The New York Times

TURNING POINTS

Six Ways We Can Adapt to Climate Change

Dec. 5, 2017

A member of an expedition group stands on the edge of a crater in northern Siberia. Reuters

This is an article from Turning Points (https://www.nytimes.com/spotlight/2018-turning-points)*, a magazine that explores what critical moments from this year might mean for the year ahead.*

As our climate changes, human creativity has been turning to solutions to problems ranging from restoring water supplies to rebuilding failing ecosystems. In interviews, six scientists discussed their efforts to slow or even reverse changes brought by warming. Their comments have been edited and condensed.

TURNING BACK TIME ON THE SIBERIAN STEPPE

Nikita Zimov and his father, Sergei, two scientists at the Northeast Science Station of Chersky, Russia, are trying to revive the Ice Age steppe ecosystem in today's Siberian Arctic. As they brave harsh environments and long journeys to bring animals and vegetation back to their Pleistocene Park (https://www.nytimes.com/2014/03/02/magazine/the-mammoth-cometh.html), they hope to provide the planet with a sustainable template for climate change mitigation.

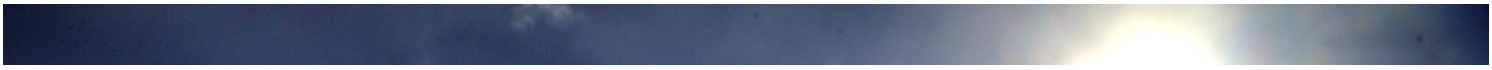
Nikita Zimov, director of Pleistocene Park, shared his ambitious plans:

During the Pleistocene geological era, the Siberian Arctic was an extremely productive ecosystem, with high animal density. Human intervention has affected that mostly badly.

Reviving the steppe ecosystem could help reduce global temperatures by preventing its permafrost from melting; if it thaws, the microbes in the soil will start producing high levels of greenhouse gases. Our ecosystem could help slow this process, since large numbers of animals can trample down the snow, making the cold travel downward and keeping the deep layers of permafrost cool. The revived environment would also increase the albedo effect, lower methane output and increase the soil's potential for carbon sequestration.

Increasing the density of animal populations in the park is our main focus right now. We are hoping to bring in more bison and musk ox soon; next, we would like to introduce predators. It will prove very challenging. The park is very remote, and we have no government support and only limited financial resources.

Pleistocene Park is a starting point. If you want to create an ecosystem big enough to have an impact on the climate, you need people to understand that they have a role to play.



The Khumbu Glacier in Nepal. Millions in the Himalayan region rely on ice and snow melted from glaciers for their water supply. Subel Bhandari/Agence France-Presse — Getty Images

LADAKH'S NEW ICE CONES

In the mountainous desert region of Ladakh (http://www.nytimes.com/2011/01/23/travel/23ladakh-journeys.html), water from the glaciers is needed to feed the barley fields and fruit trees that sustain communities. But villages in the Indian Himalayas are seeing glaciers gradually disappear due to global warming, intensifying seasonal water shortages. Ice Stupa, a project that an engineer, Sonam Wangchuk, created and has been leading since 2014, offers a solution using artificial glaciers that store water as ice until springtime.

Suryanarayanan Balasubramanian, project manager and researcher for Ice Stupa, talked about how the project was inspired by a centuries-old practice of growing glaciers:

The people of Ladakh have long stored their water in the form of ice high in the mountains. With this method, ice formed horizontally and required shade from the sun that the mountain valleys provided. We set out to improve this design so

that the artificial glaciers would last into the summer months and be built at lower altitudes, where the farmers could better access the stored water.

Our aim was to build a structure that would not melt in the sun, and give people a model for building their own artificial glaciers. Creating an artificial glacier that would last until May seemed like a crazy idea.

Sonam began by designing an artificial glacier based around vertical ice formation. We then experimented, creating a pipe system that sends the glacial lake water down to the structure site. At the site, the pipe points upward, and the water spurts out of it, into the freezing air. The ice builds upward, forming a conical ice structure.

We have ice stupa experiments in the Himalayas, and now also in the Alps and Andes Mountains. People see glacial lakes as a hazard; we see them as opportunities. Artificial glaciers are not a permanent solution, but an adaptation strategy for climate change. Ice stupas can make life a bit easier.

