

# RESEARCH HIGHLIGHTS



Smithsonian  
Institution

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## OUR SHARED FUTURE: RESEARCH HIGHLIGHTS

The following stories highlight Smithsonian research that has helped to shape and champion our strategic pan-Institutional initiatives including **Life on a Sustainable Planet** and **Solving the Mysteries of the Universe**. These highlights also show the collaborative nature of the Institution's research, not only across Smithsonian units but in connection with leading research, art, and cultural organizations as well as government partners.

## FACING CLIMATE CHANGE THROUGH ART



The Yale Program on Climate Change Communication shows that most American adults think global warming is happening (72%), but far fewer believe that global warming will harm them personally (43%) and fewer yet (35%) engage in discussions about global warming even occasionally. Perhaps art can help?

Presented by the Asia Society and the Helen Frankenthaler Foundation, with support from

the **Hirshhorn Museum and Sculpture Garden**, the Frankenthaler Climate Art Awards aim to foster climate change awareness through the imagination and insights of an upcoming generation of visual artists.

The Frankenthaler Climate Change Awards is searching for eligible applicants and collectives to submit video artworks (e.g. digital video art, animation, film) or videos about visual artworks (e.g. documentation of 2D or 3D artworks, such as sculptures, photos, paintings, installation, or performance works) that tackle the climate change emergency.

A shortlist of finalists will be announced in February 2022 and their videos displayed online. Three winners will be selected by a jury of leaders from collaborating institutions across the District of Columbia and New York, including: Melissa Chiu, Director of the Hirshhorn Museum and Sculpture Garden; Molly Donovan, Curator of Contemporary Art at the National Gallery of Art; Dorothy Kosinski, Vrandenburg Director and CEO of The Phillips Collection; and Michelle Yun Mapplethorpe, Vice President for Global Artistic Programs at Asia Society and Director of the Asia Society Museum.

Each winner will receive \$15,000 and will be honored in April 2022 at the John F. Kennedy Center for the Performing Arts on the occasion of the Asia Society's [COAL + ICE](#) exhibition (March 15-April 22).

## LIVING ON A PRIVATE ISLAND ... OF TRASH



*Anika Albrecht of Ocean Voyages Institute, on a 2020 expedition collecting plastic in the North Pacific Subtropical Gyre, where she served as Chief Mate. (Photo courtesy of Ocean Voyages Institute 2020 Gyre Expedition)*

Coastal plants and animals have found a new way to survive in the open ocean—by colonizing plastic pollution. A new commentary published Dec. 2 in *Nature Communications* reports coastal species growing on trash hundreds of miles out to sea in the North Pacific Subtropical Gyre, more commonly known as the “Great Pacific Garbage Patch.”

“The issues of plastic go beyond just ingestion and entanglement,” said Linsey Haram, lead author of the article and former postdoctoral fellow at the **Smithsonian Environmental Research Center** (“SERC”).

“It’s creating opportunities for coastal species’ biogeography to greatly expand beyond what we previously thought was possible.”

Gyres of ocean plastic form when surface currents drive plastic pollution from the coasts into regions where rotating currents trap the floating objects, which accumulate over time. The world has at least five plastic-infested gyres, or “garbage patches.” The North Pacific Subtropical Gyre, between

California and Hawai’i, holds the most floating plastic, with an estimated 79,000 metric tons of plastic floating in a region over 610,000 square miles.

The authors call these communities *neopelagic*. “Neo” means new, and “pelagic” refers to the open ocean, as opposed to the coast. Scientists first began suspecting coastal species could use plastic to survive in the open ocean for long periods after the 2011 Japanese tsunami, when they discovered that nearly 300 species had rafted all the way across the Pacific on tsunami debris over the course of several years. But until now, confirmed sightings of coastal species on plastic directly in the open ocean were rare.

For this discovery, Haram teamed up with Ocean Voyages Institute, a nonprofit that collects plastic pollution on sailing expeditions. During the first year of the COVID-19 pandemic, the Ocean Voyages Institute team collected a record-breaking 103 tons of plastics and other debris from the North Pacific Subtropical Gyre. They shared some of those samples with **SERC’s Marine Invasions Lab**. There, Haram analyzed the species that had colonized them. She found many coastal species—including anemones, hydroids, and shrimp-like amphipods—not only surviving, but thriving, on marine plastic.

