

Bromotrimethylsilane

Trifluoromethanesulfonic anhydride

Bis[4-(1,1-dimethylethyl)phenyl]iodonium salt with 1,1,2,2,3,3,4,4,4-nonafluoro-N-[(1,1,2,2,3,3,4,4,4-nonafluorobutyl)sulfonyl]-1-butanesulfonamide (1:1)

(1S,4R,5R)-4-Methyl-1-(1-methylethyl)bicyclo[3.1.0]hexan-3-one

2-Tridecenal

(E,E)-3,7-Dimethyl-2,6-octadien-1-yl 2-methyl-2-butenate

**The following substance (already classified) had its classification updated:  
Phosphoric acid**

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2-Methyl-2-propenal

Chloroacetic acid compound with cyclohexylamine (1:1)

4-Chloro-2-(methylsulfonyl)pyrimidine

Yordas Group, 25 March 2020

<https://www.yordasgroup.com/hive/news/article/867>

### India increases priority substance list to 750 chemicals

2020-03-26

As India goes into lockdown over the coronavirus Covid-19, the country's Ministry of Chemicals and Fertilisers has circulated a fourth draft of its Chemicals (Management & Safety) Rules 20XX. The document increases the number of priority substances that may require registration, promises public consultations ahead of substance restriction and outlines clearer timeframes.

Despite indications that the previous draft would be the final version, the government has made further changes "based on the comments given by various industry associations and discussions held in the committee meetings". This latest draft was circulated to 12 trade associations, companies and NGOs on 16 March.

The government is accepting comments until 31 March.

The circulated document makes several significant changes to the draft shared on 6 February. The expansion of the Schedule II list of priority substances from 26 to 750 is one of the most substantive.

This hugely increases the number of substances companies may be required to register in the country. When the rules come into force, the Risk Assessment Committee will be responsible for assessing those listed in Schedule II and may add them to the list of substances that must be registered (Schedule VI).

Notification and registration

In another important change, the latest draft says that before a substance is added to, or removed from, Schedule VI, the Steering Committee – which will oversee all administrative activities of the law – will hold a public consultation within 60 days of any recommendation.

In addition the Risk Assessment Committee will include a socio-economic impact assessment and an examination of the "availability of suitable

**The document increases the number of priority substances that may require registration, promises public consultations ahead of substance restriction and outlines clearer timeframes.**

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alternatives” in its decision making, before banning or placing any restrictions on a registered chemical after evaluation.

In previous drafts, registration periods of 24, 36 and 48 months, based on tonnage band were proposed. The third draft removed this, but this latest version gives a timeline of 18 months to register a substance on Schedule VI from the date of its inclusion, if imported or manufactured in volumes above one tonne a year. However, timelines for other tonnage bands are not mentioned.

And the draft clarifies the rules on articles containing Schedule VI substances. Manufacturers and importers must register these if:

- the substance is intended to be, or likely to be, released from an article under normal or foreseeable conditions of use; and
- the substance is present in an article in quantities over one tonne per producer or importer a year.

It also says that the chemistry and toxicology units of the Chemical Regulatory Division – which will provide technical and scientific support to the risk and scientific committees that sit under it – will be responsible for evaluating technical dossiers, and the previous 60-day timeframe for this has increased to 90 days.

### Safety data sheets

Companies subject to safety data sheet (SDS) requirements were previously listed as “all notifiers of a substance or intermediate”. This provision has been extended to notifiers of:

- any of the 750 priority substances listed in Schedule II;
- any of the 669 hazardous chemicals listed in Schedule X; and
- intermediates that are also a priority substance or a hazardous chemical.

All importers or manufacturers of an article containing a priority substance above a concentration of 0.1% by weight are now subject to this.

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SDSs must also contain information on the “legal status of the substance in other jurisdictions”. This includes whether it has been restricted or prohibited under any other laws.

Chemical Watch, 26 March 2020

<https://chemicalwatch.com/102893/india-increases-priority-substance-list-to-750-chemicals>

### AMERICA

#### Pentagon Reports 250 New Sites Are Contaminated with PFAS

2020-03-20

Task Force report contains inaccuracies and contradictions unreported by the media. The Pentagon now admits that 651 military sites are contaminated with per- and poly fluoroalkyl substances, (PFAS), a 62 percent increase from its last count of 401 sites in August, 2017.

See the DOD's latest addition of 250 contaminated locations organized in a logical fashion by our friends at the Environmental Working Group.

PFAS is found in the drinking water or groundwater at the new sites, although the exact levels of contamination are not known because the DOD has not conducted testing to ascertain the levels of the cancer-causing substances.

The nation's experience thus far with the coronavirus pandemic has demonstrated the importance of testing individuals as a first step in containing the spread of the virus. Similarly, testing all municipal and private drinking water sources for contaminants like PFAS must be undertaken to begin the process of protecting public health. It's not enough to know the water is poisonous.

The military's continued use of aqueous film-forming foam (AFFF), made with various PFAS chemicals, is causing widespread disastrous impacts to human health and the environment.

The military's continued use of aqueous film-forming foam (AFFF), made with various PFAS chemicals, is causing widespread disastrous impacts to human health and the environment. Maureen Sullivan, Deputy Assistant Secretary of Defense for Environment told McClatchy's Tara Copp this week that “any location where drinking water was contaminated has already

**The nation's experience thus far with the coronavirus pandemic has demonstrated the importance of testing individuals as a first step in containing the spread of the virus.**

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been addressed.” Sullivan went on to say, “As the Defense Department begins to study the groundwater contamination in more depth, it will look at ‘where is the plume? How is it moving?’”

These statements are deceitful and contradictory. Groundwater plumes carry the carcinogens to municipal and private drinking wells. The DOD has failed to seriously address the public’s vulnerability. The deadly plumes may travel for miles, while the DOD has failed to test private wells just 2,000 feet from PFAS releases on bases in Maryland and is redacting information regarding deadly plumes in California. For years, the carcinogenic plumes have been moving in a southeasterly direction at the Wisconsin National Guard’s Truax Field in Madison, but the DOD has not been testing private wells there. People in Alexandria, Louisiana where one kind of PFAS known as PFHxS was found in groundwater at levels over 20 million ppt., haven’t had their wells tested.

Meanwhile, public health scientists warn against ingesting more than 1 ppt of PFAS daily. The DOD is deceiving the American public and the result is misery and death.

LA Progressive, 20 March 2020

<https://www.laprogressive.com/pfas/>

### Requirement to Report Accidental Releases to Chemical Safety Board Takes Effect

2020-03-25

Under a new rule effective on Monday, March 23, 2020, owners and operators of stationary sources are required to report qualifying accidental releases to the ambient air of hazardous substances to the federal Chemical Safety and Hazard Investigation Board (CSB). While many companies are currently consumed with handling operations and logistics related to the coronavirus pandemic, compliance will still be expected going forward. Importantly, however, the CSB’s preamble to the new rule expresses a one-year grace period from the effective date of the rule, during which it will refrain from referring reporting violations for enforcement absent a knowing failure to report.

The extent of this reporting obligation will vary depending on whether reporting to the National Response Center (NRC) is also required and has been accomplished. Detailed reporting to the CSB may be required for certain accidental releases. However, if a release report has already been submitted to the NRC pursuant to the federal Comprehensive Response,

**While many companies are currently consumed with handling operations and logistics related to the coronavirus pandemic, compliance will still be expected going forward.**

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Compensation, and Liability Act (CERCLA), a facility need only submit the NRC identification number to the CSB.

**Who is the CSB?** The CSB is an independent federal agency established by the federal Clean Air Act Amendments of 1990 (CAA) and tasked with investigating industrial chemical accidents. The CSB reports its findings on the cause of chemical releases and makes recommendations to facilities and federal agencies, like the Environmental Protection Agency (EPA) and Occupational Safety and Health Administration (OSHA), with an aim to reduce the likelihood and consequences of accidental releases in the future. The CSB published its [final rule](#) on Accidental Release Reporting, codified at 40 C.F.R. Part 1604, in February 2020, and the rule took effect on March 23, 2020.

**What type of release must be reported to the CSB?** Any accidental release that results in a fatality, serious injury (*i.e.*, results in hospitalization), or property damage at or outside the stationary source that is estimated to be equal to or greater than \$1,000,000 must be reported. Key definitions follow:

- An “accidental release” is “an unanticipated emission of a regulated substance or other extremely hazardous substance into the ambient air from a stationary source.”
- “Regulated substances” and “extremely hazardous substances” include those substances listed under CAA Section 112(r)(3), 42 U.S.C. § 7412(r)(3), and its accompanying regulation, 40 C.F.R. § 68.130, as well as any other substance that may cause death, serious injury, or substantial property damage.
- “Ambient air” includes “any portion of the atmosphere inside or outside a stationary source.”
- “Stationary sources” include “any buildings, structures, equipment, installations, or substance-emitting stationary activities which belong to the same industrial group, which are located on one or more contiguous properties, which are under the control of the same person (or persons under common control), and from which an accidental release may occur.”

**When is reporting to the CSB required?** In general, an owner or operator is required to submit a report to the CSB within eight hours of the accidental release.

However, if a facility has a release of a reportable quantity of a hazardous substance that has already been reported to the NRC as required, the

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facility need only report the NRC identification number to the CSB within 30 minutes of submitting a report to the NRC.

**What information must be included in a report?** Except where already reported to the NRC, the following information must be reported to the CSB:

- the name of, and contact information for, the owner or operator;
- the name of, and contact information for, the person making the report;
- the location information and EPA facility identification number;
- the approximate time of the accidental release;
- a brief description of the accidental release;
- an indication whether the accidental release entailed a (1) fire; (2) explosion; (3) death; (4) serious injury; or (5) property damage;
- the name of the hazardous substance(s) released, as well as the Chemical Abstract Service (CAS) number(s) or other appropriate identifiers;
- the amount of the release, if known;
- the number of fatalities, if known;
- the number of serious injuries, if known;
- estimated property damage at or outside the stationary source; and
- whether the accidental release has resulted in an evacuation order impacting members of the general public and others, and, if known, information about the scope of the evacuation order

**How must CSB reporting be submitted?** Reports are to be made by email to [report@csb.gov](mailto:report@csb.gov) or by telephone at (202) 261-7600.

**Can information reported to the CSB be revised?** Yes. An owner or operator is permitted to revise or update a report made to the CSB via email to [report@csb.gov](mailto:report@csb.gov) or by letter to CSB 1750 Pennsylvania Ave. NW, Suite 910, Washington, DC 20006, within 30 days following the submission of the initial report to the NRC or CSB. An update may also be submitted up to 90 days following the submission of an initial report, but the email or letter must explain why the revised report could not have been provided within the first 30 days.

**Is there a grace period for enforcement?** Yes. As mentioned above, the preamble to the final rule that there will be a one-year grace period from the effective date of the rule, during which time it will refrain from

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referring reporting violations for enforcement, unless there is a knowing failure to report.

The National Law Review, 25 March 2020

<https://www.natlawreview.com/article/requirement-to-report-accidental-releases-to-chemical-safety-board-takes-effect>

### Canadian Center for Occupational Health and Safety Posts Podcast on Hazards of Nanomaterials and How to Control Exposure

2020-03-26

On March 9, 2020, the Canadian Center for Occupational Health and Safety (CCOHS) posted a podcast entitled "The Hazards of Nanomaterials and How to Control Exposure." CCOHS states that nanomaterials have many useful properties, but the same properties that make them desirable in manufacturing present unique potential safety hazards when workers are exposed to them. In this episode, Todd Irick from the Occupational Health Clinics for Ontario Workers' Nanotechnology and Health Network explains why nanotechnology is a health and safety concern in the workplace and how exposure to nanomaterials can be controlled.

Bergeson & Campbell, P.C., 26 March 2020

<https://nanotech.lawbc.com/2020/03/canadian-center-for-occupational-health-and-safety-posts-podcast-on-hazards-of-nanomaterials-and-how-to-control-exposure/>

## EUROPE

### NGOs urge tougher FCM controls in EU Farm to Fork strategy

2020-03-24

8Proposal for legal obligations to ensure traceability of hazardous chemicals

NGOs have called on the European Commission to use its Farm to Fork strategy to establish mechanisms to ensure information on chemicals in food contact materials (FCMs) is shared along the value chain, ensuring traceability and safety of recycled content.

**CCOHS states that nanomaterials have many useful properties, but the same properties that make them desirable in manufacturing present unique potential safety hazards when workers are exposed to them.**

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The strategy is an initiative under the EU's Green Deal and sets out regulatory and non-regulatory measures needed to create more efficient systems that provide healthy food.

It has "strong connections with and directly contributes" to the new Circular Economy action plan and the Zero Pollution strategy, the Commission has said.

Separately the EU executive has been evaluating the existing legislation on FCMs, which critics have said is "outdated and full of holes". Publication of the report on the evaluation may be delayed by two years, the EU executive recently said.

In its comments to the consultation to the Farm to Fork strategy, which ran from 17 February to 20 March, ClientEarth said these traceability obligations should be legally binding throughout the lifecycles of articles. This would serve as a fundamental tool to prevent the presence of highly toxic chemicals in consumer products, including food packaging.

"Tracking is currently made solely on a voluntary basis by very few sectors, in a non-harmonised [and] hence not most effective way," the NGO said.

Additionally, any supplier "should be responsible for sharing data with sufficient information to allow safe use of the chemicals contained in the product, during the whole lifecycle", it added.

### New legislation

ClientEarth also called for the strategy to deliver new EU legislation that ensures the safety of food by adopting criteria for determining SVHCs and non-threshold chemicals, including endocrine disruptors. It should also enact EU-level harmonised rules on chemicals in paper, card, inks, glues and coatings, it added.

"Such new EU legislation should be coherent with REACH and require urgent actions given that parts of the food industry are moving away from plastic packaging towards other, less regulated, materials."

The Farm to Fork strategy roadmap says the Green Deal cannot be achieved without addressing food sustainability, CHEM Trust said. "We believe that a reform of the regulatory framework for FCMs is an essential element in achieving the goals of both the Farm to Fork strategy and the European Green Deal as a whole."

It called on the Commission to ensure that the strategy "will commit the Commission to addressing the problems related to hazardous chemicals

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in FCMs. This should include a timeline for the development of new, more protective and effective, legislation.”

### Industry response

In its comments, trade association Plastics Europe said plastics used in food packaging applications must comply with “clear and stringent” regulatory requirements that guarantee a high level of consumer health protection. Plastics producers only use starting substances and additives that are authorised by the Commission, it added.

“We ask for the creation of a regulatory framework that will keep fostering innovative, increasingly safe and more sustainable solutions.”

Cefic said it welcomes the aim of achieving a further sustainable food system that contributes to climate neutrality and the circular economy. One of its sector groups, Food Contact Additives (FCA), said food contact additives are essential to achieve a physical or chemical effect in the final material or during its processing.

FCMs help protect food against chemical and microbial deterioration during storage and transportation, while helping to reduce food waste and losses and “thus contributing to the objectives of the circular economy of the food system”, it said.

The FCA added that it would welcome further harmonisation of EU specific rules for all FCMs in support of the overall aims of the Farm to Fork strategy.

The Commission plans to adopt the strategy in the first quarter of this year, but this may be set back due to the impacts of the global coronavirus Covid-19 pandemic.

Chemical Watch, 24 March 2020

<https://chemicalwatch.com/102459/ngos-urge-tougher-fcm-controls-in-eu-farm-to-fork-strategy - overlay-strip>

## EU Commission to ban three more allergenic fragrances in toys

2020-03-25

The European Commission has issued a draft amendment to the EU toy safety Directive to add three more substances to the list of prohibited allergenic fragrances.

**The amendment to include atranol, chloroatranol and methyl heptene carbonate in Annex II of the Directive concerning banned fragrances was notified to the WTO on 17 March.**

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The amendment to include atranol, chloroatranol and methyl heptine carbonate in Annex II of the Directive concerning banned fragrances was notified to the WTO on 17 March.

The Commission proposes to adopt the amendment in the last quarter of the year with entry into force in the second quarter of 2022. There is a 60-day period for comments.

Annex II currently contains 55 prohibited allergenic fragrances. A further 11 require labelling for concentrations exceeding 100mg/kg in the toy or its components.

Chemical Watch, 25 March 2020

<https://chemicalwatch.com/102705/eu-commission-to-ban-three-more-allergenic-fragrances-in-toys#overlay-strip>

### **The ADCR Consortium has extended its membership window**

2020-03-27

The first Consortium meeting of 2020 took place in Brussels from 27 – 29 January. Over the three days, members received a selection of presentations from the Technical Services team, voted on key issues, agreed future strategy and discussed forthcoming activities in support of the Consortium.

Despite the membership window closing in December 2019, interest in joining the ADCR remains strong. Therefore members agreed to reopen the membership window for a four month period, effective immediately, and expiring on 31 May 2020. There are no planned re-openings after this period and up to the submission of the first round of re-authorisation applications for those substance use combinations that have review periods ending in 2024.

Any company or organisation wishing to join the ADCR within the new window is encouraged to do so as soon as possible.

ADCR Consortium, 27 March 2020

<https://www.adcr-consortium.eu/adcr-extends-membership-window>

**Despite the membership window closing in December 2019, interest in joining the ADCR remains strong.**

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## REACH Update

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### CLH targeted consultation launched on Daminozide

2020-03-19

On 16 March 2020, ECHA started a public commenting period on the Harmonised Classification and Labelling (CLH) targeted consultation for the following substance:

1. Daminozide

Yordas Group, 19 March 2020

<https://www.yordasgroup.com/hive/news/article/861>

### 22 REACH Testing proposal consultations launched

2020-03-24

On 23 March 2020, ECHA started a 45 day public commenting period on 22 testing proposals for the following substances:

1. (Octahydro-4,7-methano-1H-indenediyl)bis(methylene) diacrylate
2. (Z)-4-[C11-13 (branched) alkylamino]-4-oxo-2-butenic acid
3. 1,4-bis(2,3-epoxypropoxy)butane
4. 2-(1-oxa-4-azaspiro[4.5]dec-4-yl)ethyl methacrylate
5. 2-[[[(butylamino)carbonyl]oxy]ethyl acrylate
6. 2-isocyanatoethyl methacrylate
7. 4-(1,1-dimethylethyl)cyclohexyl acrylate
8. 4-phenylbutenone
9. Benzyldimethylamine
10. Dialkyl-methyl-dihydro-heteropolycycle
11. Dimethyl (p-methoxybenzylidene)malonate
12. Dioctyltin dilaurate
13. N,N''-(4-methyl-m-phenylene)bis[N',N'-dimethylurea]
14. Reaction products of 1H-Imidazole-1-ethanol, 4,5-dihydro-, 2-(C7-C17 odd-numbered, C17-unsatd. alkyl) derivs. and sodium hydroxide and chloroacetic acid

**On 16 March 2020, ECHA started a public commenting period on the Harmonised Classification and Labelling (CLH) targeted consultation for the following substance:**

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15. Reaction products of 2-hydroxyethyl methacrylate and diphosphorus pentoxide

16. Tert-butyl perbenzoate

Yordas Group, 24 March 2020

<https://www.yordasgroup.com/hive/news/article/864>

### ECHA to support EU-wide action against COVID-19

2020-03-20

ECHA will, together with the European Commission, support Member States and industry in addressing disinfectant shortages. The Agency will also extend some of its deadlines to help chemicals companies.