A diver surveys coral at Heron Island on Australia's Great Barrier Reef after a mass bleaching event in 2016. XL Catlin Seaview Survey/Agence France-Presse — Getty Images

HELPING THE GREAT BARRIER REEF TO SAVE ITSELF

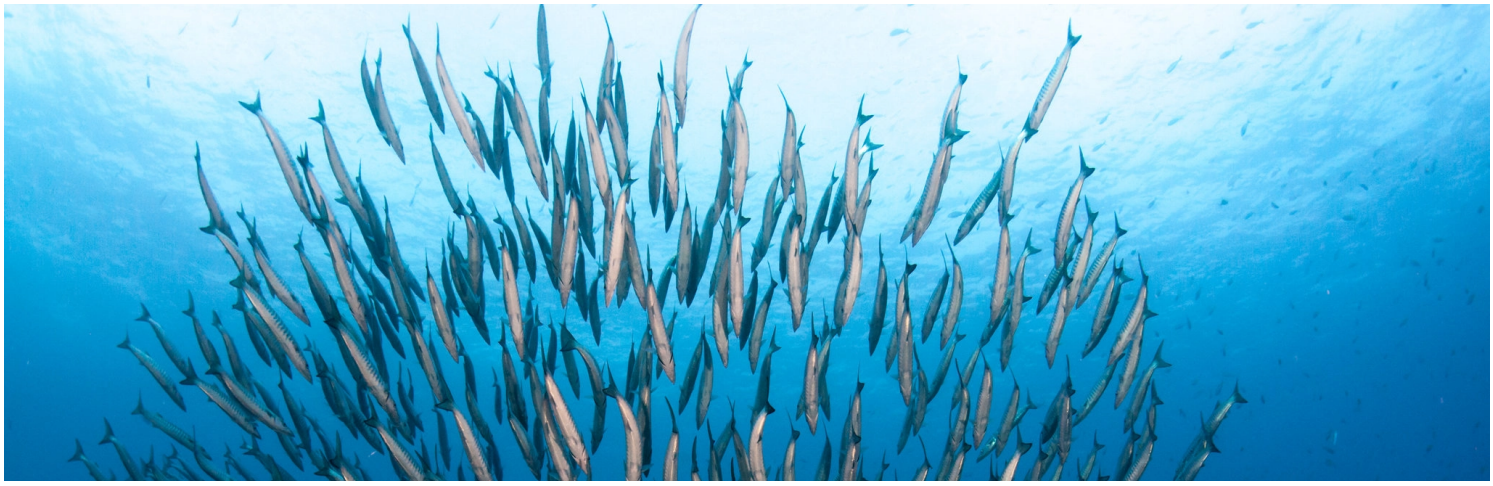
In March, scientists announced that large parts of the Great Barrier Reef had been killed by rising seawater temperatures (https://www.nytimes.com/2017/03/15/science/great-barrier-reef-coral-climate-change-dieoff.html). The news came on the heels of the Australian government's finding that the reef experienced mass bleaching in both 2016 and 2017 — the first time the devastating ecological event was recorded in consecutive years. Researchers at the Australian Institute of Marine Science are now racing to test natural solutions to help the world's largest reef system repair and protect itself.

Ken Anthony, a scientist at the institute, discussed the new interventions that he is most hopeful about:

There is no doubt in my mind that climate change has driven the devastation we've seen in recent years on the Great Barrier Reef. At the Australian Institute of Marine Science, we're working on ways to help the reef's ecosystem to become more resilient to global warming. I'm particularly excited about assisted gene flow, which would move corals that have adapted to Australia's warmer northern climate to cooler southern waters, helping the reefs there to be at a lower risk of bleaching.

Another intervention we're testing is assisted evolution, where we speed up the evolutionary process by interbreeding the most resilient corals that have survived past bleaching events. This involves artificial selection, which has been done for centuries in agriculture, and poses fewer risks than genetic modification.

Coral reefs are the rain forests of the sea, a huge concentration of diversity. We have a responsibility to do the best we can to save them.



Chevron Barracuda in the Indian Ocean. Researchers predict that climate warming and the use of fertilizers will cause lower levels of oxygen in the ocean, which will stress, kill and displace ocean species. Caine Delacy for The New York Times

THE OCEAN DEPTHS GROW DARKER

As ocean temperatures rise, water is able to hold less oxygen, causing "respiratory stress" for marine life miles below the surface. This year, a team at the Georgia Institute of Technology released the results of an analysis of global data on oxygen levels in oceans around the world between 1958 and 2015, where they discovered a sustained decline, exacerbated, they said, by global warming. Oxygen levels are falling (https://www.nytimes.com/2017/07/29/opinion/sunday/when-life-on-earth-was-nearly-extinguished.html) two to three times faster than predicted, and the marine ecosystem is at risk, the team concluded.

Takamitsu Ito, an associate professor at Georgia Tech, spoke for the team:

The ocean is where biology, chemistry and physics meet. Oceans absorb the oxygen essential for marine life from the atmosphere; water currents then transport it deeper into the ocean. As global temperatures rise, the ocean warms, and warmer waters hold less oxygen. Warmer surface waters are also less dense, hindering the downward circulation of oxygen.

There have been naturally occurring hypoxic events along the Oregon coast, for example; this area is very susceptible to deoxygenation. It displaces species, kills them if they can't move away. The situation can be exacerbated by the use of chemical fertilizers on land, which eventually end up in the water, causing oxygen loss.