For marine scientists, the very existence of this “new open ocean” community is a paradigm shift. “The open ocean has not been habitable for coastal organisms until now,” said SERC senior scientist Greg Ruiz, who heads the Marine Invasions Lab. “Partly because of habitat limitation—there wasn’t plastic there in the past—and partly, we thought, because it was a food desert.”

The new discovery shows that both ideas do not always hold true. Plastic is providing the habitat. And somehow, coastal rafters are finding food. Ruiz said scientists are still speculating exactly how—whether they drift into existing hot spots of productivity in the gyre, or because the plastic itself acts like a reef attracting more food sources.

Now, scientists have another shift to wrestle with: How these coastal rafters could shake up the environment. The open ocean has plenty of its own native species, which also colonize floating debris. The arrival of new coastal neighbors could disrupt ocean ecosystems that have remained undisturbed for millennia.

## TONGA VOLCANO: EIGHT MINUTES SEND RIPPLES OF WORLDWIDE EFFECTS



*Maxar satellite imagery of homes and buildings in Tonga before the volcanic eruption and tsunami (left) and after, coated in ash (right). SATELLITE IMAGE (C) 2022 MAXAR TECHNOLOGIES*

On January 14, 2022, a very large eruption on Hunga Tonga–Hunga Ha’apai, an uninhabited volcanic island of the Tongan archipelago in the South Pacific Ocean, began. Hunga Tonga is 65 km (40 mi) north of Tongatapu, the country's main island. The volcanic eruption continued throughout the day with satellite imagery indicating a 5km wide plume of ash, steam, and gas rising into the air 20km above the volcano. The eruption was one of the biggest in Tonga in the past 30 years. During the initial eight minutes, it was so violent it could

be heard as "loud thunder sounds" in Fiji, more than 800km away. The eruption caused tsunamis in Tonga, Fiji, American Samoa, Vanuatu, and along the rim of the Pacific Ocean, including damaging tsunamis in New Zealand, Japan, the United States, the Russian Far East, Chile, and Peru.

Scientists are trying to better understand the global effects of the eruption. They already know the answer to one crucial question: Although it appeared to be the largest eruption in the world in three decades, the explosion of the Hunga volcano will very likely not have a temporary cooling effect on the global climate, as some past enormous eruptions have.

Scientists are racing to understand a puzzling series of massive ripples in Earth’s atmosphere triggered by the eruption of the Tongan volcano. Satellite data shows that the event provoked an unusual pattern of atmospheric gravity waves. Previous volcanic eruptions have not produced such a signal, leaving experts stumped. The discovery was made in images collected by the Atmospheric Infrared Sounder (“AIRS”), mounted on NASA’s Aqua satellite, in the hours after the eruption. They show dozens of concentric circles, each representing a fast-moving wave in the gases of the atmosphere, stretching for more than 16,000 km. The waves reached from the ocean surface to the ionosphere, and researchers think that they probably passed around the globe several times.

The **Global Volcanism Program** at the **National Museum of Natural History** took to Twitter (@SmithsonianGVP) to provide context, historical information, and educational opportunities about impacts from previous volcanic activity. The Global Volcanism Program (“GVP”) is the hub of an international network for monitoring, reporting, and maintaining data related to volcanic activity around the world. GVP plays a leadership role in global volcano information—tracking events as they happen, building the database of critical information, and using these resources both for our own forefront research projects and for answering questions about volcanology from other scientists, the media, and the public. The large and growing database contains the geographic, historic, and volcanological characteristics of nearly 3,000 active volcanoes from around the world. Monthly reports concerning on-going eruptive activity are published in the Global Volcanism Network Bulletin. GVP works in close collaboration with non-SI scientists and organizations concerned with volcano hazards, airline safety, geothermal energy, and global climate change (USGS, DOE, NASA, NOAA, and FAA).

## ANTS HEAL WOUNDED TREES



*During the pandemic, five curious high school students accidentally discovered how Azteca alfari ants respond to damage to their Cecropia host trees. Credit: Donna Conlon.*

These are “ant-plant” trees, which famously cooperate with fierce *Azteca* ants; the trees provide shelter and food to the ants, and in exchange the ants defend their leaves against herbivores. The next morning, to his surprise, the *Azteca alfari* ants living within the *Cecropia* trunk had patched up the wound.