Helsinki, 20 March 2020 – ECHA is taking measures to support EU action to fight the pandemic caused by the coronavirus disease (COVID-19).

The Agency will, together with the European Commission, support Member States and industry to address shortages with the supply of disinfectants, which has become a critical issue in several EU Member States.

Bjorn Hansen, ECHA's Executive Director says: "It is essential to ensure that there are enough disinfectants available for health professionals and European citizens. The main limiting factor seems to be the availability of active substances used in these biocidal products – in particular isopropanol, 1-propanol and ethanol. We are working, together with the Commission, on special arrangements to help Member States and companies get more disinfectants on the market as soon as possible." More details about concrete actions will follow soon.

Deadlines for certain processes will also be handled flexibly, including the payment of invoices. For certain deadlines that fall between now and the end of May 2020, companies will receive an extension of two months. This applies to cases where companies have initially failed to provide a complete registration for their chemicals and were granted a final deadline between March and May 2020, as well as for requests for further information related to confidentiality claims.

An extension of 30 days will also apply for companies to comment on ECHA's draft decisions in cases where a registration has been considered non-compliant with legal requirements.

**Helsinki, 20 March 2020 – ECHA is taking measures to support EU action to fight the pandemic caused by the coronavirus disease (COVID-19).**

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More information on these arrangements will be published soon and duty holders will also be informed directly through ECHA's IT systems.

ECHA, 20 march 2020

<https://echa.europa.eu/-/echa-to-support-eu-wide-action-against-covid-19>

### Speeding up the supply of disinfectants

2020-03-24

To increase the manufacture and supply of disinfectants on the European market, ECHA is supporting EU/EEA authorities to apply derogations from the normal authorisation requirement for biocidal products.

Helsinki, 24 March 2020 – As the COVID-19 pandemic grows, it is essential for healthcare professionals and European citizens to have access to more disinfectants. To improve this access, there is a need to increase the manufacture and supply of these products.

Companies looking to quickly access the market with their disinfectants that contain an already approved active substance, can apply for permission to the relevant national authority by relying on Article 55(1) of the Biocidal Products Regulation (BPR). This provision allows national authorities to give time-limited derogations from the standard product authorisation requirements in situations where there is a threat to public health.

Several EU/EEA countries have already granted such permissions to companies that have the capacity to manufacture disinfectants. For applications that target several countries, a centralised submission to ECHA is being developed. More information about that will follow in the coming days.

ECHA is also recommending certain compositional requirements for the two approved active substances, propan-1-ol and propan-2-ol, for their use in disinfectants. These recommendations will enable national authorities to swiftly check the quality of the incoming applications before deciding on a derogation.

Furthermore, to ease the work of authorities and for companies looking for information, ECHA is making three lists available with information on:

- biocidal active substances approved or being reviewed for their use in disinfectant products;

**ECHA is also recommending certain compositional requirements for the two approved active substances, propan-1-ol and propan-2-ol, for their use in disinfectants.**

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- disinfectant products that are authorised under the Biocidal Products Regulation (BPR); and
- disinfectant products authorised under national regimes in Spain, the Netherlands and Switzerland.

The European Commission has also prepared a document about the measures that national authorities could use (or have already used) to permit the sale of disinfectant products and help to reduce the spread of the novel coronavirus.

A new dedicated web page on COVID-19 collects information on the Agency's supportive actions during the pandemic. It will be updated as new arrangements are agreed.

ECHA, 24 March 2020

<https://echa.europa.eu/-/speeding-up-the-supply-of-disinfectants>

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## Janet's Corner

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### Sammy the Solute

2020-03-17

#### Paramecium Parlor



Sammy the solute was starting to regret having a pool party for his birthday.

<https://www.pinterest.com.au/pin/426293920979195033/>

# Bulletin Board

## Hazard Alert

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### Ethanol

2020-03-17

Ethanol—also called ethyl alcohol, grain alcohol or simply alcohol—is a chemical compound with the formula  $C_2H_6O$ . It is a clear, colourless liquid and readily dissolves in water and other organic compounds. It is naturally produced by fermentation of sugars by petrochemical processes or by yeasts. It is found in overripe fruit and it has also been detected in outer space in interstellar clouds. [1,2]

### USES [2,3]

Ethanol is used in a range of applications, including in beauty products, fuel, alcoholic beverages and as a solvent in various industries. In personal care products, ethanol is used as a preservative or as an astringent. It is also a common ingredient in hand sanitiser. When mixed with water, ethanol makes an effective solvent to use in lacquers, varnish, paints and household cleaning products. It is also used as a food additive and is a primary ingredient in alcoholic beverages, such as beer. Ethanol is also used in fuel; more than 97% of fuel in the US contains ethanol—typically in an E10 mixture. Due to its psychoactive effects, ethanol is considered a drug.

### ROUTES OF EXPOSURE [2,4]

- People can be exposed to ethanol by inhalation, skin contact or by eye contact.
- To discourage humans from drinking pure ethanol from products—such as cleaning or personal care products—a “denaturant” is added, such as a bitter flavouring. While making the ethanol unsuitable for human consumption, it will not change the other properties of the compound.

### ~h1 Health Effects

Ethanol poisoning can affect a range of systems including the nervous, respiratory and cardiovascular systems.

### Acute Effects [4]

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

- If ethanol is inhaled in high concentrations, the victim will experience respiratory difficulties, including a dry/sore throat, coughing, irritation of the respiratory tract and nasal mucous membranes, and central

**Ethanol—also called ethyl alcohol, grain alcohol or simply alcohol—is a chemical compound with the formula  $C_2H_6O$ .**

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nervous system (CNS) depression. There could also be symptoms similar to those when ethanol is ingested (see below).

- Skin contact with ethanol could result in a slight irritation.
- Eye contact with ethanol may result in redness of the eye tissue and lacrimation. If there is continuous exposure, the victim's eye tissue will be irritated.
- If ethanol is ingested in large quantities, victims may experience these symptoms: red skin, rising body temperature, clammy skin, accelerated heart rate, CNS depression, narcosis, dizziness, drunkenness, vomiting, nausea, co-ordination disorders, delusions, dilated pupils, tremors, impaired concentration, disturbed motor response and uncontrollable muscular contractions.

### **Chronic Effects [4]**

Ethanol is toxic to multiple body systems. Long-term or repeated exposure to the compound can cause symptoms, including: dry skin, enlargement of the liver, cardiac and blood circulation effects, impairment of the nervous system, mental confusion, affection of the bone marrow, weakening of the immune system, high arterial pressure and affection of the endocrine system.

## **SAFETY**

### **First Aid Measures [4]**

- Ingestion: If ingested, rinse mouth with water and DO NOT induce vomiting. Immediately call a doctor or a poison centre. For ingestion of large quantities of ethanol, take victim to hospital immediately.
- Skin contact: In case of skin or hair contact, rinse with water. If irritation persists, take victim to the doctor.
- Eye contact: Immediately flush eyes with water. DO not apply a neutralizing agent. Take victim to an ophthalmologist if irritation persists.
- Inhaled: Take contaminated person to nearest fresh air source and monitor their breathing. If there are persistent respiratory problems, consult a doctor.

### **Exposure Controls/Personal Protection [4,5]**

- Engineering controls: Safety showers and emergency eyewash fountains should be accessible in the immediate area of the potential

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exposure. Ensure there is adequate ventilation. Whenever possible, material should be handled in a laboratory.

- Personal protection: Safety glasses, protective and dustproof clothing and gloves (nitrile rubber gloves, PVC or neoprene recommended).

### REGULATION

#### United States [6]:

The Occupational Safety and Health Administration (OSHA) has set an 8-hour time-weighted average (TWA) concentration for ethanol of 1000 parts per million (ppm).

#### Australia [5]

Safe Work Australia: Safe Work Australia has set an 8-hour, 5-days-a-week TWA concentration for ethanol of 1,880 mg/m<sup>3</sup> (1000ppm). In industrial settings, it is recommended to keep exposure below the TWA levels. This can be done by using local exhaust ventilation for example.

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### **BPA and babies: Controversial chemical and substitutes pollute the womb**

2020-03-18

Bisphenol A and its substitute chemicals—pervasive in food and beverage containers, canned goods and store receipts—are showing up in mothers' wombs at "unexpectedly high levels," according to a new study published in the journal [Environmental Science and Technology](#).

The study builds on previous evidence that BPA and its common replacement BPS can pass through a mother's placenta and is the first to show the same for a range of other replacements, suggesting that fetuses are being exposed to a cocktail of chemicals linked to behavioral and reproductive disorders, among other health problems.

"We are very clearly seeing these compounds going straight to the baby at totally unacceptable concentrations," Terrence Collins, a green chemist at Carnegie Mellon University, who was not involved in the study, told EHN.

The study, published in March, looked for 15 different bisphenols—including a BPA, BPS and other popular substitutes—in 60 pairs of maternal plasma, cord plasma and placenta samples from pregnant women in South China. Four bisphenols were frequently detected in all three samples: BPA, BPS, BPAF and BPE.

BPSIP, a relatively new compound commonly used in thermal paper for store receipts, appeared at high levels in all maternal plasma samples. The researchers note that BPSIP "exhibits a similar estrogenic potency and greater reproductive toxicity than BPA."

"This is another shriek from nature, 'Stop throwing BPA, or things like it, at me,'" added Collins.

The study is concerning as BPA is a known endocrine disruptor, meaning it is capable of scrambling hormone signals, and has been linked to cancer, diabetes and infertility. In-utero BPA exposure has been shown to derail the normal growth of the brain and other organs and manifest later in life as early puberty or an increase in anxiety-related behaviors or attention deficit hyperactivity disorder (ADHD). Some replacements have been tied to similar issues including obesity and reproductive problems. The new study linked BPAF concentrations in cord plasma with both premature birth and low birth weight.

Most BPA replacements are created by tweaking the BPA molecule to form similar compounds. As a result, most pose similar health concerns. A [2017](#)

**The study is concerning as BPA is a known endocrine disruptor, meaning it is capable of scrambling hormone signals, and has been linked to cancer, diabetes and infertility.**

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study found that six substitutes used in products promoted as BPA-free had as much, if not more, of an estrogen-mimicking effect on human breast cancer cells as BPA.

Pat Hunt, a geneticist at Washington State University in Pullman, Wash., suggested that the latest BPSIP finding reflects an ongoing pattern of regrettable replacements.

“Oh great, another one. When is this going to end?” she told EHN. “We need to worry about all these new players that come onto the scene.”

### Market expands, leaving children at highest risk

BPA still made up the highest concentrations detected in the new research. Despite thousands of studies that highlight its health effects, the global BPA market continues to increase at about 3 percent per year and is projected to top seven million tons by the end of 2023.

“They are still expanding BPA into every imaginable product,” said Collins. “BPA should not be produced. Period.”

Meanwhile, the U.S. Food and Drug Administration maintains that the chemical poses no harm at levels to which people are exposed.

In November 2019, EHN published a year-long investigation of the FDA’s handling of BPA science. It found that U.S. regulators have stacked the deck against findings from independent scientists that BPA, as well as many BPA substitutes, can harm people at very low doses.

Cheryl Rosenfeld, a biologist at the University of Missouri, published a study of mice in February that found both BPA and BPS exposure lowered serotonin production in the placenta, the primary source of the critical neurotransmitter for developing offspring. The effect could have “dramatic consequences” on brain development, Rosenfeld told EHN.

The bisphenol concentrations that the researchers found in the placenta and cord blood are both troubling, she said, as impacts may come through the placenta or by directly affecting the brain itself. «Yes, it can cross the placenta and that’s important because it tells you that whatever mom is exposed to can reach the developing fetus,» said Rosenfeld. «But we’re even seeing effects before it gets there.»

Still, not all bisphenols necessarily behave the same way. For example, BPAF crossed the placenta more readily than other bisphenols highlighted in the new study. “We can’t assume that what we know about BPA will translate to the other bisphenols,” said Hunt.

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### Searching for a safe replacement

One newly developed bisphenol might prove a welcome change from its chemical cousins. Valspar, recently acquired by Sherwin-Williams, has created a replacement for food and beverage can linings historically made with BPA.

Rather than just slightly tweaking the chemical structure of BPA, they assessed safety alongside functionality throughout the process. They enlisted academic scientists to test the compound, tetramethyl bisphenol F (TMBPF), for a range of endocrine disruptive activities. "The evidence is very encouraging," said Collins.

"Endocrine disruptors are having a dreadful impact on civilization," he added. "We need to give Valspar its due. But we also need to know more."

ehn.org, 18 March 2020

<https://www.ehn.org>

### **It's Time to Sound the Alarm for Communities Most Vulnerable to the Coronavirus**

2020-03-17

The spread of the novel coronavirus and the disease it causes, COVID-19, is driving massive disruption of financial markets, exposing huge gaps in government preparation and focusing worldwide attention on citizen health. Amid the upheaval, however, we still find that those who are far too often unseen and unheard are once again in the crosshairs of disease and death. These are truly our most vulnerable communities: lower-income people, people of color and indigenous peoples.

After 20-plus years of working at the highest levels on responses to both natural and man-made disasters, I know firsthand what can happen to vulnerable communities when their lives and unique challenges are ignored while governments struggle to react. We must prioritize underserved communities by being willing to place the resources and expertise in the areas that are most at need.

Public health pioneer and former Army Surgeon General William C. Gorgas explained it best when he said, «In times of stress and danger such as come about as the result of an epidemic, many tragic and cruel phases of human nature are brought out, as well as many brave and unselfish ones.» We are now at the eve of the coronavirus epidemic and it provides an opportunity for us to be brave and unselfish. If we fail, our

**These are truly our most vulnerable communities: lower-income people, people of color and indigenous peoples.**

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most vulnerable – those always hit first and worst – will unfortunately pay a higher cost.

Let me break it down for you: There has been a health crisis in vulnerable communities for decades.

Yes, the elderly are among those most in danger from infection by the COVID-19 virus. But people in communities that have been impacted by pollution for decades are also in danger, because they face an elevated risk of underlying conditions that increase vulnerability to the coronavirus.

Front-line communities feeling the disproportionate impacts of pollution are dealing with serious chronic medical conditions and underlying health problems, and no one seems to be talking about them in a substantive way. These communities are more at risk of cancers, high blood pressure, chronic respiratory disease, diabetes and liver and kidney disease – just to name a few daily realities of the public health crisis, in the absence of environmental justice.

These communities are also dealing with a serious lack of trust in their government, spurred by numerous rollbacks of basic protections needed to protect their health and their lives. And trust is essential in an epidemic, when individuals are asked to make sacrifices for the greater good.

To compound the public health challenges already facing front-line communities, we have more than 80 million people in our country who are uninsured or underinsured and forced into unacceptable choices between purchasing their medicine versus putting food on the table. As the economy slides, workers face layoffs and unpaid sick days, threatening to push an untenable situation over the brink. What can low-income folks do, without insurance and financial resources to draw on in a crisis?

Many of our communities of color – in both rural and urban areas – are also living in medically underserved areas, needing to travel great distances to reach basic health care. Research has highlighted that there is racial bias in medicine that leads to worse care for black and brown people and that the treatment often received is substandard. Having this knowledge means we have to put safeguards in place as doctors are deciding who will and will not get testing for the virus, and who may be left exposed to unnecessary harm.

The question for many communities of color is quite simple: Why would we trust an administration that has never prioritized our lives in the last three years to do so now? Former President Barack Obama shared with the

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country that “if the people cannot trust their government to do the job for which it exists – to protect them and to promote their common welfare – all else is lost.”

For millions of Americans, all soon could be lost if we don't also prioritize the lives of those who are often unseen and unheard.

usnews.com, 17 March 2020

<https://www.usnews.com>

### Newly discovered ‘magic methyl’ reaction could turbocharge the potency of some drugs

2020-03-16

For years, drug discovery chemists have struggled to streamline a process that can boost a drug's potency up to 2000-fold: “magic methylation.”

The reaction sweeps out single hydrogen atoms and replaces them with methyl groups—reshaping the drug molecule to more easily interact with its biological targets. But carrying out this sleight of hand is so difficult that few researchers even try. Now, a team of chemists reports it has created a new catalyst that performs this delicate exchange with ease on a wide variety of druglike molecules, an advance that could lead to novel treatments for everything from cancer to infectious diseases.

“This paper is just stunning,” says Tim Cernak, an organic chemist at the University of Michigan, Ann Arbor, who was not involved in the research. The new catalyst manages the reaction in one easy step—a huge improvement on previous multistep methods that were expensive and time-consuming. “This is the wish [of] every drug hunter,” Cernak says. “It really is a dream reaction.”

To understand the dream, it helps to know one way chemists build drug molecules, explains M. Christina White, an organic chemist at the University of Illinois, Urbana-Champaign. Most drug molecules contain a skeleton of carbon atoms shaped as a rod or a ring, with multiple hydrogen atoms hanging off each carbon. Chemists act as molecular surgeons, cutting out specific carbon or hydrogen atoms and replacing them with oxygen or nitrogen atoms. If researchers want to add a magic methyl group (which consists of one carbon atom bonded to three hydrogen atoms), they often have to start over, building a new skeleton from scratch.

**The reaction sweeps out single hydrogen atoms and replaces them with methyl groups—reshaping the drug molecule to more easily interact with its biological targets.**

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White wanted to find a way to add a methyl group at the end of the drug building process. To do that, she needed to surgically snip one carbon-hydrogen (C-H) bond at a time, without cleaving the other dozen or more C-H bonds in the molecule. Adding further difficulty, C-H bonds are among the strongest in organic molecules, which makes it harder to target just one bond without affecting others, White says.

Nature builds and reshapes molecules “in a totally different way,” White says. Chemical changes are made using large, complex enzymes that grasp hydrocarbon scaffolds so that just one C-H bond nuzzles up to the enzyme’s catalytic site—the point at which a reaction takes place. However, each enzyme typically works with only one specific molecule. “If I want to work on a different molecule, I need a new enzyme,” White says. “We want [a reagent that is] just as selective, but general.”

In an effort to find just such a catalyst, White and then-graduate student Mark Chen in 2007 devised a snowflake-shaped compound with an iron atom at its center that added oxygen atoms to desired spots in druglike molecules. The catalyst could work as selectively as an enzyme. But it simply didn’t work on a lot of molecular structures or when it was next to a nitrogen atom, which are common in drug molecules.

But White’s team kept at it. In 2015, she and her colleagues devised a set of conditions that allowed the iron catalyst and a variant to add oxygen atoms to druglike molecules. And in 2019, they created a similar manganese-based catalyst that performed the oxygen-for-hydrogen swap on druglike molecules containing nitrogen and other common add-ons.

But that was just the first step. Now, White’s team reports it has come up with chemical additives that help this latest catalyst complete the “magic methyl” process. After replacing a hydrogen with an oxygen, it steals a methyl group from a reagent known as trimethylaluminum and inserts it in oxygen’s place. White’s team carried out this molecular surgery on 41 different hydrocarbons, including 16 common druglike scaffolds, the researchers report today in *Nature*.