According to our model, we will witness widespread deoxygenation by 2030 or 2040.The conditions in the ocean will be harsh, making it difficult for fish, shellfish, sea snails and so on to function. This is already evident in the Southern Indian Ocean and in some parts of the East and Tropical Pacific Ocean, but we expect it particularly in the North Pacific.

Unfortunately, there is no simple solution for global warming or nutrient pollution. Reduce your carbon footprint and eat organic if you can.

Gyrocopters fly over an artificial archipelago constructed along the Dubai coastline in the United Arab Emirates. Concerned about falling groundwater reserves, the U.A.E. has invested in weather modification research. Karim Sahib/Agence France-Presse — Getty Images

THE UNITED ARAB EMIRATES EMBRACES RAINMAKING

As water security becomes a national priority amid climate change, the United Arab Emirates has turned to rain enhancement solutions in hopes of replenishing depleting groundwater reserves. In 2016, the government-initiated U.A.E. Research Program for Rain Enhancement Science began awarding grants to

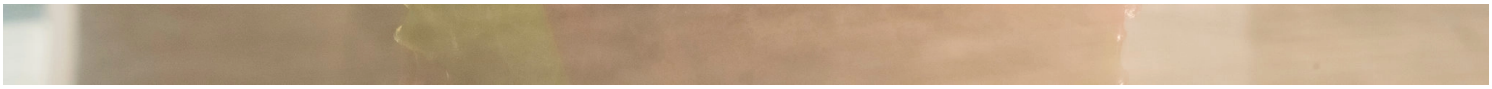
scientists whose work explores weather modification in the area. Prof. Linda Zou was among the first winners, for her interest in cloud seeding, the dispersing of artificial nuclei into clouds to coax precipitation.

Zou, a professor of civil and environmental engineering at the Masdar Institute, part of Khalifa University of Science and Technology, discussed how her experiments mimic and enhance what naturally occurs in rain clouds:

Clouds need naturally-occurring nuclei such as dust or pollen to condense the water vapor into droplets, which eventually grow large enough to fall as rain. In a country with a dry climate like the United Arab Emirates, cloud-seeding materials, which act like nuclei, can help.

I create cloud-seeding materials by coating salt crystals — a conventional cloud-seeding material — with a nanometer-thick titanium dioxide shell. The shell makes the surface of the crystals hydrophilic, allowing the cloud seed to better absorb water vapor, and condense to form rain.

Climate change is like a train you can't stop, but we have to do what we can to live well. In the U.A.E., cloud seeding is just one measure, but it can grow into a solution. Meanwhile, even a single drop of rain is welcome.



A Beyond Meat burger, a vegan meat substitute that oozes fats and bleeds beet juice as it's cooked.
Ángel Franco/The New York Times

THE NEW AGE OF MEAT: NO ANIMAL REQUIRED

The warming influence of greenhouse gases surged 40 percent between 1990 and 2016, according to the National Oceanic and Atmospheric Administration. Scientists have long warned that livestock, particularly cows, are a major source of these emissions — and around the world, people are eating more and more meat. To help reduce our growing environmental footprint, some entrepreneurs are experimenting with new plant-based alternatives that look and taste like meat.

Ethan Brown (https://www.nytimes.com/2016/05/23/business/plant-based-the-beyond-burger-aims-to-stand-sturdy-among-meat.html), founder and chief executive of Beyond Meat, discussed his California-based company's efforts to replicate meat in the lab:

I started this business with the goal of perfectly creating a piece of meat, in both taste and appearance, using only plants. This is possible because all of the elements of meat — amino acids, lipids, minerals and water — can be sourced outside an animal. We know the makeup of meat, so we optimized a method that heats, cools and applies pressure to plant protein, creating the fibrous texture of muscle.

To match the flavor and smell of meat, we've isolated molecules that contribute to these attributes. We then try to identify the same ones in plants. Every year, we make progress toward an exact match. The Beyond Burger, which we released in 2016, is the closest we've come so far. It looks, sizzles and even "bleeds" like ground beef.

What you put at the center of your plate has the power to mitigate climate change. I want to give people more choices, to make that decision easier.

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Roger Cohen
Opinion: A Fractured 2017

As the world lurches into a new year, peace feels fragile, the truth is blurred and spectacle has taken over.

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Madeleine Albright
Opinion: Madeleine Albright: How to Protect the World From North Korea

Maneuvering with North Korea is precarious and complicated, but a thoughtful strategy is imperative for the nuclear safety of the planet.
(https://www.nytimes.com/2017/12/04/opinion/madeleine-albright-north-korea.html?action=click&module=Associated&pgtype=Article&region=Footer&contentCollection=Turning Points 2018)

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More in Opinion (https://www.nytimes.com/section/opinion?action=click&module=MoreInSection&pgtype=Article&region=Footer&contentCollection=Opinion)

Pool photo by Kevin Dietsch

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