This unexpected occurrence drove five curious high school students, with time on their hands, to participate in the **Smithsonian Tropical Research Institute’s** (“STRI”) volunteer program, and they enlisted STRI scientist William T. Wcislo’s help in devising their experiment.

Despite significant movement restrictions during the first wave of the pandemic, they roamed their neighborhood drilling holes into *Cecropia* trees and documenting the ants’ responses to the damage.

They found that as soon as the plants had holes drilled into them, the ants ran to the wound area and began patching it up. Within 2.5 hours, the size of the hole had been significantly reduced and it was often completely repaired within 24 hours.

Details of this newly discovered behavior were published in the *Journal of Hymenoptera Research*. *Azteca alfari* ants and *Cecropia* trees are known to have a symbiotic relationship, with the ants using the trees as their homes.

Their experiment also left them with new questions, since not all of the ant colonies repaired the damage to their host plants. Understanding what factors influence the ants to take action could be the subject of future research for these budding scientists, although perhaps to be addressed after graduating from high school.

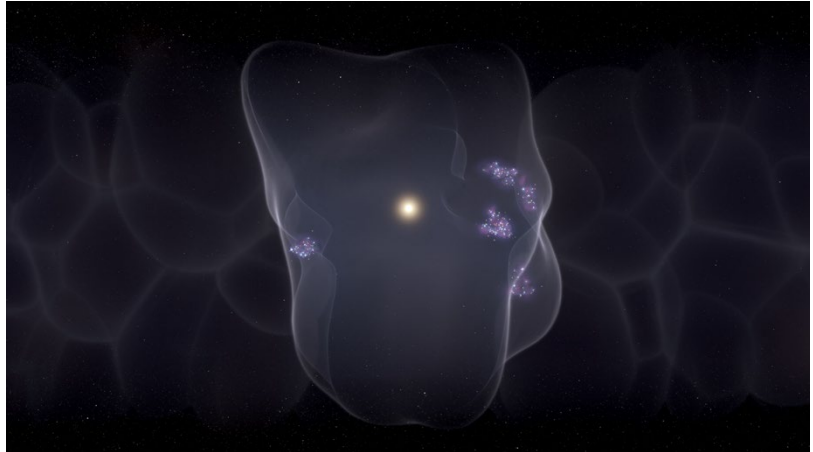
Cue Carole King: *When you're down and troubled, and you need some lovin' care ...*

It seems trees have a friend in ants. Ants have been seen healing wounded trees in Panama—behavior that is believed to have never been observed before.

One afternoon, during the early days of the COVID-19 pandemic in Panama, a bored teenager with a slingshot and a clay ball accidentally shot entry and exit holes in a *Cecropia* tree trunk.

## STARS BORN IN A BUBBLE

Are stars born in a bubble? This isn't a celebrity gossip story, but rather a compelling new origins discovery. Astronomers from the **Center for Astrophysics | Harvard & Smithsonian** ("CfA") and the Space Telescope Science Institute ("STScI") reconstructed the evolutionary history of Earth's galactic neighborhood, showing how a chain of events beginning 14 million years ago led to the creation of a vast bubble that is responsible for the formation of all the young stars nearby. Their research was published January 12 in *Nature*.



*Artist's illustration of the Local Bubble with star formation occurring on the bubble's surface. Credit: Leah Hustak (STScI)*

Using a trove of new data and data science techniques including [3D spacetime animation](#), the scientists showed how a series of supernovae that first went off 14 million years ago pushed interstellar gas outwards, creating a bubble-like structure with a surface that's ripe for star formation. The oddly shaped bubble is not dormant and continues to slowly grow.

"This is an incredible detective story, driven by both data and theory," said Harvard professor and Center for Astrophysics astronomer Alyssa Goodman, a study co-author and founder of glue, data visualization software that enabled the discovery. "We can piece together the history of star formation around us using a wide variety of independent clues: supernova models, stellar motions, and exquisite new 3D maps of the material surrounding the Local Bubble."

Next, the team, including co-author and Harvard doctoral student Michael Foley, plans to map out more interstellar bubbles to get a full 3D view of their locations, shapes, and sizes. Charting out bubbles, and their relationship to each other, will ultimately allow astronomers to understand the role played by dying stars in giving birth to new ones, and in the structure and evolution of galaxies like the Milky Way.

The articles, analyzed data (on the Harvard Dataverse) and interactive figures and videos are all freely available to everyone through a [dedicated website](#).