The upshot, White says, is that this reagent will now make it simple and cheap for drug hunters to insert “magic methyl” groups into their molecules. “We hope a lot more drugs with the magic methyl effect will be discovered,” White says.

This could help “across the board” in drug discovery, says David Rees, chief scientific officer of Astex Pharmaceuticals. Where adding a methyl group

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does increase a drug's potency, doctors may be able to give their patients less of a drug. That could improve safety and reduce side effects. Among the drugmakers he knows, Rees says, "Everyone will jump on this."

sciencemag.org, 16 March 2020

<https://www.sciencemag.org>

### **BPA exposure: Scientists spar over how contaminated we really are**

2020-03-19

A fight is brewing over just how polluted our bodies are by BPA, the plastic additive found in everything from canned food to thermal paper receipts and water bottles.

In December researchers declared that the method used by federal regulators dramatically undercounted the amount of bisphenol-A (BPA) in our blood and urine. This week two dozen scientists weighed in both challenging and defending the work.

BPA is a key ingredient in polycarbonate plastic and epoxy resins. It's used to keep acidic foods like tomatoes from interacting with the metal in tin cans, is absorbed by the skin and digestive tract and rapidly transformed and passed by the body. But since the additive – along with "BPA-free" substitutions like BPZ and BPS – is ubiquitous in everyday products, traces of the chemical and its breakdown products, called metabolites, are found in almost every person on the planet.

When BPA enters the liver most of it is converted to metabolites. These metabolites are then excreted.

To accurately measure a chemical, scientists need to be able to compare what they are measuring to a known amount of the same chemical, called a standard. A 'standard' has been available for BPA for a long time.

Until recently, however, there have not been standards for the metabolites, so it was not possible to test for them directly.

To get around this the current federal test for total BPA exposes BPA metabolites from urine to a snail enzyme which in theory converts it back to the original form. They then measure the total BPA after that conversion.

The December study, published in *The Lancet Diabetes & Endocrinology* journal, measured the metabolites and BPA directly. The

**Until recently, however, there have not been standards for the metabolites, so it was not possible to test for them directly.**

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researchers discovered that the snail enzyme doesn't work how the federal scientists think it does. It does alter the metabolites chemically but not all of it to BPA. The more metabolite there is, the more it is converted to something else, not BPA.

The researchers found the average level of BPA in test subjects was 44 times higher than using the federal standard.

"This would indicate the old method is highly inaccurate," Pat Hunt, co-author of the December analysis and researcher at Washington State University, told EHN in December, referencing the U.S. Food and Drug Administration's method. "It's a case of having better tools in our hands. Tools we were using were cruder and highly inaccurate."

Four letters published this week in *The Lancet Diabetes & Endocrinology* journal carry that debate forward.

The first, from U.S. Centers of Disease Control and Prevention scientist Antonia Calafat and 18 other researchers at university and government labs across Europe, Australia and the United States, defended the indirect, or status quo, method.

"Both human pharmacokinetic and laboratory studies have demonstrated the validity of the indirect method, the approach used by most laboratories routinely measuring BPA," they said. "Current population levels of BPA in urine are accurately and precisely measurable."

According to the response to this by Hunt and colleagues, proper vetting could not have been done without the standards needed to accurately determine the metabolites' concentration. And neither the FDA nor the CDC used those standards.

BPA interferes with our hormone system at extremely low doses. Researchers have linked it to a range of health problems, including cancer, diabetes, obesity, infertility and behavioral problems.

A year-long investigation by EHN.org found that federal agencies discount cutting-edge science that shows worrisome results at low, everyday exposures. Instead, the investigation found, regulators favor industry-backed studies and research methods that are decades old.

Two other letters counter that the new approach needs attention—and should be applied to chemical testing beyond BPA.

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“We believe that measurement of ‘real’ BPA is the best tool to assess risks to human health,” wrote Antoine Dupuis and three other biomonitoring experts at the University of Poitiers in France.

According to Hunt and colleagues, this misses the point that BPA levels in urine have been used in risk assessments, where total BPA levels of exposure are assessed by looking at BPA levels plus the levels of metabolites. Because of the enzymatic degradation of BPA in the liver and the excretion of metabolites in urine, the amount of BPA observable in blood is only one piece of the puzzle.

Incorrect exposure readings could have profound public health ramifications, cautioned Kerri Palmer and Valerie Speirs of the University of Aberdeen in a third letter. “Perceptions that BPA is present in low levels has led regulators to be dismissive about its potential adverse health effects, even though there is potential for continuous, low-level exposure throughout our lifetime.”

Responding to the debate, the December study’s three authors—Pat Hunt, Roy Gerona of the University of California, San Francisco; Fred vom Saal of the University of Missouri—noted in the fourth and final letter that their data are never disputed.

“Calafat and colleagues provide no criticism of our methodology, findings, or the profound implications for BPA risk assessment,” they said. “To echo Palmer and Spiers: Regulators are urged to take note.”

ehn.org, 19 March 2020

<https://www.ehn.org>

### **Paul R. Erlich: A pandemic, planetary reckoning, and a path forward**

2020-03-20

In addition to great concern over the COVID-19 pandemic, I’m also disappointed.

For more than half a century, scientists have been expressing concern over the deterioration of what I like to call the “epidemiological environment.” That environment consists of the constellation of circumstances that influence patterns of disease and factors related to health.

It includes such things as population sizes and densities, diets, speed and type of transportation systems, toxics, climate disruption, frequency

**For more than half a century, scientists have been expressing concern over the deterioration of what I like to call the “epidemiological environment.”**

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of human-animal contacts, availability of medical isolation facilities, stockpiles of medicines, vaccines, and medical equipment.

The epidemiological environment also includes cultural norms: levels of education, equity in societies, competence of leadership. Few aspects of the human predicament do not impinge on our epidemiological environment.

My own interest in one part of that environment, transmissible diseases, started as a grad student working on the evolution of DDT resistance in fruit flies. The results of that research had obvious implications for the evolution of antibiotic resistance, a key element in the epidemiological environment.

It clearly influenced my wife Anne and my scenarios in our 1968 book, *The Population Bomb* and a section on the epidemiological environment in *The Population Explosion*, the 1990 sequel book. We were responding not just to our own fears, but the fears of colleagues much more knowledgeable in areas like virology and epidemiology.

Of course, the utter failure of global society to deal appropriately with high probability threats to civilization warned of by the scientific community is hardly limited to pandemics.

Climate disruption is the best recognized of contemporary health threats, but the decay of biodiversity, and “updating” the American nuclear triad as part of the Russian-United States “mutually assured imbecility” are among the most critical.

Those, at least, are not obvious to the average citizen or decision-maker, but what about others such as increased flows of plastics and toxics (especially synthetic hormone mimicking compounds) into the global environment?

Everyone knows about volumes of plastics in waste streams and oceans and has personal experience with the thermal paper receipts coated with bisphenol-A (BPA), yet little to no remedies have been undertaken.

Indeed, why are there so few effective responses to the epidemics and the maladies of industrial civilization?

### Bolster basic medical care

It is convenient for progressives to blame the COVID-19 disaster in the United States on the spectacular incompetence and corruption of the

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current Republican national leadership. Yes, it has turned away from science, and worked hard to speed the demise of civilization.

One of the Republicans' many steps in that direction was to destroy the global health security and biodefense directorate that the Obama Administration created to help prepare for emergent diseases. Americans are now likely paying with their lives for Trump's move there.

But the basic problem dates much further back and is bipartisan. After all both parties have been supportive and remain supportive of the growthmania that has been the basic driver of environmental destruction.

Rather than dwell on the past, however, let's look at what the U.S. should be doing about the epidemiological environment starting right now. The U.S. has long stood alone in failing to supply all its citizens with health care, an error COVID-19 has highlighted. Changing that, however it is done, should be top priority.

Besides the obvious ethics and justice reasons, people without basic medical care exacerbate public health problems, especially pandemics, in ways that threaten even senators and presidents.

A comprehensive national health program should also remove incentives for infected people to go to work sick and for keeping businesses and other entities that provide essential services functioning.

Plans and equipment should be put in place to greatly increase the capacity of the medical system to deal with large surges of victims of epidemics.

Programs are needed to keep both the plans and essential supplies up to date. A provision for quickly establishing unified leadership in disasters is essential.

### Climate change and biodiversity

U.S. security in a globalized world demands leadership in dealing with all aspects of the world's epidemiological environment.

In addition to rejoining the Paris agreement, America should demand greatly increased ambition in replacing fossil fuels in energy systems so it will have a better chance of ameliorating the building climatic catastrophe and reduce the likely huge refugee flows that will transform the entire global epidemiological environment.

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The U.S. should aid China to reduce that nation's huge pig-duck-pond-wildlife market, which is a lethal virus manufacturing machine. Putting pigs and ducks together with ponds is bad in itself, but adding wildlife markets to the mix makes it worse – and it's an important factor in the global epidemiological environment.

America and China could lead a civilization-wide program to halt the destruction of biodiversity – another factor which negatively impacts that environment.

What I'm basically saying is that the U.S. should fix the epidemiological environment by taking the obvious steps to solve the human predicament – to avoid the collapse of civilization now entrained.

### Teaching planetary literacy

This seems wildly optimistic in a world that has not even recognized its problems of overpopulation and overconsumption or the impacts on health and well-being of socio-cultural regression: rising xenophobia, racism, religious prejudice, sexism, and, especially, economic inequity.

What explains this?

There are the causes usually noted, such as the power of money, not just in politics but in global culture as a whole. But a major element is widespread ignorance, partly due to broken educational systems – allowing, for example, mobs of innumerate economists, politicians, and decision-makers in general to believe in perpetual growth in population and consumption.

The widespread inability of “educated” people to think is frequently underlined by statements on how “we don't have a population problem, just a problem of too much consumption.”

Can't they grasp the not-so-difficult idea that a billion people are likely to consume more than a hundred? Case in point on the ignorant “educated”: Donald Trump got a B.S. in economics from the Wharton School of my alma mater, the University of Pennsylvania.

To overwhelm this vast ignorance demands resuscitation of our higher education system. Universities and colleges remain stalled in a 19th century Aristotelian state. They have given up any goal except turning out people who will be financially successful in a deteriorating culture -- oiling parts of the engine with never a thought for where the train is heading.

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And that “education” clearly doesn’t even give its products a grasp of such concepts as exponential growth, as the response of Trump and many others to the COVID-19 epidemic have shown.

Educational systems have given up any pretense of supplying leadership to society or informing people about what is coming down the track. Faculty members discuss “sustainability” in major universities that will not even divest from fossil fuel stocks.

Can the absence of a draft alone explain the difference between the ferment in universities during the Vietnam War and the quiet today with the situation a million times worse?

Once again, population size and growth are major factors in this human dilemma – maybe *Homo sapiens* shouldn’t have tried to organize itself into groups exceeding the Dunbar number, which anthropologist Robin Dunbar showed was about 150 people, the size of hunter-gatherer groups. He also showed that’s roughly the size of groups in which human beings are comfortable today.

### Rethinking resources

Where could all the money come from to make the changes to preserve civilization? That’s one of the challenges for the economists who today are operating in a perpetual-growth fairyland.

Much depends on the course of events and whether the debt pyramid collapses. One obvious step, however, is repurposing the military. When Anne and I were working with them on nuclear winter issues, we were greatly impressed by the intelligence and ethics of some of the field-grade officers with whom we were involved.

The military is already way ahead of the present civilian government in addressing existential threats like climate disruption. Various military units have already been deployed to deal with emergencies ranging from pandemics to hurricanes, and there is no reason why they cannot be used to help in tasks ranging from building medical isolation facilities to small-scale affordable housing for the homeless.

Allocation of resources is part of the epidemiological environment. The gigantic amounts of money wasted on such nearly useless toys as nuclear weapons, aircraft carriers, main battle tanks, and air superiority jet fighters could be redirected toward rebuilding infrastructure such as sewage systems, modernized electric grids and water-handling networks, and on and on.

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The same can be said for the other funds and activities used for decades to support (often clandestinely) U.S. state terrorism that has cumulatively killed millions since the second World War.

Is all this impractical, pie-in-the-sky, never-happen stuff? Sure.

But nothing is more impractical than civilization trying to continue business as usual as it circles the drain.

The current pandemic disaster may end up damping down consumerism and improving the environment – there are reports of the lethal smog usually blanketing some Chinese cities clearing during pandemic lockdowns.

Maybe there's some chance that people are learning lessons.

We can always hope.

ehn.org, 20 March 2020

<https://www.ehn.org>

### **With temperatures rising, can animals survive the heat stress?**

2020-03-19

In the early 20th century, pioneering naturalist Joseph Grinnell and his team studied the flora and fauna of California, conducting meticulous surveys across large swaths of the state, including the Mojave Desert. They collected 100,000 specimens and took 74,000 pages of field notes, creating an invaluable baseline against which to measure long-term change.

Several years ago, a research team from the Grinnell Resurvey Project at the University of California, Berkeley set out to find how desert birds had fared over the last century. The changes were profound. In a study published last fall, the team found that on average temperatures in the desert had increased 3.6 degrees Fahrenheit, making one of the world's hottest places even hotter.

They also found that nearly a third of the 135 bird species present a century ago are far less common today and not nearly as widespread. The "heat stress associated with climate change" is the culprit, the study concluded, because desert birds need more water to keep cool, but it is not available.

**In a study published last fall, the team found that on average temperatures in the desert had increased 3.6 degrees Fahrenheit, making one of the world's hottest places even hotter.**

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“We often think that climate change may cause a mass mortality event in the future, but this study tells us that the change in climate that has already occurred is too hot and in certain areas, animals can’t tolerate the warming and drying that has already occurred,” said Eric Riddell, a physiological ecologist and the lead author.

The impacts of a hotter world are no longer off in the future — they have already arrived. As the planet grows warmer, the effects of heat stress on organisms trying to survive outside the temperature envelope they evolved in is becoming increasingly evident. From insects to coral reefs to biodiversity across entire ecosystems, researchers are chronicling the serious impacts of heat stress as temperatures break records. And several leading scientists believe we are underestimating the impacts, even as the heat ramps up.

The period from 2015 to 2019 was the warmest five-year period on record, according to a new [report](#) from the World Meteorological Association, and the just-finished decade was the hottest since record-keeping began. Last summer across Europe numerous high temperature records were broken, and the “frequency, intensity, and duration of heat waves are all expected to increase,” according to a [recent paper](#). Marine heat waves are occurring four or five times more frequently than in the 1980s, according to another [recent study](#).

Australia has been ground zero for recent extreme heat waves. Heat waves have occurred for centuries across the dry continent, but of the 39 known ones, 35 have taken place since 1994. This past summer was the second-hottest on record and the country is projected to warm faster than the global average, rising 4 degrees Celsius (7 degrees F) by 2100. Australia set a new record high in 2019 of 107.4 degrees F, which was an average of highs across the country. The individual record-high temperature was 121 degrees F in 2019 in Port Augusta.

One of the best-studied heat events in Australia took place in 2011 and shows how devastating the effects of extreme heat can be, on both terrestrial and marine ecosystems. The exceptional temperatures, a [2018 paper](#) concluded, caused “rapid, diverse, and broad scale” changes and “triggered abrupt, synchronous ... ecological disruptions, including mortality, demographic shifts, and altered species distributions.” The paper said that tree die-off and coral bleaching occurred simultaneously in response to the heat wave and “were accompanied by terrestrial plant mortality, seagrass and kelp loss, population crash of an endangered terrestrial bird species [Carnaby’s black cockatoo], plummeting breeding

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success in marine penguins, and outbreaks of terrestrial wood-boring insects.”

This cascade of events led the team of researchers to conclude that “the extent of ecological vulnerability to projected increases in heat waves is underestimated.”

Other recent events show the disparate impacts of extreme heat. In November 2018, the temperature in northern Australia soared to 107 degrees and stayed there for days. Endangered spectacled flying foxes — 2-pound animals with 5-foot wing spans — were overwhelmed. They tried to cool off by fanning themselves with their wings and panting, but that fell far short. In the end, some 23,000 of the endangered animals fell out of trees and died. The heat also killed fish, wild horses, and camels.

In 2014, an Australian heat wave killed more than 45,000 bats of various species. In some places fire trucks were deployed to spray and cool off dying bats.

Last month, the U.S. National Oceanic and Atmospheric Administration (NOAA) predicted that this year would bring the third major coral bleaching event to the Great Barrier Reef in five years because of heat waves. Coral bleaching occurs when high sea temperatures cause the living corals to expel the symbiotic algae on which the corals depend.

Research on impacts to the natural world from increasing temperatures is still in its early stages. But David Breshears — a University of Arizona professor of ecology and an expert in forests and climate change, is deeply worried. “First you get drought, on top of that the average temperature is going up, and on top of that a heatwave occurs,” said Breshears, who co-authored the 2018 heat wave paper. “Do extremes matter? You better believe they do, and it’s scary and getting scarier.”

Extreme temperatures — as opposed to warmer average temperatures — are the catalyst for a growing number of local extinctions, experts say. A recent study looked at 538 plant and animal species at 581 sites around the world that had been previously surveyed. The goal was to understand what aspect of climate change was the most serious threat to biodiversity. Researchers found that 44 percent of the species at the sites had gone locally extinct, and that the culprit was an increase in the temperature of the hottest days of the year.

John J. Wiens, an evolutionary ecologist at the University of Arizona and a co-author of that study, said this research creates a model that allows

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scientists to estimate at what temperatures species around the world will not be able to take the heat anymore. “We can estimate the global extinction for each species,” he said. He estimated that if there is moderate global warming, 16 percent of all species would be lost; if there’s more severe warming, 30 percent could be lost. “The big picture is that one in three species could go extinct over the next 50 years,” Wiens said.

Part of what dictates whether species will survive is their physiology and habits. Birds pant to cool off, exhaling air and water. The hotter they get, the more water they need to expel. The mourning dove, for example, requires 10 to 30 percent more water to keep cool than it did a century ago, according to the Grinnell Resurvey Project.

Insect or animal-eating birds, which get their water from their prey, are even worse off. The Mojave Desert study found that if water needs increase by 30 percent, larger birds need to catch 60 to 70 bugs more per day to satisfy their water needs, which has an energetic cost. That’s why avian carnivores in the desert — including the kestrel, prairie falcon and turkey vulture — have declined along with insectivores such as gnatcatchers and mountain chickadees. All told, the increasing need for water has led to a 43 percent decline in species richness, the Grinnell Resurvey Project concluded.

Birds suffer more than other animals. “They have high exposure to climate change,” said Riddell. “They are diurnal and exposed to the hottest part of the day. Small mammals live underground and are generally nocturnal.” Insects are small and can take advantage of smaller habitat niches.

“If current trends continue, we’ll see more declines in the desert birds,” Riddell said. “Even desert specialists are struggling to live in this environment that they are supposedly well adapted for.”

Some insects in some places have taken a heat hit as well. A recent study found that the number of areas that native bumblebees occupy has plummeted 46 percent in North America and 17 percent in Europe compared to surveys taken from 1901 to 1974. Those bee-less areas were also places with a high degree of climate variation, especially higher temperatures. “Climate change is related to the growing extinction risk that animals are facing around the world,” lead author Peter Soroye said, because of “hotter and more frequent extremes in temperatures.”

At the same time, an increase in temperatures is also expected to boost some insect populations — including those that eat crops. A 2018 study predicted that could have a serious detrimental impact on

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world food supplies. “Warmer temperatures increase insect metabolic rates exponentially,” said Chris Deutsch, a professor of oceanography at the University of Washington, who led the team. “Second, with the exception of the tropics, warmer temperatures will increase the reproductive rates of insects. You have more insects and they’re eating more.”

Warmer temperatures are already causing major damage to the world’s forests. As temperatures warm, trees become less resilient and die-offs become more frequent — as much as five times more so. “If the climate warms a little more, things don’t get a little different, they get very different,” said Henry Adams, a plant biologist at Oklahoma State University and co-author of a [recent paper](#) on the topic. “You get an acceleration in the rate of mortality. As you crank up the heat, the time it takes to kill trees is less and less.”

Warmer temperatures, in other words, make droughts more deadly.

And there is concern that warmer temperatures will also keep burned forests from re-growing and that those ecosystems will instead transform into grasslands or shrub ecosystems.

Part of the reason is that, in the American West, fires are becoming bigger and hotter and more frequent, which kills the mother trees needed to drop seeds and regenerate the forest. Extreme heat then reduces seedling survival. “The hotter, drier climate is making it more difficult for trees to regenerate on sites to which a lot of these conifers were suited,” said Craig Allen, a research ecologist with the U.S. Geological Survey in New Mexico. “Parts of the landscape are becoming less available” to regrowth.

This trend is especially important because forests are a significant carbon sink. For 30 years, nearly 100 institutions studied 565 tropical forests in Africa and the Amazon to understand their role in taking up and sequestering atmospheric carbon dioxide, which helps mitigate climate warming.

What they found, in a [paper](#) published this month in the journal *Nature*, is that the uptake of CO<sub>2</sub> in these forests peaked in the 1990s. By 2010, their ability to take up carbon had dropped by a third.

As warming alters Alaska, can a key wildlife refuge adapt?

The cause was the growing number of dead trees in these forests, which were killed by higher temperatures, according to Wannes Hubau, who worked on the project as a post-doctoral researcher at the University of

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Leeds and who now works with the Royal Museum for Central Africa in Belgium.

“Our modeling of these factors shows a long-term future decline in the African [carbon] sink,” said Hubau, “and that the Amazonian sink will continue to rapidly weaken, which we predict to become a carbon source in the mid-2030s.”

e360.yale.edu, 19 March 2020

<https://www.e360.yale.edu>

### **Ocean fish swi away from warming waters**

2020-03-19

As ocean temperatures rise, many fish species are shifting their ranges and moving to cooler waters.

That means fishing fleets often have to travel farther to catch them, which takes time and money.

“So in areas like the Pacific Ocean, where it’s just so vast that you need to actually have the capacity, the gasoline, the crew, the timing, to follow the fish around, it’s becoming a massive issue,” says Rachel Gregg, a senior scientist at the nonprofit EcoAdapt.

She says some companies are using climate data to make their expeditions more efficient.

“A lot of it is based on trying to get more fine-scaled research around specific species and how they are moving, where they are likely to go,” Gregg says, “so that you can actually start to predict and time your operations a little bit better.”

But many companies – especially smaller ones – are making more drastic changes. Gregg says some are fishing for different species or taking a new approach.

“Like moving on to aquaculture or fish hatcheries, trying to actually farm these species instead,” she says.

Gregg says climate change is bringing new challenges, but fishermen are used to adjusting as conditions shift.

**That means fishing fleets often have to travel farther to catch them, which takes time and money.**

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“People who undertake fishing for a living already have adaptation in their blood,” she says.

yaleclimateconnections.org, 19 march 2020

<https://www.yaleclimateconnections.org>

### Bringing the wolves back

2020-03-22

Let me assume you didn't come to this page because you lack other options for coronavirus info. Instead, let's pause to celebrate the 25<sup>th</sup> Anniversary of an ecological triumph.

In the winter of 1995, a remarkable experiment took place in a frigid Yellowstone National Park. Eight wolves, imported from Alberta, were held in the park in acclimation pens for two months, then released in late March.

More followed, and a quarter century later, roughly 100 gray wolves roam the park, with as many as 400 more establishing territory outside the park's perimeter.

The external wolves continue to rankle two constituencies. Hunters regard wolves as competition for elk – a favored target for both. Ranchers resent wolves due to losses of lambs and other livestock to wolf raids. The latter concern is the main reason that wolves disappeared from the park in the first place.

When white explorers first traversed Yellowstone in the mid-1800's, they reported an abundance of evidence that wolves ruled there. As ranchers settled the area, political pressures ruled instead, and by 1926 the last Yellowstone wolf packs were exterminated.

There was no public pressure to protect wolves, thanks largely to the public relations ineptitude of the *canis lupus* species. To most of the world, wolves' branding was controlled by the likes of the Brothers Grimm and their huff-and-puff, house-destroying, little pig-eating villain.

And messaging was dominated by voices like the menacing, howling gangstaz that served as Dracula's backup singers in Bram Stoker's classic book and the 1931 movie.

But it became clear that the absence of wolves was throwing entire ecosystems for a loop. With wolf packs exterminated, elk thrived. The elk munched on young trees like cottonwoods and aspen, reduced tree-

**More followed, and a quarter century later, roughly 100 gray wolves roam the park, with as many as 400 more establishing territory outside the park's perimeter.**

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covered areas to relatively barren meadows. Studies show that the return of wolves has led to a recovery of trees, and that the trees' return has helped other animals, from beavers to songbirds.

This is hardly the dominance of the grays that once spanned from the current locales of Los Angeles, Dallas and Washington DC. And the only wolves whose range include those environs would be showbiz wolves, Big Oil wolves, and wolves of Wall Street respectively (see "Bad PR," above).

Interbreeding with coyotes is another challenge, not just for grays, but for their endangered cousins in the Southeast. Red wolves' domain once spread from the current locations of Talladega, Daytona, Martinsville and beyond.

But a concerted extermination effort and habitat loss brought *Canis rufus* to a virtual end. The U.S. Fish and Wildlife Service gathered the last known 14 reds in 1980. An intensive captive breeding program now boasts 200 captive reds. Roughly 40 released wolves struggle for existence in five low-lying counties in North Carolina, where sea level rise may soon pose a new threat.

Landowners there remain cold to the notion of wolves at their door, or at least nearby, and the survival of the wild red wolf is in doubt.

In the Southwest U.S., biologists are helping the Mexican gray wolf avoid oblivion. The Mexicans held on to habitat in parts of Arizona and New Mexico until the 1970's, when many of the last wild wolves ran afoul of ranchers. The Fish and Wildlife Service began a captive breeding program and recently announced that the wild population is at 163 and growing.

So wolf reintroduction may not be an unqualified success, but it's heartening, and certainly better than writing them off.

Preservation or reintroduction efforts continue for hundreds of species under stress. Kemp's Ridley turtles, Northern right whales, black footed ferrets, and eastern chestnut trees are all among the many objects of all-out efforts by people looking to avert oblivion.

The results are mixed, but these species have one thing in common: The potential recovery of each is dependent, at least in part, on a federal government whose current leadership is indifferent, if not downright hostile, to ecological values.

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We should be thanking medical workers for their selfless efforts on coronavirus. But let's also thank the miracle workers trying, and sometimes

ehn.org, 22 March 2020

<https://www.ehn.org>

### How 'undertaker' bees recognize dead comrades

2020-03-20

They're the undertakers of the bee world: a class of workers that scours hives for dead comrades, finding them in the dark in as little as 30 minutes, despite the fact that the deceased haven't begun to give off the typical odors of decay. A new study may reveal how they do it.

"The task of undertaking is fascinating" and the new work is "pretty cool," says Jenny Jandt, a behavioral ecologist at the University of Otago, Dunedin, who was not involved with the study.

Wen Ping, an ecologist at the Chinese Academy of Sciences's Xishuangbanna Tropical Botanical Garden, wondered whether a specific type of scent molecule might help undertaker bees find their fallen hive mates. Ants, bees, and other insects are covered in compounds called cuticular hydrocarbons (CHCs), which compose part of the waxy coating on their cuticles (the shiny parts of their exoskeletons) and help prevent them from drying out. While the insects are alive, these molecules are continually released into the air and are used to recognize fellow hive members.

Wen speculated that less of the pheromones were being released into the air after a bee died and its body temperature decreased. When he used chemical methods of detecting gases to test this hypothesis, he confirmed that cooled dead bees were indeed emitting fewer volatile CHCs than living bees.

Wen then designed a series of experiments to see whether undertaker bees were picking up on this change. He turned to five hives belonging to Asian honey bees (*Apis cerana Fabricius*), a small, hardy insect found across Asia, and began to heat up the corpses of perished honey bees. When he placed regular, cool dead bees in a hive, workers always removed them within half an hour. However, when he placed the bee in a heated petri dish and warmed it up by a few degrees Celsius, it often took undertakers several hours to even notice the body. That's presumably because the warm bee body was releasing close to the same amount of CHCs as a living bee, he reports in a preprint published this month on bioRxiv.

**When he used chemical methods of detecting gases to test this hypothesis, he confirmed that cooled dead bees were indeed emitting fewer volatile CHCs than living bees.**

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To seal the deal, Wen washed the CHCs off dead bees with hexane, which can dissolve waxes and oils, heated them up to about the temperature of a live bee, and placed them back in their respective hives. The undertakers sprang into action and removed nearly 90% of the hot, clean dead bees within half an hour. That suggests it's not temperature, but the absence of CHC emissions that undertakers use to diagnose death.

"I think [the heating experiments] were the coolest part of this study," Jandt says. "[Wen] makes a strong case that a reduction in temperature and a reduction in cuticular hydrocarbons leads to undertakers perceiving a dead bee as something that needs to be removed."

Death recognition is a complex process, though, and Yehuda Ben-Shahar, an entomologist at Washington University in St. Louis, says more research will be needed to shore up Wen's claims. "I think this study is a good start," he says. "It does make sense that there is some chemical signature of a dead bee, but I wouldn't say that we now know exactly what is going on." For example, although bees can "smell" with their antennae, they can also "taste" with their feet, he notes, which might add another layer to the way they perceive dead comrades.

sciencemag.org, 20 March 2020

<https://www.sciencemag.org>

### How soon will we have a coronavirus vaccine? The race against covid-19

2020-03-18

POTTERING around her kitchen on the morning of 31 December, Kate Broderick scrolled through the headlines while she waited for her tea to brew. One story caught her eye: a mysterious outbreak of severe pneumonia in Wuhan, China. Nearly overnight, the number of cases seemed to explode. "I knew we didn't have time to wait," she says.

A molecular geneticist at Inovio Pharmaceuticals in California, Broderick was poised for what came next. When Chinese officials published the genetic sequence of the new SARS-CoV-2 coronavirus causing the illness just two weeks after the first cases were reported to the World Health Organization, Broderick got to work. Within 3 hours, her team had a prototype vaccine ready for initial testing. It was an unprecedented turnaround, but a moment Broderick and many others had long seen coming.

**With global confirmed cases of the new disease, covid-19, surging past 180,000 at the time of writing, time is of the essence.**

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Making vaccines usually takes a decade or more between development, safety testing and manufacturing, says [Seth Berkley](#), head of Gavi, an international group that promotes vaccine use around the world. With global confirmed cases of the new disease, [covid-19](#), surging past 180,000 at the time of writing, time is of the essence.

To speed things up, scientists are [turning to untested classes of vaccines](#), and rethinking every part of how they are designed, evaluated and manufactured. If the approach works, we will, for the first time, have identified a new disease and developed a vaccine against it while the [initial outbreak](#) is still ongoing.

But speed can come with downsides. “We could have a vaccine in three weeks, but we can’t guarantee its safety or efficacy,” says Gary Kobinger, a virologist at Laval University in Canada.

The hope is to have at least 1 million doses of coronavirus vaccine available to the public in 12 to 18 months, according to [Melanie Saville](#). She is head of vaccine development and research at the [Coalition for Epidemic Preparedness Innovations \(CEPI\)](#), set up in 2017 with funding from the Bill & Melinda Gates Foundation, the Wellcome Trust and several governments. Until now, the fastest we have ever cranked out a [vaccine in response to an outbreak](#) was with [Ebola](#) – and that took five years, says Berkley. Eighteen months to make a new vaccine widely available is “naively optimistic”, says Kobinger. It isn’t impossible, but it may mean ripping up the rule book.

All vaccines work by tricking the body into believing it has been exposed to a pathogen. This causes the immune system to respond with antibodies and T-cells to neutralise or kill the invader. Afterwards, some of these remain in circulation, ready for action in case you are exposed to the actual infection. In other words, your immune system is primed.

The more closely a vaccine mimics the disease, the more protection it will provide. We currently have four main strategies for pulling off this trick. Live-attenuated vaccines use actual viruses or bacteria that have been altered to prompt an immune response but not full-blown illness. Inactivated vaccines are exactly what they sound like: they are made by growing huge amounts of the pathogen in vats, which is then inactivated – or killed – with heat or chemicals. Both these strategies are used with flu vaccines, for instance.

The third variety, toxoid vaccines, are used against bacteria that cause disease indirectly, by producing a toxin, as is the case with tetanus,

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diphtheria and botulism. They contain a piece of the toxin that readies your body's response to the full thing. Lastly, subunit vaccines contain just the small pieces of a pathogen that activate the immune system, which can be polysaccharides (sugars), proteins or a combination of these, called a conjugate. These subunits are made by producing the right sugars and proteins in large vats using engineered bacteria or yeast, then painstakingly removing impurities.

These key vaccine types have been around for decades and have an established safety record, but it can still take up to 15 years to go from prototype to general use, says Berkley (see "How to make a vaccine, step by step"). Two main factors are behind long development times: historically, scientists have spent years studying how a pathogen interacts with the body and the immune system before developing a vaccine; and fewer than one in four candidate vaccines that start clinical trials make it through the whole process and get licensed for use, he says.

### A head start

In principle, the tried and tested nature of these approaches should give them an advantage in the sprint to develop a vaccine against the new coronavirus, says [Maria Bottazzi](#) at Baylor College of Medicine in Texas. While these vaccine types typically take years to develop, their established safety profile could mean fewer, shorter trials in people.

And getting out of the starting blocks has become easier. New approaches to vaccine development allow us to dramatically shorten the first step in the process. For the new coronavirus, researchers like [Annie De Groot](#), co-founder of the biotech company [EpiVax](#) in Rhode Island, used computational models that can jump directly from the genetic sequence to a potential vaccine by zooming in on those parts of the virus that would be good vaccine targets. As soon as SARS-CoV-2 was sequenced, researchers at labs around the world were able to jump in and get to work figuring out what made it tick and how to fight it, says [Florian Krammer](#), an infectious disease and vaccine specialist at Mount Sinai School of Medicine in New York. Like Inovio, many had mock-ups of prototypes ready within hours. Such advances have been a long time coming. "It took us 21 years of work to be able to develop a vaccine in 3 hours," says De Groot.

[Matthew McKay](#) at Hong Kong University of Science and Technology is one of those taking advantage of such leaps. He and his team looked at genetic similarities between the new virus and another, earlier coronavirus that shares up to 90 per cent of its DNA: SARSCoV, the one that caused a SARS outbreak in 2003. Their work on SARS showed that the human

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immune system responded most strongly to the protein spikes that form the crown, or corona, surrounding the virus and to the proteins that envelop its nucleus. McKay's team also found that one in five of the sites that the immune system could recognise, known as epitopes, were identical between the new coronavirus and the earlier SARS one. His team published that work in February. "This says these appear to be important targets for a vaccine," says McKay. An independent lab published similar findings last week.

This initial flurry of work has yielded at least 35 candidate vaccines, six backed by CEPI. In the wake of earlier epidemics such as Ebola, MERS and SARS, CEPI was created to help us respond better – and faster – by having rapid response systems at the ready.

Many of these use the well-established vaccine types, but hope to accelerate the usual timelines by streamlining each step in the process, most notably prototype development. For example, CEPI is funding a collaboration between EpiVax and the University of Georgia to use the results of the company's computer modelling to genetically engineer a segment of the virus into a subunit vaccine, like the one used for hepatitis B worldwide. Bottazzi's team at Baylor is developing a similar vaccine.

Janssen, a pharmaceutical company owned by Johnson & Johnson, has begun work on a possible vaccine using a harmless, genetically engineered adenovirus. That is the same strategy the firm used for Ebola.

Another CEPI-funded initiative uses technology developed by researchers at the University of Queensland in Australia to stabilise the coronavirus protein subunit that would be used in a vaccine and so improve its ability to generate an immune response. The university already has its vaccine in animal trials, according to Saville.

But the tried-and-tested vaccine types aren't the only game in town this time. Inovio, for example, aims to use nucleic acids like RNA or DNA in its vaccine. Although neither DNA nor messenger RNA (mRNA, which helps the body translate genes into protein) create an immune response directly, these vaccines get cells to make the proteins that will create a response.

"Instead of producing viral proteins in a factory, we're injecting RNA and letting your cells be the factory," says Joe Payne, head of Arcturus Therapeutics, one of the companies using this approach.

Once the DNA or mRNA enters a cell, the person's own protein-making machinery takes over. DNA vaccines must be converted by cells into

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mRNA first, whereas mRNA allows you to skip this stage. Depending on the genetic code used, the resulting viral protein made in the body can be secreted from muscle or skin cells, displayed on the cell's membrane, or be embedded in the membrane itself. These strategies trick the immune system into thinking the body has been invaded by a pathogen, which leads to the creation of T-cells and antibodies – or so the theory goes. So far, no such vaccines have been approved.

A major hurdle with these vaccines is getting the DNA or RNA into cells, as our blood is filled with enzymes that can chop these substances into bits within seconds. Each company pursuing this approach has developed its own technology to circumvent this problem. Arcturus and a Massachusetts-based biotech firm called Moderna are enveloping the vaccine's genetic material in a protective core, while Inovio is administering a tiny electrical current at the injection site to encourage nearby cells to swallow DNA whole. All three have said they will be able to rapidly scale up production. Moderna has already recruited people in Seattle for an early-stage clinical trial to test for safety. The trial, which will include 45 healthy volunteers, began on 16 March.

"It's a crazy, awesome speed, beyond what we saw with Ebola," says Kobinger.

The safety and efficacy of these new types of vaccines remain unknown, and there are concerns that DNA-based vaccines might affect our own genes or somehow spur harmful immune reactions. As of 17 March, none of the companies had released detailed data about the immune responses generated in animal models or any potential adverse events.

Moderna is also taking its RNA-based vaccine, mRNA-1273, directly to human trials before completing standard toxicological testing in animals. The firm is relying on safety testing already completed for its other mRNA vaccines in development.

Yet with any new vaccine, there are concerns about something called "immune enhancement". This can happen when a prior vaccination or infection inadvertently facilitates a virus's ability to enter cells and make copies of itself. It means that instead of protecting you, the vaccine could make you vulnerable to more severe infection. Harmful immune enhancement was seen in early animal trials of SARS vaccine and in human trials of a vaccine for a respiratory virus called RSV.

These types of concerns, and the track record of very few vaccines making it from clinical testing through to approval for use in humans, are what

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make lengthy clinical trials so necessary, says [Johan Van Hoof](#), head of infectious diseases and vaccines for Janssen. Older vaccine technologies have an advantage as they have already been vetted. “It gives a certain level of comfort that you can use these [older] vaccines in an emergency and you already have a solid safety database,” he says.

Striking the balance between speed and safety is always going to be a challenge. If a vaccine takes too long to develop, the initial outbreak may be over, which creates its own set of problems. For example, by the time clinical trials of an Ebola vaccine were under way during a large outbreak that began in West Africa in 2014, disease transmission had slowed so much that researchers couldn't treat enough people to gather the robust data needed for regulatory approval. Only after a larger outbreak and a bigger trial was there enough evidence to prove safety and efficacy, says Kobinger, who worked on that vaccine, called Ervebo. It was finally approved by the European Medicines Agency in November 2019.

### Left in limbo

None of the other vaccine candidates for Ebola made it as far. The rest, says Greg Poland at the Mayo Clinic in Minnesota, were stored in freezers, unable to find funding quickly enough to even begin testing. No SARS vaccine made it beyond phase I safety trials before the disease vanished and funding dried up.

Money is also critical to vaccine development. “Scientists need to be assured of research funding. Science is not a spigot you can turn on and off,” says Poland.

In part, it was the stark realisation during the West African Ebola outbreak that Big Pharma could no longer be relied upon to solely underwrite expensive vaccine research – especially for diseases with little chance of recouping the outlay – that prompted governments and NGOs to seek an alternative. “The formation of CEPI has been a paradigm shift,” says Broderick. “Before that, everything was completely reactive.”

CEPI's strength isn't only funding research, but also pairing small, innovative biotech firms with the might of established drugs companies. The coalition has funded efforts to develop vaccines against Lassa fever, Zika and Nipah, and even to prepare for “Disease X”, the World Health Organization name for any unknown infection that may yet emerge – precisely the situation that arrived with the new coronavirus. CEPI-funded scientists also worked on vaccines against MERS, a coronavirus spotted in 2013 and closely related to SARS, both of which can cause pneumonia.

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So when the first reports of severe pneumonia caused by the new coronavirus began trickling out of China, CEPI was ready for action. But it, too, needs a steady supply of funds. Saville estimates that \$350 million will be required in just the next few months to meet the accelerated timeline of creating a vaccine for covid-19 within 12 to 18 months.

Given the all-consuming nature of the current pandemic, there is good reason to believe CEPI will get the money it needs. From there, it is a matter of seeing which vaccine options make it through the many steps to eventual regulatory approval. When one does, then the final challenge will be to rapidly scale up manufacturing to produce millions of doses to exacting medical standards.

All these steps are hard enough when there isn't an outbreak, says De Groot, and no one can say how the pandemic will affect supply chains and labour pools related to vaccine development. It is also possible that, by the time a vaccine is ready for late-stage clinical trials, there won't be enough virus circulating to provide firm answers about its efficacy.

So how realistic is the 12 to 18-month timeline? "It's still fairly aspirational," says Saville. It is based on everything going well and faster-than-ever progress through each step in the process. In other words, it is a long shot.

The teams making vaccine candidates know every minute counts. Broderick says the rising number of cases and deaths rattle through her head from the moment she wakes up.

She and others have no doubt that we will eventually have a vaccine against covid-19. It is just too early to say which candidate will be ready first, or what problems we may hit along the way. It could be a bumpy ride, says Poland. "We're building the plane as we're flying."

newscientist.com, 18 March 2020

<https://www.newscientist.com>

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### How Long Will Coronavirus Live on Surfaces or in the Air Around You?

2020-03-17

The coronavirus can live for three days on some surfaces, like plastic and steel, new research suggests. Experts say the risk of consumers getting infected from touching those materials is still low, although they offered additional warnings about how long the virus survives in air, which may have important implications for medical workers.

The new study, published Tuesday in The New England Journal of Medicine, also suggests that the virus disintegrates over the course of a day on cardboard, lessening the worry among consumers that deliveries will spread the virus during this period of staying and working from home.

When the virus becomes suspended in droplets smaller than five micrometers — known as aerosols — it can stay suspended for about a half-hour, researchers said, before drifting down and settling on surfaces where it can linger for hours. The finding on aerosol in particular is inconsistent with the World Health Organization's position that the virus is not transported by air.

The virus lives longest on plastic and steel, surviving for up to 72 hours. But the amount of viable virus decreases sharply over this time. It also does poorly on copper, surviving four hours. On cardboard, it survives up to 24 hours, which suggests packages that arrive in the mail should have only low levels of the virus — unless the delivery person has coughed or sneezed on it or has handled it with contaminated hands.

That's true in general. Unless the people who handle any of these materials are sick, the actual risk of getting infected from any of these materials is low, experts said.

"Everything at the grocery store and restaurant takeout containers and bags could in theory have infectious virus on them," said Dr. Linsey Marr, who was not a member of the research team but is an expert in the transmission of viruses by aerosol at Virginia Tech in Blacksburg. "We could go crazy discussing these 'what ifs' because everyone is a potential source, so we have to focus on the biggest risks."

If people are concerned about the risk, they could wipe down packages with disinfectant wipes and wash their hands, she said.

**The virus lives longest on plastic and steel, surviving for up to 72 hours.**

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It is unclear why cardboard should be a less hospitable environment for the virus than plastic or steel, but it may be explained by the absorbency or fibrous quality of the packaging compared with the other surfaces.

That the virus can survive and stay infectious in aerosols is also important for health care workers.

For weeks experts have maintained that the virus is not airborne. But in fact, it can travel through the air and stay suspended for that period of about a half-hour.

The virus does not linger in the air at high enough levels to be a risk to most people who are not physically near an infected person. But the procedures health care workers use to care for infected patients are likely to generate aerosols.

“Once you get a patient in with severe pneumonia, the patients need to be intubated,” said Dr. Vincent Munster, a virologist at the National Institute of Allergy and Infectious Diseases who led the study. “All these handlings might generate aerosols and droplets.”

Health care workers might also collect those tiny droplets and larger ones on their protective gear when working with infected patients. They might resuspend these big and small droplets into the air when they take off this protective gear and become exposed to the virus then, Dr. Marr cautioned.

A study that is being reviewed by experts bears out this fear. And another study, published March 4 in JAMA, also indicates that the virus is transported by air. That study, based in Singapore, found the virus on a ventilator in the hospital room of an infected patient, where it could only have reached via the air.

Dr. Marr said the World Health Organization had so far referred to the virus as not airborne, but that health care workers should wear gear, including respirator masks, assuming that it is.

“Based on aerosol science and recent findings on flu virus,” she said, “surgical masks are probably insufficient.”

Dr. Marr said based on physics, an aerosol released at a height of about six feet would fall to the ground after 34 minutes. The findings should not cause the general public to panic, however, because the virus disperses quickly in the air.

“It sounds scary,” she said, “but unless you’re close to someone, the amount you’ve been exposed to is very low.”

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Dr. Marr compared this to cigarette smoke or a foggy breath on a frosty day. The closer and sooner another person is to the exhaled smoke or breath, the more of a whiff they might catch; for anyone farther than a few feet away, there is too little of the virus in the air to be any danger.

To assess the ability of the virus to survive in the air, the researchers created what Dr. Munster described as “bizarre experiments done under very ideal controllable experimental conditions.” They used a rotating drum to suspend the aerosols, and provided temperature and humidity levels that closely mimic hospital conditions.

In this setup, the virus survived and stayed infectious for up to three hours, but its ability to infect drops sharply over this time, he said.

He said the aerosols might stay aloft only for about 10 minutes, but Dr. Marr disagreed with that assessment, and said they could stay in the air for three times longer. She also said that the experimental setup might be less comfortable for the virus than a real-life setting.

For example, she said, the researchers used a relative humidity of 65 percent. “Many, but not all viruses, have shown that they survive worst at this level of humidity,” she said. They do best at lower or much higher humidity. The humidity in a heated house is less than 40 percent, “at which the virus might survive even longer,” she said.

Mucus and respiratory fluids might also allow the virus to survive longer than the laboratory fluids the researchers used for their experiments.

Other experts said the paper’s findings illustrate the urgent need for more information about the virus’s ability to survive in aerosols, and under different conditions.

“We need more experiments like this, in particular, extending the experimental sampling time for aerosolized virus beyond three hours and testing survival under different temperature and humidity conditions,” said Dr. Jeffrey Shaman, an environmental health sciences expert at Columbia University.

Dr. Munster noted that, over all, the new coronavirus seems no more capable of surviving for long periods than its close cousins SARS and MERS, which caused previous epidemics. That suggests there are other

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reasons, such as transmission by people who don't have symptoms, for its ability to cause a pandemic.

nytimes.com, 17 March 2020

<https://www.nytimes.com>

### Smart Ponds Creating A Splash In Field Of Stormwater Control

2020-03-17

One of the oldest methods for capturing runoff, the stormwater pond, is getting a digital makeover. It no longer simply collects rainfall washing off pavement and lawns. The new version anticipates precipitation before it begins and adjusts itself to reduce downstream pollution and flooding.

Welcome to the dawn of "smart" stormwater management.

A few dozen runoff collection ponds that were built years ago in the Chesapeake Bay watershed have already been retrofitted to "smarten" them up. Equipped with real-time sensors and cloud-based controls, they remotely release or retain stormwater in response to online weather reports. More — likely many more — are on the way.

"I think we're on the cusp of a great transformation," said David Rubinstein, chief executive officer of Opti, who said his Massachusetts-based company has built 150 smart ponds in 20 states. It has 18 so far in the Bay watershed, most of them in Maryland.

Others are more cautious, but still optimistic about the promise of the new technology.

"It's somewhat of a revolution," said Tom Schueler, executive director of the Maryland-based nonprofit Chesapeake Stormwater Network.

For the last 30 to 40 years, Schueler said, engineers have been relying on gravity alone to capture and treat runoff, mainly to control flooding and stream erosion. Dry and wet stormwater ponds pepper the landscape across the Bay watershed, where they passively collect and hold runoff whenever it rains.

But just as the "internet of things" has transformed daily life in other ways, from smartphones to smart appliances, web-based technology is offering a new way to deal with stormwater, one of the leading sources of pollution in the Chesapeake.

**Welcome to the dawn of "smart" stormwater management.**

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Runoff carries dirt, fertilizer, pet waste, oil, chemical contaminants and litter into nearby streams. It accounts for 16% of the nitrogen, 18% of the phosphorus and 24% of the sediment fouling the Bay, according to the state-federal Chesapeake Bay Program. Reducing stormwater pollution has proven to be difficult, as development spreads more runoff-inducing rooftops and pavement.

Local and state agencies have turned increasingly to restoring eroding stream banks in an attempt to reduce the flow of sediment and nutrients washing into the Bay from existing development. Those projects have proven to be costly and varied in effectiveness.

“A lot of the money we’re spending now is to fix the sins of the past,” said Bob Bathurst, a principal with Century Engineering, a Hunt Valley, MD, firm that also works on smart ponds. “The stream channel erosion that’s ongoing, unless we control the runoff rate, we’re going to continue to have it.”

Schueler said he sees wired, actively managed smart ponds as complements to stream restoration projects. They can curb the surge of runoff that erodes stream banks, he said, and can enhance the pollution-trapping performance of old stormwater basins 25–50%. They can also reduce the frequency or severity of downstream flooding from intense rainstorms.

“You have potentially tens of thousands of older stormwater ponds in the upland areas where this treatment can take place,” Schueler said.

It doesn’t take a lot to convert an old pond into a smart one. A sensor placed on the bottom monitors the water level, while an electronically activated “actuator” is used to open or close a butterfly valve installed in the pond’s water release outlet. A microcomputer connected to the internet collects water-level and weather forecast data and manipulates the release valve.

“It’s all automatic,” Bathurst explained as he surveyed a large pond his firm converted a couple years ago in the suburban Windsor Mill area west of Baltimore.

When heavy rain is forecast, Bathurst said, the control system calculates the amount of runoff that’s expected to flow into the pond. A signal is sent over the internet to open a valve at the pond up to 48 hours in advance of the precipitation. The pond level drops as the water is gradually released into a nearby tributary of the Gwynns Falls, until there is enough storage

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created in the basin to accommodate the projected accumulation without overflowing.

“So then, when it rains, other parts of the watershed are contributing to downstream erosion and flooding,” Bathurst said, while the smart pond “acts like a receiving vessel.” It holds onto its runoff rather than adding to the flooding and the rush of polluted water downstream.

Once the storm has passed, Bathurst added, the pond can hold onto the water for as long as it takes — or at least until the next deluge approaches — to settle out as much sediment and nutrient pollution as possible.

The status of the pond is monitored on a digital dashboard that Bathurst can access with his smartphone. “You can see it’s in a retaining status right now — we’re not discharging,” he said, holding up his phone screen. Should anything go wrong, like a stuck valve, he said, the system sends an alert, so a repair crew can be dispatched.

The pond control system also adapts to seasonal conditions. In winter, when a deep freeze is forecast, the water depth is lowered to two feet or less for safety reasons. Though the ponds are fenced off, it’s all too easy for someone to sneak in. But with the water drained down, there’s less chance a trespasser could break through the ice and drown. Likewise, in summer, pond levels can be manipulated in an attempt to limit mosquito populations.

Wired or not, the ponds still serve as neighborhood wildlife refuges. “I saw my first wood duck after we retrofitted a pond,” Bathurst said.

Smart pond technology was developed six or seven years ago, according to Stuart Schwartz, a senior research scientist at the University of Maryland, Baltimore County. He said it’s a natural extension of internet-connected systems that have been developed to operate wastewater treatment plants and water reservoirs.

Even so, he cautioned that smart-pond technology is no cookie-cutter panacea for curbing polluted runoff. Not every stormwater pond is a candidate for retrofitting, and there are other logistical, legal and political complexities that have held back a rush to install it.

“Every pond has a different drainage area and runoff potential and storage,” he said. Their effectiveness also depends on the reliability of weather forecasts. It’s a question, he concluded, of finding that “sweet

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spot” where a pond is big enough or can be manipulated enough to provide significant stormwater retention, even in intense downpours.

Smart ponds have other challenges, which are relatively easy to deal with. If the power goes out or the internet goes down, the gear is preprogrammed to keep the valve closed, and the pond performs much like an old passive detention basin. Most ponds are solar-powered, though, with batteries on site to provide electricity during the night and on cloudy days. There is also the risk of vandalism, which could impair their activities.

The other hurdles to rapid deployment are more systemic. There are 65,000 privately owned stormwater ponds in the Bay watershed, by the U.S. Environmental Protection Agency’s estimate. But private landowners often have no incentive to upgrade passive ponds, and government traditionally shies away from investing public funds to enhance private property.

Nonetheless, the Maryland Department of Transportation sees great potential in the new technology, said Sandy Hertz, assistant director of the department’s office of environment. Her agency owns about 800 ponds that could be retrofitted, but it has been waiting for state regulators to verify the technology’s effectiveness before taking the plunge with its own facilities.

The department announced a public-private partnership in November, though, where it pledged to pay \$4 million to facilitate smart stormwater ponds at four Wal-Mart and Sam’s Club stores across Maryland. Opti, the Massachusetts-based company, forged a partnership with The Nature Conservancy to make the retrofits and oversee the facilities’ operations for 20 years.

The department won’t actually be financing the retrofits directly. Instead it will be buying credits from the partners that will help it meet its regulatory requirements to treat stormwater runoff from thousands of acres of highway pavement. Transportation officials said they’ll be saving money that way. The credits will cost about \$37,500 per acre, one-fourth of the \$150,000 per acre the state has paid to put in runoff infiltration swales, bioretention cells and stormwater ponds.

“Stormwater is one of the biggest problems facing the Chesapeake Bay right now,” noted Mark Bryer, Chesapeake Bay Program director for The Nature Conservancy. “It’s the only source of pollution that’s increasing, and

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this partnership is an opportunity to reverse that and actually save money at the same time.”

When the deal was announced last fall, Ben Grumbles, Maryland’s secretary of the Department of the Environment, called it “a sneak peek into the future, the future of stormwater management around the country.” Diana Esher, the EPA’s deputy mid-Atlantic regional administrator, echoed that, describing the arrangement as a national model the federal agency hopes to see spread.

Bathurst said that he envisions a time when all the stormwater ponds in a stream watershed are wired in a network, and their retention and release is coordinated to minimize water-quality impacts. Opti’s Rubinstein said his company is exploring a beta version of that now with a municipality elsewhere in the country.

“I would never dare say this is the only solution,” Bathurst said. “It’s just that this is going to do wonderful things, particularly as it relates to existing stormwater ponds that are out there, already paid for and underperforming.”

bayjournal.com, 17 March 2020

<https://www.bayjournal.com>

### Could horses save the Arctic permafrost?

2020-03-18

Seeking ways to combat the thawing of permafrost soils in the Arctic, German scientists have rather counterintuitively shown that resettling massive herds of large herbivores could do the trick.

They were inspired by Russian scientist Sergey Zimov who resettled herds of horses, bison and reindeer in Pleistocene Park in the icy Siberian locality of Chersky 20 years ago and has been monitoring the impact on the soil.

The long-term experiments showed that resettling 100 animals halved the average snow cover height, which effectively reduces the amount of insulation it provides, intensifying the freezing of the permafrost.

Christian Beer, Earth system expert from the University of Hamburg, and colleagues thought this might offer hope for thawing permafrost soils in the Arctic, which could release large amounts of greenhouse gases and accelerate climate change.

**The long-term experiments showed that resettling 100 animals halved the average snow cover height, which effectively reduces the amount of insulation it provides, intensifying the freezing of the permafrost.**

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As described in the Nature journal *Scientific Reports*, they used a climate model to simulate such temperature processes on the land surface over a full year.

Results showed that if emissions continue to rise unchecked, permafrost temperatures would likely increase by 3.8 degrees Celsius, which would cause half of it to thaw.

However, with animal herds the ground would only warm by around 2.1 degrees – 44 percent less, which the model showed would be enough to preserve 80 percent of the current soils.

“It may be utopian to imagine resettling wild animal herds in all the permafrost regions of the Northern Hemisphere,” Beer says. “But the results indicate that using fewer animals would still produce a cooling effect.

“What we’ve shown here is a promising method for slowing the loss of our permanently frozen soils, and with it, the decomposition and release of the enormous carbon stockpiles they contain.”

cosmosmagazine.com, 18 March 2020

<https://www.cosmosmagazine.com>

### Why did Ecuador’s tallest waterfall suddenly disappear?

2020-03-18

On February 2, something strange happened in Cayambe Coca Park in the Ecuadorian Amazon. The emblematic San Rafael waterfall, located on the Coca River between the provinces of Napo and Sucumbíos, disappeared from its home of thousands of years.

The 150-metre-high waterfall – the highest in the country and a big tourist draw – stopped being part of the landscape. A huge hole appeared in the riverbed, just before the original fall. Now the water falls a few meters behind it, divided into three sections and with a less steep slope. The river flows under an arch that survived the collapse of the land, but from the place where it used to be photographed, it’s as if it never existed.

Sucumbíos province’s Emergency Operations Committee (COE) has restricted access to San Rafael and the Ministry of Environment (MAE) announced that it is carrying out studies to determine what happened. Ecuadorian scientists are surprised by an event that cannot be remembered in Latin America’s recent history – be it natural or caused by human activity.

**The 150-metre-high waterfall – the highest in the country and a big tourist draw – stopped being part of the landscape.**

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### San Rafael's volcanic, seismic origins

Alfredo Carrasco, a geologist and former secretary of Natural Capital at the ministry, says the event is fascinating. The San Rafael waterfall did not actually disappear. Rather, the river changed its course and the water now falls upstream. It is located in an area of seismic and volcanic activity near the Reventador volcano, one of the most active in the country having last erupted a decade ago. Its lava and strong earthquakes that eroded the mountains thousands of years ago formed San Rafael.

"There are many quite intense earthquakes here. In March 1987, a very strong one appeared that caused tremendous damage to the trans-Ecuadorian oil pipeline that passes right through it," Carrasco recalls. "That year I had the opportunity to evaluate the impact of the earthquake in that area. There were floods of up to 20 meters above the level of the valley where the river passes."

Carrasco continues to analyse the formation of the San Rafael waterfall and ensures that at the same time as volcanic activity caused the natural damming of the river, a natural process of water erosion began towards the base of the dam. "It is very typical that the energy of the water falling erodes the base. For me, the phenomenon [the collapse of the waterfall] is eminently of natural origin," he says.

However, what now worries Carrasco is that the new place where the river falls at three separate points is not an area with consolidated sediment. These new falls cause a process of 'regressive erosion', triggering a river upstream, which will change the morphology of the valley.

Carrasco says that in 30 to 50 years' time these new waterfalls could be between three and five kilometers higher.

"It's a very interesting phenomenon that will have to be monitored," he says.

### Hungry waters: A possible explanation

Emilio Cobo, coordinator of the South America Water Program at the International Union for the Conservation of Nature (IUCN), is concerned that the environment ministry cannot conclusively report on what happened at San Rafael.

"It must be very difficult to measure what happened and if there is a clear answer because I'm not sure that the ministry has the ability to investigate it. We don't know if there were previous studies or monitoring of the area."

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For Cobo, it is very important to know if erosion in the area was monitored before and after the construction of the Coca Codo Sinclair hydroelectric plant, one of the largest in the country. Coca Codo Sinclair's diversion reservoir (the plant's intake is 'run-of-the-river', not from a dam) is some 20 kilometers upstream from the San Rafael waterfall.

Coca Codo Sinclair is one of eight hydroelectric plants built by Chinese companies or financed by Chinese banks in Ecuador, part of plan to transform its electricity matrix that has so far depended mostly on coal-fired thermoelectric plants.

The work, constructed by Sinohydro and financed by China EximBank, has had problems with cost overruns, worker strikes, and accidents such as the 2014 collapse of a pressure well that claimed the lives of 14 workers. It was inaugurated in 2016, four years later than scheduled.

Mongabay contacted the ministry to ask about the existence of official technical information, previous monitoring and any link between the diversion reservoir and the erosion of the waterfall. It responded that the governor of Sucumbíos, is the official spokesperson. Governor Tony Rojas had not responded to requests for comment by the time of publication.

Emilio Cobo hypothesizes that the hydroelectric plant is indirectly related to the collapse of San Rafael.

The Coca Codo Sinclair plant is not located on the river, but the diversion reservoir itself has a system of sand traps that remove sediment so as not to affect its operation. "When a river loses sediments, water increases its erosive capacity, an effect called 'hungry waters,'" says Cobo. "All rivers carry eroded sediments from the soils and rocks on which they pass. All dams and reservoirs trap part of this sediment, especially heavy materials, and thus deprive the downstream river of its normal sediment load." Large reservoirs and dams will typically trap more than 90%, and sometimes 100%, of the incoming sediment, Cobo says.

The clear water under a dam is said to be 'hungry' and will seek to recover its sediment load by eroding the river bed and banks, Patrick McCully writes in his book *Silenced Rivers: The Ecology and Politics of Large Dams*.

While many Ecuadorian researchers find it hard to believe that the Coca Codo Sinclair plant influenced what happened with San Rafael, Emilio Cobo is convinced it was no coincidence.

"A waterfall that has been there for thousands of years does not collapse, coincidentally, a few years after opening a hydroelectric project. These are

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processes that are in scientific papers and there is sufficient evidence that a dam can cause effects of this type on a river," he says.

The collapse of San Rafael is such an important event for scientists that IUCN is set to hold an academic debate to find stronger scientific ground to determine what happened.

Jorge Celi, director of the National Water Reference Laboratory of the Ikiam Amazon Regional University, also believes that there could be relationships between the hydroelectric plant and the waterfall's collapse.

"What happened is not common, it should happen once every 1000 years, but I think it's a process that is accelerated a bit more by human activities in the basin," he says.

There's no consensus that Coca Codo Sinclair is responsible for what happened and the company has not responded to requests for information.

Fears that the river would run out of water because of the plant's construction has long been a concern. According to Cobo, Coca Codo Sinclair's environmental study details the erosive processes and sediment dynamics that would be affected by the work, but can't say what implications this will have over decades. "The designs of works and the way they were built- in the sixties and seventies did not consider climate change factors, for example" he says.

### What will happen?

Although geologist Alfredo Carrasco believes the collapse of the San Rafael waterfall to be a natural phenomenon, he agrees with Cobo and Celi that the current risk is that the river bed, upstream, will continue to erode and cause new landslides.

"In the future, it could potentially affect the site where the waters of the hydroelectric project are captured. But we would have to do a risk analysis, I don't want to speculate too much," says Carrasco.

For Jorge Celi, it is difficult for corrective measures to be taken unless the dam releases sediments. "If the sink deepens, the edges are more susceptible and new landslides could happen," he says.

Celi believes that the collapse of the San Rafael waterfall would not mean a big impact on nature, since this has served as a geographical barrier for many species for centuries.

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"If the barrier [waterfall] had completely disappeared, connectivity would have increased and some migratory fish could climb upstream. The effect of what happened is that many sediments were suddenly released, but after a while the rivers recover from those landslides," he says.

Cobo believes that there will be "very serious" impacts on infrastructure in the Coca River channel between the waterfall and the collection dam that could compromise the future of the hydropower plant. If the river depth increases by three or four meters, the structures of bridges will be compromised. Houses and other works could also be affected. He is sure there will be costs that the State will then have to deal with.

Cobo is concerned about the impacts the erosive processes may have on freshwater species such as fish and macroinvertebrates, the groups that have lost most species in the last 30 years, according to the IUCN Red List of endangered species. Many more could follow.

Ecuador has more rivers per square kilometer than any country in the world, but Cobo says there is said a regional concern about what happened at San Rafael and the state of Latin America's rivers.

Many populations depend on fish protein. The absence of fish means more hunting for monkeys and other species in the jungle. "In the scientific world, many do not see rivers as ecosystems, when in reality it is a reduced surface that ends up absorbing many of the environmental impacts," Cobo says.

The discussion about what happened with the San Rafael waterfall on February 2 promises to occupy scientists for a long time. There are still more doubts than certainties and many contradicting views. An in-depth analysis is a must. The researchers hope that this work will help Ecuador to become aware of its strengths, weaknesses, successes and errors in environmental matters.

Alfredo Carrasco recalls the strong earthquake that in 1987 altered the level of the river in this area, he took photographs and analysed them. "After what happened on February 2, I will be taking pictures very soon," he says.

This story originally appeared on [Mongabay Latam](#) in Spanish and was first published in English by [Diálogo Chino](#).

[news.mongabay.com](https://news.mongabay.com), 18 March 2020

<https://www.news.mongabay.com>

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### U.S. House of Representatives Approves Cosmetic Safety Enhancement Act of 2020

2020-03-13

Members of the House Energy and Commerce Committee's Subcommittee on Health have approved landmark cosmetics safety legislation, a significant step towards finally protecting consumers from potentially toxic chemical ingredients in personal care products.

#### Companies to Substantiate Product Safety

The Cosmetics Safety Enhancement Act of 2020 (H.R. 5279) is authored by Energy and Commerce Committee chairman Rep. Frank Pallone (D-N.J.). The bill would, among other provisions:

- Require cosmetics companies to substantiate the safety of their products
- Notify the Food and Drug Administration of any adverse health events
- Give the FDA the power to conduct its own safety reviews
- Mandate that manufacturers provide more transparency about ingredients on their labels

#### Contaminants in Cosmetics May Pose Risk

Although many of the chemicals and contaminants in cosmetics are likely to pose little risk, repeated exposure to some chemicals and contaminants used in cosmetics and other personal care products has been linked to serious health problems, including cancer.

*"Since 2009, 617 cosmetics manufacturers have reported using 93 chemicals that have been linked to cancer, birth defects or reproductive harm in more than 81,000 products,"* said Scott Faber, EWG's Senior Vice President of Government Affairs.

By voting to advance Rep. Pallone's bill today, house leaders have taken an important and historic first step. It has been more than 80 years since a committee of Congress last voted to update cosmetics law.

[cosmetics.specialchem.com](https://www.cosmetics.specialchem.com), 13 March 2020

<https://www.cosmetics.specialchem.com>

**The bill would, among other provisions:  
Require cosmetics companies to substantiate the safety of their products**

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### Farming Insects to Save Lemurs

2020-03-19

As a young boy, Julien Jean Donehil would often go out searching for insects. For kids his age living on the dry west coast of Madagascar, the pastime doubles as both a game and a snack. Crickets and cicadas can be found amid the leaf litter, their high-pitched songs a dead giveaway. During the summer rainy season, locusts appear in abundance on the stems of corn and cassava plants. Always the tastiest, Donehil told me, are rhinoceros beetles (*Oryctes nasicornis*), which clamber around the corrals of zebu cattle. To a young boy, the beetle's thick exoskeleton and curled, weaponlike horns are like those of an action figure. Donehil and his friends would often stage mock battles, and then bring their quarry back home. There, after first removing the insects' wings, they would roast the protein-packed treats in their mothers' cooking fires.

Back then, in the early 2000s, Donehil and the other children in his village, Beroboka, never went hungry. There was always arable land to grow peanuts and maize, and grass for zebu to graze. A vast succulent woodland forest, unique in Madagascar and the world, surrounded the village, stretching for miles. Towered over by giant baobab trees (*Adansonia grandidieri*), it was home to creatures found nowhere else, like the Madame Berthe's mouse lemur (*Microcebus berthae*), the world's smallest primate, and a giant rat (*Hypogeomys antimena*) that hops around like a kangaroo. Panther-like fossas (*Cryptoprocta ferox*) and hedgehog tenrecs (*Echinops telfairi*) and flying foxes (*Pteropus rufus*) frequently wandered past or flew over his home. "It was beautiful," he recalls.

Donehil is now 18 and no longer forages for insects as younger boys still do. Beroboka is no longer the village it once was, either. Around eight years ago, Donehil says, the neighboring forest started to disappear. The destruction accelerated, through slash-and-burn practices, whereby land is cleared to make way for crops, the soil becomes degraded, and then more forest has to be destroyed. Around the same time, the human population was also swelling as migrants from Androy, the southernmost region of Madagascar, arrived. Fleeing a years-long drought and desperate, these pastoral people were often offered cash by powerful entities to plant corn on any piece of land they could set a match to.

Immigration and murky agrobusiness dealings have now laid waste to vast swaths of the unique, deciduous dry forest that blankets Madagascar's west coast, driving its biodiversity toward the brink. Conservation groups have organized raids to catch illegal loggers and destroy their camps, but

**The destruction accelerated, through slash-and-burn practices, whereby land is cleared to make way for crops, the soil becomes degraded, and then more forest has to be destroyed.**

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limited resources make the effort halting; plumes of grey smoke still mark the sky daily. The outlook is grim: It's predicted that by 2025, the Menabe Antimena Protected Area, an 812-square-mile tract that includes villages like Beroboka, will have lost 80 percent of its forest cover.

"This region really has no hope unless something different happens," says Brian Fisher, an entomologist at the California Academy of Sciences, as we climb into our S.U.V. to leave Beroboka. Out the window, the landscape has an almost post-apocalyptic quality: barren fields of charred earth stretch out to the horizon, interrupted only by sporadic fire-resistant baobab trees that stand like starved survivors. Fisher, who has been coming to Madagascar for 25 years to study ants, has witnessed the island lose a staggering amount of its unique biodiversity to the forces of population growth, deforestation, and malnutrition, as desperate locals turn to the forest for food. Recently, he launched an audacious plan to reverse the tide of destruction. Boosting a local tradition of consuming insects, he hopes, might offer a nutritious substitute for wild animals. For impoverished people, farmed insects could also provide a viable source of income.

Fisher has had some initial success in the jungles of eastern Madagascar, where a pilot project to boost the numbers of native, edible insects seems to have reduced pressure on lemurs and other hunted animals. But the destruction he now sees along the island's west coast is on a different scale. "I feel like I'm absorbing the severity of the situation here," he said. But if insect farming can work here, he figures, he can make it work anywhere.

*"You go back to an area where you were just three years earlier... and find the whole forest is gone. Not just degraded. It's leveled"*

— Brian Fisher, entomologist

In the popular imagination, Madagascar exists as a cartoon version of itself, a land of staggering biological richness. The world's oldest and fourth largest island, it was once wedged between Africa and India, part of the supercontinent Gondwana, an ancient landmass that began to fragment some 180 million years ago. Madagascar then splintered off with India and drifted northeastward, until around 80 million years ago, it was left behind as India continued its march toward the collision with Asia that would form the Himalayas. This geological history of separation, as well as the island's varied topography and climates—ranging from tropical mountain valleys to plateaus to coastline to arid deserts—allowed life to evolve, and diversify, in isolated pockets. Eighty-five percent of Madagascar's plants, nearly all of its reptiles, and half of its birds exist

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nowhere else. When humans first arrived some 10,000 years ago, they'd have found an island containing 5 percent of the world's biodiversity, including lemurs the size of gorillas and a flightless elephant bird that stood more than 9 feet tall.

Those megafauna have since gone extinct, but for biologists like Fisher, Madagascar remains a treasure trove. "You never know what you're going to find until you get to a patch of forest," he says. "And every time you get to a new patch, you always find something unique there." Little was known about Madagascar's ants when Fisher first began studying them in 1993 as a PhD student. His often swashbuckling fieldwork has led him to some of the island's most remote corners, where he's been able to describe more than 450 new species of ants. Over time, though, Fisher encountered a disturbing pattern. "You go back to an area where you were just three years earlier and discovered something dramatically new, and find the whole forest is gone," he said. "Not just degraded. It's *leveled*—there's not a tree left on the mountain. And you're like, *Oh, there goes that species*. After a while, it is kind of shocking. You wonder, how many times that's happening to forest we haven't even been to yet."

It's been happening at an astonishing pace. Since the early 1950s, deforestation has reduced Madagascar's forest cover by nearly half. In 2018, the island lost a higher proportion of its primary rainforest than any other tropical country, a consequence of slash-and-burn agriculture, as well as pockets of sapphire and nickel mining. The familiar threats of climate change, invasive species, overharvesting, and habitat loss and fragmentation have also exacted a heavy toll: Madagascar's endemic lemurs are now the most threatened group of primates on Earth, and nearly all of its species (94 percent) are at risk of extinction because of habitat loss and unsustainable hunting.

In 2013, Fisher caught wind of an influential report published by the Food and Agricultural Organization (FAO), which put forward a provocative approach to addressing the world's looming environmental and humanitarian crises. By 2050, the report stated, 9 billion people will inhabit the planet. To meet this future demand, food production would need to almost double from its current rate. Farmland is scarce, and continuing to expand it is neither viable nor sustainable. Oceans are already overfished. Climate change, and related water shortages, will likely impact agriculture dramatically—and there are already nearly 1 billion chronically hungry people worldwide. To meet these challenges, the FAO report concluded, "we need to find new ways of growing food."

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Edible insects, it argued, present a sensible solution. More than 1,900 different species of insects are already consumed worldwide, mostly across Africa, Latin America, and Asia. Insects are made up of as much as 65 percent protein; studies have found that grasshoppers, crickets, and mealworms contain significantly higher sources of minerals such as iron, zinc, copper, and magnesium than sirloin does. Pound for pound, insects require less land, less water, and less feed than other animals. And they also produce less waste than livestock, including fewer greenhouse gases.

It's not hard to see Madagascar as a microcosm of the world that the FAO envisions. The country ranks in the bottom 15 percent of the UN's Human Development Index, and is one of the least food-secure nations in the world. More than 90 percent of Madagascar's population lives below the international poverty line, and it is one of the few countries where the rate is *increasing*. Madagascar, as a whole, has the world's fourth highest rate of chronic malnutrition: Almost half of all Malagasy children under five are malnourished. That constant, desperate need for food is what leads people into the forest to hunt for bushmeat, a factor widely recognized as a major contributor to global biodiversity loss.

As he crisscrossed the island documenting ants, Fisher began to wonder whether he was devoting his time wisely. "All of this work, and I have saved not a single tree in Madagascar," he told me. "And if I continue doing this, pretty soon I'll just be documenting what was *once* in Madagascar. So, I challenged myself—*it's time not to be on the sidelines*. What could I possibly do to participate in conservation?"

Fisher knew that the Malagasy ate insects—he'd seen them sold at local markets across the island. As he dug deeper, he read that as early as 1617, missionaries and other visitors to Madagascar attested to the natives' taste for Orthoptera—the classification that includes grasshoppers, locusts, crickets, and katydids. Periodic locust outbreaks might devastate a crop, but could also provide a valuable source of nutrition, especially between harvests. A preparation that involved soaking dried locusts for half an hour in saltwater and then frying them in fat "appeared on the tables of princes." It's said that Queen Ranaivalona II, who reigned Madagascar in the 19th century, frequently dispatched female servants to the countryside to collect locusts for her.

Fisher assembled a working group, dubbed Insects and People of the Southwest Indian Ocean (IPSIO), comprised of insect researchers and regional conservation and humanitarian organizations. The group's aim was to explore ways to leverage Madagascar's edible-insect tradition as

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a way of conserving its biodiversity. Although industry groups estimate edible insects to be a 600-million-dollar business worldwide, most are used in pet food, livestock feed, and fish feed for aquaculture.

With this new objective in mind, Fisher reached out to Entomo Farms, North America's largest producer of human-grade insects, based in Ontario. The company's ground cricket powders supply a burgeoning market of insect-based protein bars, smoothies, chips, crackers, pasta, hot dogs, and pet treats. Entomo's co-founder, Darren Goldin, considered Fisher's idea a worthy "passion project," he told me, and helped design a production facility in Antananarivo, Madagascar's capital.

Crickets, it turns out, are an exemplary food to farm. They grow quickly—six weeks to full maturity—and thrive in confined spaces. They require few inputs—a bit of drinking water and grain feed is all—and as cold-blooded creatures, they don't expend energy regulating their core temperature, as most farm animals do; half of what a chicken eats goes toward warming its body. A recent study even suggests that in addition to high protein levels, crickets contain chitin and other fibers that may improve gut health, as well as reduce systemic inflammation. There are ancillary agriculture benefits, too: Dry cricket frass (poop), a byproduct, is a useful fertilizer.

"In the end, nobody *cares* that it's cricket powder," Fisher said recently. "They eat it because it *tastes good*." He was speaking one afternoon last November to a group of NGOs with food assistance programs in Madagascar, showing them his modest production facility, Valala Farms. The operation occupies part of the three-story insect research center that Fisher established 15 years ago on a hilly plot above the city's zoo and botanical gardens. (There are plans to break ground on an expansive, 23,000-square-foot facility later this year on adjacent land donated to him by the country's education ministry.)

On this occasion, the young Malagasy staff had prepared a spread of cricket *hors d'oeuvres*: skewers of honey-roasted whole insects, a yogurt dip flecked with ground powder. Fisher first led the visitors into a humid room that sounded discomfitingly like a plague—the din of 200,000 chirping crickets confined inside two rows of mesh-covered enclosures grouped by life stage.

The insects skittered across stacks of egg crates meant to provide them ample surface area and airflow, occasionally gathering at small trays of water and chicken feed. Once they reach maturity and mate, the females use a pair of barbed ovipositors to lay their eggs into moist cotton balls (meant to mimic sand). The impregnated cotton then gets transplanted

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to a separate incubation room, kept at 31 degrees Celsius (88 degrees Fahrenheit), and the mature adults are euthanized by carbon dioxide and collected. In an adjacent kitchen, the “harvested” crickets are washed, ground into a moist slurry using a meat grinder, dehydrated on baking sheets, and milled into a fine brown powder that smells something like roasted sunflower seeds.

With their deep pockets and wide reach across the country, Fisher views humanitarian organizations as the primary customers for cricket powder. A successful pilot project with Catholic Relief Services (CRS) demonstrated its potential to tackle malnutrition. CRS introduced cricket powder to elementary and middle school children in Antananarivo through a school lunch program, where it was sprinkled on top of traditional Malagasy meals like rice and beans. (Fisher’s team has also conducted studies in Antananarivo’s schools to gauge student perceptions of eating insects.) In the drought-stricken region of Androy, Madagascar’s impoverished south, Catholic sisters there run a tuberculosis clinic and fed the powder with meals to patients suffering from appetite and weight loss as a consequence of their infections. After just two weeks, all of the patients had gained weight, a critical factor in recovery; within the first three weeks, one had added more than five pounds. “We’re super excited about this work,” CRS’s Tanja Englberger told me. “When they don’t add it, [patients] ask, ‘Where is the cricket powder?’” CRS is now extending the project to another 10 clinics across Madagascar, and may launch a series of nutritional studies.

*“I get at least eight Facebook messages from random communities being like, ‘Hey, when are you going to come bring sakondry here?’”*

— Cortni Borgerson, anthropologist

To help reverse the loss of Madagascar’s biodiversity though, Fisher needs to bring the project closer to critical areas. A few years ago on an Air France flight from Paris to Antananarivo—the type of scene where a surprising amount of networking occurs—he struck up a conversation with Cortni Borgerson, an anthropologist at New Jersey’s Montclair State University. For 15 years, Borgerson has looked at subsistence hunting practices in Madagascar, particularly around Masoala National Park, a species-rich rainforest on the eastern coast. The largest of the country’s protected areas, Masoala is seen as a likely last stronghold of intact habitat. Among people living there, poverty is nearly universal, higher than national averages. One-quarter of the population is anemic. Borgerson’s surveys have found that as much as 75 percent of all meat eaten in some

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communities comes from forest animals. Child malnutrition rates are higher in households that hunt lemurs, suggesting that when they have little else to eat, families turn to bushmeat.

During the rainy season, natives of the Masoala Peninsula take delight in an endemic Fulgorid planthopper (*Zanna madagascariensis*, or “*sakondry*” in Malagasy) that feeds on the sap of wild lima beans and related plants. Locals pick them off in large clusters like berries, rinse them twice, and fry the fatty insect whole without even the need for oil. The taste is delicious, Borgerson says—like bacon. She’d long known of this food practice, and so had Fisher: He’d first photographed *sakondry* 20 years earlier in the island’s western dry forests. But how long did the insects live? What did they eat? When do females lay eggs? Science didn’t have answers at the time, but Borgerson and Fisher felt the *sakondry* held great promise for addressing regional nutritional deficiencies and the interrelated conservation issues. They’ve received a three-year grant from IUCN’s Save Our Species initiative to test *sakondry* farming methods.

Their pilot project is set in six of the Masoala’s most remote jungle communities, where wildlife makes up a large proportion of the diet. “Find the last village on the map, and we are like four days beyond that,” Borgerson says. The communities range from 10 to 200 households; participation is voluntary. The researchers first distributed bean plant seeds, and established a sharing program. Within the first three months, one community grew around 500 lima bean plants. “It just took off,” Borgerson told me. There are now 4,200 plants growing across all test sites—more food for the humans, and an abundance of hosts for *sakondry*. (The insects drink the sap-like phloem of the plant without significantly impacting bean production.) It’s a win-win, Borgerson says, “because then you get both products.” At last estimate, 52,000 individual *sakondry* had taken up residence, and insect consumption has increased by 400 percent of what it had been before the project began. Borgerson and Fisher’s aim had been to produce enough insect meat to replace lemur meat within three years, a goal they reached within the first eight months of the project. “It went way better than expected,” Borgerson says. “And I get at least eight Facebook messages from random communities being like, ‘Hey, when are you going to come bring *sakondry* here?’”

Still, crucial questions remain. Most importantly, is it actually changing any behavior? Preliminary results show that the farming has significantly positively affected child nutrition, food security, and the sustainability of hunting, according to Borgerson. There’s now simply more food, she says, available at the times when people might typically hunt. Borgerson notes

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that the project is having the greatest impact on women and children, who've been seen grabbing *sakondry* by the fistful. In theory, as their nutrition improves, it ought to give men of the household fewer incentives to hunt lemurs.

To reach the Menabe Antimena protected area, a patchwork of dry forest and mangrove reserves on Madagascar's west coast, I flew with Fisher one hour from Antananarivo to the seaside town of Morondova, and then drove another two hours north by car along a rutted, red-sand road. The route passed by the Avenue of the Baobabs, a photogenic grove of trees that is among the island's top tourist attractions. We passed boys sitting atop zebu carts loaded with sacks of rice and peanuts, and villages where women squatted in the shade, selling corn. Crammed in the back seat was Entomo's Darren Goldin and the company's farm manager, Aran Hinton, there to help Fisher evaluate the feasibility of establishing a small-scale farm project in a local village. Also with us was Sylvain Hugel, a specialist in crickets who would be able to determine which species might work best. All had joined Fisher field expeditions before. "He's the most experienced field guy I've ever met," Hugel told me. "The amount of stories he could tell you about problems in the field—it's just crazy, you could write a book."

These stories include surviving all manner of tropical diseases, from malaria ("a recurring theme in my life," Fisher says) to leishmaniasis, which bore a hole in his leg, and loiasis, in which worms squiggled across his eyeballs. Fisher once narrowly escaped an armed group in the Central African Republic, and was forced to improvise in the Congolese jungle after local warriors his team had hired as guides disappeared with their tents and food. Vehicle breakdowns, equipment malfunctions, roadblocks, and getting lost were familiar occupational hazards. By comparison, this trip was a cakewalk. We planned to sleep in beds that night.

We turned off the road at the entrance to Kirindy Forest, a privately managed reserve with a small research center and tourist bungalows. The dry deciduous forest there is home to seven species of lemur as well as the fossa, Madagascar's largest predator; one wandered by the reception desk not long after we arrived. Skinks and lizards rustled the dried leaves lining the footpaths between bungalows. As night fell, Hugel grabbed his headlamp and a butterfly net, and with the guys from Entomo Farms, set out to collect specimens.

Crickets reveal themselves by their songs, unique to each species. Males produce sound by rubbing the serrated edge of one forewing against the sharp-edged bottom of the other, a movement known as stridulation.

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These chirps are meant to attract mature females that pick up the sound through timpana membranes on their forelegs. The females seem to find the calls irresistible. Human cultures do, too. Across Asia, crickets have long been kept as pets, and in China, where the insect symbolizes luck and prosperity, imperial concubines are said to have placed crickets in small gold cages on their bedside to delight in their songs.

*"There's not one model that can be easily applied from one village to the next. And there's a 100-percent resistance to change. First, we have to identify the issues of concern for that village."*

— Brian Fisher, entomologist

"There are many species here," Hugel remarked, noting a variety of calls. He crouched down above the leaf litter in one patch, hovering the net in his hand. With one swift motion, he slammed the hoop flat against the ground, entrapping a cricket. He then placed the specimen inside a vial along with some leafy matter, which he said relaxes them. Any candidate for potential farming must be native to the area, Hugel explained—in part so as not to disturb the native ecology should any escape. But it was also important to select a species that could be reared year-round, so he looked for both juveniles and adults of a single species as evidence that their life cycle would span across rainy and dry seasons.

Fisher had arranged with a local USAID-funded NGO project, Mikajy, for the team to be shown three villages that stood just outside the protected forest. Each were identified as potential sites to introduce cricket farming. Over a breakfast of rice porridge and French bread the next morning, Fisher explained some of the challenges the team faced. "Community work is far more complicated than commercial business models," he said. "There's not one model that can be easily applied from one village to the next. And there's a 100-percent resistance to change. First, we have to identify the issues of concern for that village. We also have to understand its structure. Is it an immigrant village, or a traditional village? Do they farm, and if so, where? If they don't farm at all, that means they're going into the forest."

In the first village, Kirindy, the team met with a thin, shirtless man in his 30s, said to be its chief, outside a home constructed with vertical tree trunks and thatched roofing. As a couple dozen family members gathered around—men on one side, women and toddlers on the other—Fisher began asking questions through a translator, in French. What year did they arrive? What crops did they grow? The picture that emerged was bleak: The surrounding land, slashed and burned to plant crops, now barely

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supported cassava, corn, yam and black-eyed peas. Their zebu cattle herd had been reduced to 10 by thieves who had taken the rest.

Fisher asked whether the people of the village consumed insects, a notion the chief seemed to find laughable. Even after Fisher described the insect's nutritional value, passing around a specimen Hugel had collected the previous night, the chief insisted that the community would have no interest in growing crickets. He mentioned taboos around certain insects. (Fisher had heard of these: Some Malagasy confuse crickets for cockroaches, which they associate with filth; and superstitions abound, such as a village in eastern Madagascar where they referred to a cricket species as "lost child" based on lore of unknown origin.) One of the women seated across the compound interjected: Perhaps, she suggested, crickets could fatten up their chickens. "Women are always thinking about the future," Hugel whispered to me. The chief's resistance puzzled Fisher. He'd mentioned that his family migrated to the area from the south—had they lost an edible-insect tradition along the way? Eventually, Fisher wrapped up the meeting. As we headed back to the car, a group of youth, who'd overheard the conversation, ran up to us and enthusiastically presented tin containers filled with rhinoceros beetles.

"I've never been presented with such a challenge," Fisher said as he surveyed the parched and barren red earth that surrounded the chief's cluster of houses. A mere half-mile away, safeguarded for now, the Kirindy Forest stood as a reminder of the landscape Fisher remembered from a field trip 15 years earlier. "How do you stop this? The scale of the problem is far more dire than I'd imagined. 'Fifty percent deforested' is hard to imagine until you come down here. And it was all happening while I was traveling across Madagascar, collecting ants."

A 20-minute drive up the road, in Beroboka, Fisher's team met with an older, wiry man named Gerome Radafy, the village schoolteacher. Radafy rattled off the insects that local people there consumed, a list that included grasshoppers, cicadas, and crickets. He then asked his niece, a girl of around 10, to prepare us a snack of rhinoceros beetle. After washing the insects and removing their wings, she then fried the lot in a pot of oil, adding in a pinch of salt. Radafy told Fisher that he wasn't opposed to cultivating crickets, but thought the idea better for feeding chickens than humans. ("We're not completely against it, but it's not what I would prefer to do," Fisher interpreted later.)

Fisher began to wonder whether he'd been too idealistic. "We shouldn't kid ourselves," he said that evening. "The problems are so severe here, we must

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try some radical approaches.” Insect farming could be considered a radical approach. But to stanch deforestation and bushmeat consumption there, Fisher thought, would require large-scale facilities in every village across the region, where malnutrition had become endemic. They’d have to produce enough cricket powder to feed every child, and make it available to everyone else at a reduced cost. This looked like a massive aid program. And that was just one piece of the puzzle, Fisher said. “There’s no reason to think we can have an impact on deforestation if they’re not enforcing deforestation. Enforcement *has to* happen.”

Lambokely, a dusty village the team visited the following afternoon, seemed to embody the problems facing Madagascar’s beleaguered western dry forests. According to news reports, in 2001 Lambokely’s population numbered 64 people; by 2018, that number had swelled to around 20,000 due to immigration from Androy.

“Do you worry about your future?” Fisher asked a group of a few dozen villagers that had congregated in the shade of a large kapok tree (*Ceiba pentandra*). Speaking for the chief, who sat nearby with other elders, a handsome man wearing a plaid shirt and sarong, named Elias, told a familiar story: poor soil, cattle thefts. They’d tried raising chickens and ducks, with marginal success. Yes, they ate insects— various kinds, including the *sakondry*, in abundance during the rainy season. Their elders who came from southern Madagascar, he said, used to boil locusts and pound them into a dry powder for use during lean times. When Fisher heard this, he perked up. “They know!” he said.

Fisher asked whether they’d be interested in rearing an insect to make into a powder, describing his facility in Antananarivo. He presented the vial containing the cricket sample. “Is it food?” someone asked. Fisher explained how crickets differ from locusts, and passed around lemon-lime flavored protein bars made by a Canadian brand, Crickstart, that uses Entomo Farms’s cricket powder.

At that point, the conversation turned—now the villagers began to pitch themselves as a potential farming site. “You can tell we have highly educated youth,” a man replied after Fisher raised the topic of staffing. Here were a people with a history of eating insects, and a genuine enthusiasm for the project. Fisher was encouraged. Before getting up to leave, he declared, “We’re ready to start working with you as soon as we can.”

The villagers clapped. Elias replied, “We’re ready, too.”

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"I'm feeling positive about working here," Fisher said as we drove away. "It would be a great collaboration. And what we learn here could be applied across the entire west. We could first start with the cricket, to make powder, but also start developing a technique for *sakondry*." He looked out the window at the barren fields. "These people are screwed unless something different happens. Soon it'll be a famine-relief effort."

After landing back in Antananarivo, we drove up the city's twisted, traffic-choked streets to the hilltop grounds of a new photography museum and its adjacent café, the Café Du Musee. A wraparound terrace offered a sweeping view of Madagascar's congested capital, a riot of colorful houses and tin roofs. Part of Fisher's strategy of revitalizing the country's edible-insect culture involves introducing cricket product to high-end chefs for use as a novelty ingredient. The café's chef, Johary Mahaleo, who had a reputation for inventive uses of local chocolate—the menu featured dishes like homemade *foie gras* with cocoa truffle and duck breast in chocolate sauce—had visited Fisher's facility earlier in the week and taken a whiff of the cricket powder. "Has a bit of an algae scent," he'd told me. "Plenty of room to experiment."

Mahaleo presented us with a few appetizers to taste: croquettes topped with a dollop of lemon puree and goat cheese whipped with cricket powder; a *fromage blanc* speckled brown from ground crickets. They tasted delicious; it was difficult to detect any of their crickety-ness. Mahaleo seemed pleased; cricket-infused dishes, he thought, could be something he becomes known for—perhaps a bit of a marketing ploy, too. A little further up the hill, I noted, stood the former royal palace, now a museum, where the Queen is said to have once enjoyed locusts sprinkled over her food. Madagascar's edible-insect tradition may date back centuries, but Mahaleo thought he was on to something new. Another story in the island's unique evolution, you could say.

biographic.com, 19 March 2020

<https://www.biographic.com>

### Need to get around in a pandemic? Ride a bike.

2020-03-18

On March 8, as America began to contemplate the looming specter of the coronavirus in earnest, New York City mayor Bill de Blasio tweeted:

*Plan to have some extra travel time in your commute. If the train that pulls up is too packed, move to a different car or wait to take the next one.*

**Days later, the New York City Department of Transportation reported a 50 percent surge in cycling over the East River bridges compared to the same time last year.**

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*Bike or walk to work if you can.*

— Mayor Bill de Blasio (@NYCMayor) March 8, 2020

New Yorkers laughed off the bit about the subway—until social distancing became a way of life, there was no such thing as a New York City subway train that wasn't packed during rush hour—but they took his bike-to-work advice more seriously. Days later, the New York City Department of Transportation reported a 50 percent surge in cycling over the East River bridges compared to the same time last year. Citi Bike also saw a 60 percent increase in ridership. Certainly, the warm weather and the extra hour of daylight from changing the clocks that weekend contributed to the bumper crop of cyclists, but plenty of people also cited coronavirus as the reason they chose to ride. One rider told the New York Post: "I feel better taking the bike... There are fewer hands touching these handlebars than the subway poles."

This is by no means the first time people in major cities have turned to the bicycle in a crisis. When Hurricane Sandy knocked out the subway in 2012 and caused gas rationing, people rode bicycles. When the blackout of 2003 plunged New York City and huge swaths of the northeast into darkness, halting trains and causing mass gridlock, commuters scrambled for rental bikes. The bicycle has been a clutch player during transit strikes in New York, Philadelphia, London, and Paris. And on a personal note, during the chaos, confusion, and horror of 9/11, the bicycle got me where I needed to go. When the shit hits the fan, the bicycle is a powerful contingency plan.

But like a fire extinguisher or a first aid kit or anything else that can be useful in an emergency, lots of people take bicycles for granted, consigning them to some out-of-the-way spot in their homes and forgetting about them—if they even have them at all. When things are running smoothly there's also the common misconception that the bicycle is not a practical mode of transportation: we're told over and over again by the anti-bike-lane set that they're no good in bad weather, or they're only for the young and fit, or that they're useless for carrying stuff which is why we all need to drive SUVs. Sure, all of this is demonstrably untrue—winter weather doesn't stop people in Copenhagen, age doesn't stop the Dutch, and you can easily carry your groceries with a cargo bike—but instead, pundits and blowhards reflexively dismiss the idea of riding a bike for anything other than recreation or fitness, and continue to characterize dedicated bicycle infrastructure as an indulgence and not a necessity.

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Then there's the most ironic criticism of bike lanes and other safety-oriented road designs: that they hinder emergency response. This is a myth that has been debunked time and time again. It's personal cars that are the real liability in this regard; in New York City, the sight and sound of emergency vehicles stuck in motor vehicle traffic is so commonplace that people simply tune it out—there are so many videos of it happening that it's practically its own film genre. I've never seen a fire engine stopped by a bicyclist, but I have seen one stuck behind a Fresh Direct truck.

In a crisis we see how backward this sort of reasoning is, because the fact is that, short of walking, there's no more dependable mode of transportation than the bicycle. Sure, if it rains while you're on your bike you'll get wet, and pedaling through a blizzard might be a tall order, but you don't know smugness until you've cycled past a gas line or schlepped a bunch of supplies to hurricane victims by cargo bike. It's situations like these that expose the vulnerability of public transportation to disruption, and the sheer bovine unwieldiness of cars. And that's not even addressing how indispensable a bicycle will be for the zombie apocalypse.

None of this is to say the bicycle is ever going to supplant public transit in a major city on a day-to-day basis, nor is it to imply that, should some calamity befall me, I'd prefer to be picked up in a Dutch cargo bike than an ambulance. However, the bicycle is a vital component in the fabric of any robust transportation system under any circumstances, and when another component of that system is strained or fails, the bicycle greatly enhances that system's resiliency. Alas, now it seems other countries are going in the other direction: Madrid is suspending its bike share system, and Spain and Italy are banning leisure cycling in response to concerns about the virus (though as of now they're still permitting cycling for essential transportation).

Amid this virus-related cycling boom, advocates in New York have been calling on the city to make additional provisions for people on bikes. Meanwhile, the city has limited bars and restaurants to take-out and delivery only. This will place even more pressure on New York City's food delivery people who, as advocate Do Jun Lee points out, have already been suffering under de Blasio's war on e-bikes and will now be sustaining many of New York City's small businesses. In recognition of this, the mayor has ordered the NYPD to suspend e-bike enforcement.

As this pandemic compels us to consider the shortcomings of our healthcare system, the fragility of the economy, and our need for affordable healthcare, we should also give the bicycle its due. Even when

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you neglect it, it's always there for you—all it ever needs is a little air in the tires.

outsideonline.com, 18 March 2020

<https://www.outsideonline.com>

### Why did nearly a million king penguins vanish without a trace?

2020-03-19

Where on Earth, wondered Henri Weimerskirch, were all the penguins? It was early 2017. Colleagues had sent the seabird ecologist aerial photos of Île aux Cochons, a barren volcanic island halfway between Madagascar and Antarctica that humans rarely visit. The images revealed vast areas of bare rock that, just a few decades before, had been crowded with some 500,000 pairs of nesting king penguins and their chicks. It appeared that the colony—the world's largest king penguin aggregation and the second biggest colony of any of the 18 penguin species—had shrunk by 90%. Nearly 900,000 of the regal, meter-high, black, white, and orange birds had disappeared without a trace. "It was really incredible, completely unexpected," recalls Weimerskirch, who works at the French national research agency CNRS.

Soon, he and other scientists were planning an expedition to the island—the first in 37 years, and only the third ever—to search for explanations. "We had to go see for ourselves," says CNRS ecologist Charles Bost.

As the researchers prepared for the journey, they had to grapple with the logistical, political, and scientific challenges that have long bedeviled biologists trying to understand Antarctica's remote ecosystems. The vast distances, rough weather, and rugged terrain make travel difficult and expensive. They needed a ship—and a helicopter, because frigid seas and rocky shores make for perilous boat landings on Antarctic islands. Complying with the tough permitting and biosecurity rules governing the French-controlled island—meant to prevent researchers from disturbing fragile ecosystems—required careful planning and paperwork that took months to complete. And once they arrived, they would have precious little time: just 5 days to investigate a multitude of suspects in the disappearance, including disease, predators, and a warming Southern Ocean.

In all likelihood, they would never be able to return. "We knew this was going to be a one-shot expedition," recalls conservation biologist Adrien

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Chaigne, an expedition organizer who works for the National Nature Reserve of the French Southern and Antarctic Territories, which manages the island. "It was a real kind of pressure."

Constraints like that have long faced biologists seeking to understand life at the remote bottom of the planet. Two centuries ago, researchers wanting to visit the region had to tag along with explorers, whalers, or seal hunters. The Adélie penguin, for example, was first identified by a naturalist who joined an 1837 expedition to southeastern Antarctica led by the French explorer Jules Dumont d'Urville, who named the place Terre Adélie after his wife. The harrowing voyages rewarded them with surprises: In 1895, botanists certain no plant could survive the frigid Antarctic were shocked to discover lichens on Possession Island, near Île aux Cochons.

Today, modern research budgets and a network of polar research stations have made Antarctica more accessible. Biologists have flocked to the region to tackle an array of fundamental questions, including how animals evolved to survive subzero temperatures and how ecosystems are organized in the vast, productive Southern Ocean. Climate change, which has made the Antarctic one of the fastest changing places on Earth, has inspired studies of shifting ice and acidifying seas. The potential for discovery makes the region addictive, says marine biologist Deneb Karentz of the University of San Francisco. "Once you go as a scientist you always want to go back."

But even today, Antarctic research is challenging. "If it takes you 2 hours to collect samples back home, it could take 10 in Antarctica," Karentz says. Holes drilled in sea ice to collect samples, for example, often need poking to remain open. The harsh conditions can claim valuable gear. In 1987, shifting sea ice swept away a plexiglass frame Karentz was using to study microorganisms beneath the surface. She scrambled to replace it with materials scrounged from a nearby research station. In Antarctica, she says, "You have to be resourceful."

Such lessons weren't lost on Weimerskirch and Bost, both veterans of Antarctic research, when a helicopter from the *Marion Dufresne*, a French research vessel, delivered the penguin researchers and their 700 kilograms of gear to Île aux Cochons in November 2019. It was the middle of king penguin nesting season, and they were greeted by the raucous honking and chirping of tens of thousands of chicks. They also saw vast empty swaths of bedrock, where previous generations of birds had scraped away

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the soil. The scientists estimate penguins once stood flipper to flipper on some 67 square kilometers of ground that is now abandoned.

The researchers were eager to find out what had caused those losses. King penguins, numbering 3.2 million birds in the Antarctic region, aren't in immediate danger; in fact their numbers are mostly rebounding from centuries of human hunting. By contrast, half the world's penguin species are threatened (see graphic), and several have recently experienced disturbing die-offs. But big losses of even relatively healthy species could point to broader threats, which is why the calamity on Île aux Cochons triggered alarm bells.

King penguins should be relatively easy to study. Unlike their ice-bound cousins, such as emperor penguins, king penguins live on islands dotting the subantarctic region. That means they can be reliably and repeatedly counted in satellite images over time, and scientists can camp alongside their breeding colonies to observe them. (Other ice-dependent species, like emperor penguins, are more peripatetic.) During the lengthy breeding season, the parents trade off tasks, with one incubating eggs or rearing fluffy brown chicks while the other heads to sea to catch fish and other sea creatures. These foraging round-trips can cover 500 kilometers or more, electronic tags attached to the birds have shown.

The researchers' first priority was to attach such tags to 10 penguins, to see whether foraging changes might have contributed to the losses. It wasn't easy. The team's permits stipulated they utilize just one well-trodden trail and operate only on the edge of the colony. Breaks in the rain allowed the scientists to glue transmitters on the birds' feathers.

Other researchers, meanwhile, set up traps, cameras, and night-vision optics to look for cats and mice, which were introduced by whalers or sealers long ago and are known to eat seabird eggs and chicks. The scientists also took samples of penguin blood, to be screened later for diseases and other data. And they collected feathers and dug up penguin bones that could yield further ecological clues, including dietary changes.

"The first 2 days were intense," Chaigne says. "We knew it was possible that bad weather could end the expedition any day." Luckily, they avoided serious storms, and by the end of their fifth day the researchers had tagged the penguins and gathered the samples they sought.

Reams of data remain to be digested. But the researchers have already ruled out some possible explanations for the massive penguin decline. Land predators, for instance, don't seem to have played a role.

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Examinations of chicks and adult penguins, as well as excavated bones, revealed no signs of cat or mouse bites, and the team's cameras recorded no attacks. (Rabbits, seen on previous expeditions, were curiously missing.)

Nor, it seems, had the penguins simply moved somewhere nearby. A second smaller colony on the island, a natural site for relocation, had just an estimated 17,000 pairs, not enough to explain the massive drop-off in the main group. And Bost says there's no obvious indication—in satellite images, for instance—that the colony relocated to some other island.

That leaves one main explanation, Bost says: "If the penguins are not here, they died." But what killed them?

Not disease, apparently. The team is waiting on final blood analyses, but they saw few ailing birds or fresh corpses. "We thought we'd see carrion, individuals in bad condition," Chaigne says. But the birds looked healthy.

Instead, he and his colleagues suspect that changes in the surrounding ocean forced the penguins to swim farther to find food. Studies of other king penguin colonies suggest foraging birds from Île aux Cochons normally swim toward an oceanic feature hundreds of kilometers to the south known as the polar front or Antarctic convergence. The front marks the northern extent of the colder Antarctic waters. The penguins are attracted by the many sea creatures that gather at such thermal edges—especially the bird's main prey, lanternfish, which form huge schools some 100 meters or more below the surface.

The polar front doesn't stay in the same place every year. During some years, climate anomalies known as the El Niño-Southern Oscillation and the Subtropical Indian Ocean Dipole cause ocean waters in the region to warm, and the polar front shifts south, closer to the pole and farther from Île aux Cochons. During the longer foraging trips, hunger might force the parent left back at the colony to leave the nest to feed—leaving chicks vulnerable to predators or starvation. The longer swims might also make the adult penguins more vulnerable to deadly stress and predation. And those anomalous years offer a preview of how the Southern Ocean is expected to warm in the coming decades, steadily shifting the polar front farther south.

Evidence that a warming ocean could threaten the penguins comes from a 2015 study that Bost and his colleagues did at a smaller king penguin colony, on Possession Island, some 160 kilometers west of Île aux Cochons. The island hosts France's Alfred Faure research station, and less strict biosecurity rules allow researchers to continually monitor the colony and

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climate and oceanographic conditions. The study, published in *Nature Communications*, analyzed 124 foraging routes taken by 120 tagged birds over 16 years. It found that in years when the polar front moved south, the penguins had to travel hundreds of kilometers farther. During “these very unfavorable environmental conditions,” the researchers wrote, “the penguin breeding population experienced a 34% decline.”

Building on that study, a 2018 paper published in *Nature Climate Change* forecast that warming seas and other environmental changes could cut king penguin numbers by half by the end of the century.

Whether that scenario explains the Île aux Cochons crash may never be entirely clear. (Another possibility is that the colony just grew unusually large during some bountiful decades, then fell back when conditions became more typical.) But the tags the researchers placed on the 10 penguins during the expedition could offer some new clues. Five are still transmitting and could continue to provide data into early 2021.

Already, the tags have offered some surprises: They show that a few of the penguins headed north—not south—from the island to forage. That could mean the birds are hunting at a different thermal edge, known as the sub-Antarctic front. “It’s a small sample size of course,” Weimerskirch says, “but it’s very interesting.” The tag data might also reveal a trend toward longer foraging trips, which could suggest the worrisome forecasts about the impact of climate change are accurate.

The unexpected calamity on Île aux Cochons could be a harbinger of that dire future, researchers fear, and perhaps of declines at other penguin colonies as well. But after their frenzied 5 days on the island, the scientists are resigned to monitoring its birds from afar, knowing that the authorities aren’t likely to approve another expedition any time soon. The only glimpses of the penguins’ fate will come from occasional helicopter flights over the island and, when clouds cooperate, images snapped by satellites orbiting far above.

sciencemag.org, 19 March 2020

<https://www.sciencemag.org>

**Now, paleontologists have their own version: the oldest modern bird skull ever found, which predates the split between the duck lineage and that of both chickens and turkeys—and so has traits of all three.**

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### Oldest modern bird fossil looks like a duck from the back and a chicken from the front

2020-03-18

Go to a Cajun restaurant in New Orleans, and you might be offered a slice of turducken: a fancy dish of chicken stuffed inside of a duck stuffed into a turkey. Now, paleontologists have their own version: the oldest modern bird skull ever found, which predates the split between the duck lineage and that of both chickens and turkeys—and so has traits of all three.

“This is an incredibly informative specimen,” says Amy Balanoff, a paleontologist at Johns Hopkins University, Baltimore, who wasn’t involved in the work. Whereas the earliest birds, like the 150-million-year old *Archaeopteryx*, look very different from today’s, the new fossil has clear characteristics of modern land and waterfowl, perhaps offering a glimpse of their common ancestor. Discovered near the Dutch town of Maastricht, in famous fossil beds that formed between 66.8 million and 66.7 million years ago, the turducken lived just before the mass extinction that killed off the dinosaurs. And because at least some of its descendants survived the cataclysm, “it gives us some clues about what characteristics were key in surviving that event,” Balanoff says.

Luck and technology prompted the find, says Daniel Field, a paleontologist at the University of Cambridge, who led the work. John Jagt, a curator at the Maastricht Natural History Museum, had spotted “four very small blocks of rock with broken limb bones poking out” in the museum’s collection, Field says. “It’s hard to imagine a less exciting looking fossil.” Just the same, Field and his postdoctoral fellow Juan Benito put the rock into a computed tomography scanner, hoping the x-rays would reveal the structures inside. When they saw the scan, Field says, their shouts made the technician run back into the room. “She thought we had broken the machine.”

The scan revealed a complete skull of what looked like a modern bird. The bones in the top and the back of the head closely resemble those of modern ducks, whereas the face and beak have unfused bones, as seen in today’s chickens and turkeys. “You can play this game all day: ‘Oh, it’s a duck! No, it’s a chicken!’” Field says.

Most of the bird’s body is missing, but a piece of leg bone suggests it had long legs for its head size. Combined with the fact that the Maastricht deposits formed in a shallow sea, the fossil’s proportions suggest it was a small shorebird, about the size of a modern seagull.

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In a *Nature* paper this week, Field and his colleagues named the bird *Asteriornis maastrichtensis*, for Asteria, the Greek goddess of falling stars who turns herself into a quail. The falling stars nod to the asteroid impact and extinction that struck not long after the bird lived. Some scientists had argued that modern birds evolved in the Southern Hemisphere because the oldest modern bird fossils found until now came from Antarctica. But the new fossil is likely older than the Antarctic ones, arguing against that assumption.

The ability to look inside the intact rock was crucial to the discovery, Field says. The skull is less than 1 millimeter away from the femur, so “if we had started chipping away, we would have destroyed the skull.” So was the team’s willingness to gamble on an unassuming rock, he adds. “We have to be more hopeful in our collecting.”

sciencemag.org, 18 March 2020

<https://www.sciencemag.org>

### What’s happening to the Monarch Butterfly Population?

2020-03-20

Western monarch butterflies spend their winters in Pismo Beach and other sites on the central California coast. A few months later, they breed in the Central Valley and as far north and east as Idaho.

But where they go in between remains an open question.

Now, a group of researchers wants the public’s help to solve that mystery.

They would like anyone who spots a monarch north of Santa Barbara this spring to snap a quick picture. The researchers — from Washington State University, Tufts University, the nonprofit Xerces Society for Invertebrate Conservation, and the University of California, Santa Cruz — need photographic evidence, a date and a location to confirm where the monarchs might be living. (Photos and information can be emailed to [monarchmystery@wsu.edu](mailto:monarchmystery@wsu.edu) or uploaded on the iNaturalist app.)

“Something’s going on in early spring,” said Cheryl Schultz, a professor at Washington State University in Vancouver. Researchers know that winter survival isn’t the issue in the short-term, she said.

But they don’t know whether the monarchs are not making it to breeding sites, not finding plants to nourish them along the way, or not able to find mates.

**They would like anyone who spots a monarch north of Santa Barbara this spring to snap a quick picture.**

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The Western monarch population, which lives west of the Rocky Mountains, stood in the millions in the 1980s. In 2017, an annual count found 200,000 butterflies. In 2018, the tally fell to about 30,000 — a figure that held steady last year, said Elizabeth Crone, a biology professor at Tufts University in Medford, Mass.

The monarch's decline is part of a larger trend among dozens of butterfly species in the West, including creatures with names like field crescents, large marbles and Nevada skippers, said Matt Forister, an insect ecologist at the University of Nevada, Reno, whose conclusions are based on a nearly 50-year set of data compiled by Art Shapiro, a researcher at the University of California, Davis. "The monarch is very clearly part of a larger decline of butterflies in the West."

Research pins the loss of Western butterflies on a variety of factors, including development, climate change, farming practices and the widespread use of pesticides by farmers, and on home and business lawns, Dr. Forister said.

For example, Dr. Schultz said that farms used to have rough, weedy borders that were great breeding grounds for the types of plants that monarchs love. Newer farming practices have pushed crops to the very edge of the fields, leaving no room for these weedy margins, she said.

Another factor, she said: Some homeowners, eager to attract monarchs, have planted tropical milkweed. Although the butterflies will feed on them, these plants tend to spread disease, because they don't drop their leaves, Dr. Schultz said, which may be contributing to the declining monarch population. Native milkweed supports the population without this risk, she said.

Climate change also plays a role in the challenges facing monarchs and other butterflies, said Chip Taylor, a professor emeritus at the University of Kansas, who also directs Monarch Watch, a network of students, teachers, volunteers and researchers. Temperatures in the Western monarch's overwintering sites along the coast now average 2 degrees higher in January and February than they did just two decades ago — the highest rate of increase outside Alaska, he said.

Western monarchs are quite similar to their Eastern cousins, just a bit smaller and darker, Dr. Crone said. But they have a distinct migratory pattern.

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While the Eastern monarchs migrate from Mexico to as far away as New England and Southern Canada, the Western ones mostly remain in Southern California or migrate from the mid-coast up as far as British Columbia and as far east as the Rockies, Dr. Schultz said.

In the last couple of years, she said, the range of their breeding grounds has been contracting. The butterflies are going inland as far as Nevada, but they're not making it as far as Washington State anymore.

Like other insects, butterflies often have good years and bad. "Butterfly populations are bouncy," Dr. Schultz said. "While we think the situation right now is very concerning, we do think there's a lot of potential to turn it around."

Dr. Schultz said she saw two reasons for hope. First, the population decline seen in 2017-18 wasn't repeated last year. And second, she's seen butterfly populations rebound before.

When she started working to help preserve the Fender's blue butterfly in the early 1990s, there were only about 1,500 of the insects left in the Willamette Valley in Oregon. This year, thanks to collaborative efforts by citizens, farmers, private landowners and government, there were almost 25,000.

"That's the kind of commitment that gives me both optimism and the sense that we can do this," Dr. Schultz said. "My hope with Western monarchs is we can bring the population back up."

In other butterfly-related news, a [study](#) published Jan. 28 in Nature Communications provided new insights into how butterflies keep their wings from overheating in the sun.

Previous temperature research had focused on the thorax, because butterflies cannot fly if their thorax is too cold. But their thin wings build up heat quickly, and the new research examined how that heat is dispersed so it does not kill the fragile living cells in the wing.

Using imaging techniques, researchers from Harvard and Columbia universities found specialized scales on the living parts of the wing that have tiny, intricate structures allowing them to dissipate heat. This enhanced thermal radiation allows the parts of the wing with living cells to remain cooler than other parts of the wing, by as much as 10 to 15 degrees Celsius.

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“There’s incredible fine-tuning to keep the wing cool, especially the living parts of the wings,” said Naomi Pierce, a butterfly expert and biology professor at Harvard, who helped lead the research. “I’ve found it really interesting and surprising.”

These structures have already been mimicked in paint that can disperse heat and reduce energy costs, Dr. Pierce said.

Dr. Taylor said the research opened entirely new areas of butterfly research and “understanding of how this group of organisms has to deal with incident radiation.”

nytimes.com, 20 March 2020

<https://www.nytimes.com>

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