Smithsonian Institution

Our Shared Future: Research Highlights

June 2024

The following stories highlight Smithsonian research that has helped to shape and champion our strategic pan-Institutional initiatives, notably Life on a Sustainable Planet, from research focused in the ocean to across the Universe. These highlights also show the collaborative nature of the Institution's research and educational outreach across Smithsonian units and in connection with leading universities and national and international research organizations aimed at mitigating climate change and other human impacts on nature.

SMITHSONIAN AT THE OUR OCEAN CONFERENCE IN GREECE

Pictured: Ana Spalding, Director of The Adrienne Arsht Community Based Resilience Solutions Initiative, speaking at the Our Ocean Conference in Athens.

The 9th annual Our Ocean Conference was held in Athens, Greece, in April. Smithsonian staff attended this conference among other members of the U.S. Delegation from April 15 to 17, reflecting the Institution's ongoing commitment to "Our Shared Future" and science-driven global decision-making.

Committed to fostering harmony between humanity and the natural world, Smithsonian scientists collaborate globally to enrich our shared understanding of people and nature and support nature-based solutions to improve Earth's sustainability. The Smithsonian focused on expanding the scientific collaboration needed to effectively support marine biodiversity conservation and ocean ecosystems across the U.S. and abroad. The Institution does this work under our ***Life on a Sustainable Planet*** | Ecosystems on the Edge program.

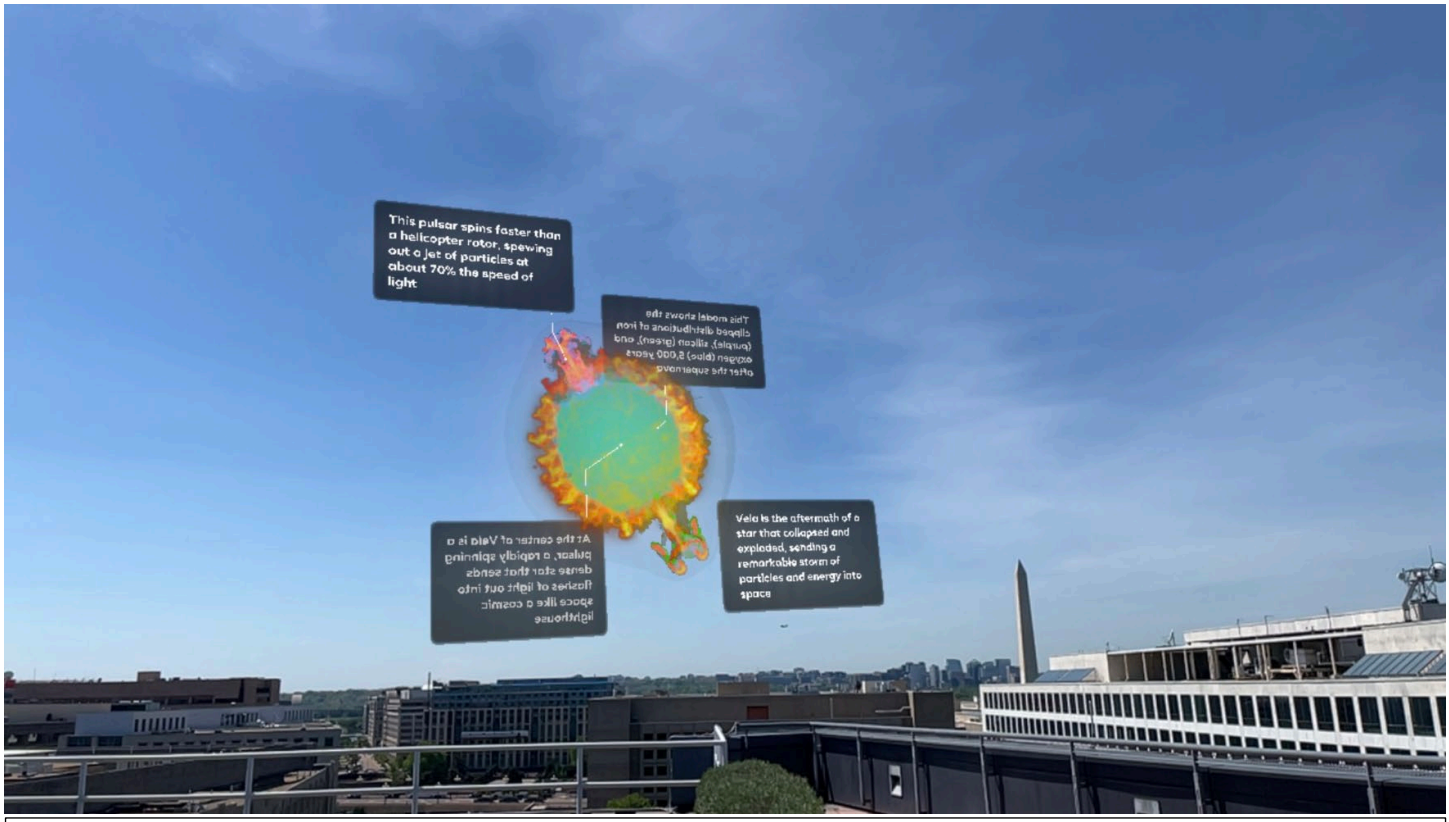
Life on a Sustainable Planet's Ocean-focused "Ecosystems on the Edge" areas of research:

- **Blue Carbon and Ecosystem Services:** By deepening our understanding of marshes, mangroves, and seagrasses, we aim to develop standards for ecosystem service valuation, aiding in conserving these vital habitats.
- **Renewing Reef Resilience:** Exploring resilient coral and oyster species, we seek to inform reef management and support ecosystems reliant on them.
- **Developing Next-Generation Genomics:** By mapping the vast, uncharted biodiversity of the ocean, we aim to reverse the decline of ocean biodiversity through cutting-edge genomics and analytics.
- **Marine Resilience in a Changing World:** Collaborating with coastal communities, we are developing science-based solutions for conservation and sustainable use, ensuring ecological and community resilience.

- **Preserving Life and Livelihoods in Urbanized Estuaries:** We are setting standards for managing the delicate balance between urban development and estuarine conservation, which is crucial for the well-being of city-dwelling communities and biodiversity.
- **Building and Communicating Marine Biodiversity Knowledge:** Our extensive collections and research uniquely position us to share crucial ocean biodiversity insights and reliable open-access data with the public and academic communities.
- **Supporting STEAM Education for Sustainable Development:** With programs like the Smithsonian Science for Global Goals Project, including the Ocean! free community research guide and curriculum, we help young people develop a habit of taking local action on global issues.

The Smithsonian was represented by a powerful delegation featuring Ana Spalding, Director of the **Adrienne Arsht Community-Based Resilience Solutions Initiative,** and Lisa Barnett, Director of Development at the **Smithsonian Tropical Research Institute.** Staff participated in two key OOC events**:** "Achieving 30x30 Through Marine Conservation and Protection" and "Ten Years of The Our Ocean Conference: Commitments Lead To Real Ocean Protection."

3D-Rendered Chandra X-ray Observatory Data Kicks Off The Smithsonian's "Cosmic Journey"



Pictured: The Vela Pulsar appears over the Washington D.C. skyline with the help of augmented reality.

The Smithsonian has created interactive Instagram experiences using 3D models of celestial objects generated from data collected by the Chandra X-ray Observatory and other telescopes. Through augmented reality, users can view and immerse themselves in nebulae, exploded stars, and more through their phone cameras while listening to the data transformed into sound—or data sonification. The images are accompanied by informative text that explains what users see. The effects are free and available on Instagram and a dedicated Smithsonian website.

The Chandra X-ray Observatory is the most powerful X-ray telescope in the world. It observes the lifecycles of stars and galaxies, detecting nebulae, supernovae, black holes, and other objects in space.

In addition to Instagram, some of these new 3D renderings of celestial objects have joined the Smithsonian's collection of 3D digital objects, making the observatory's data permanently accessible to everyone in their homes and classrooms. Further, the data sonification extends an accessibility project that the Chandra team has led since 2020.

The new Chandra Instagram filter collection objects include the Tycho Supernova Remnant, the Vela Pulsar, the Helix Nebula, the Cat's Eye Nebula, and the Chandra spacecraft. The 3D models of the first three objects were done in conjunction with Sal Orlando, an astrophysicist at Italy's National Institute for Astrophysics in Palermo. The Cat's Eye Nebula was created with data from Ryan Clairmont, physics researcher and undergraduate at Stanford University. Arcand worked with Brown University's Tom Sgouros and his team, research assistant Alexander Dupuis and undergraduate Healey Koch, on the Chandra Instagram filters.

These new effects were released to celebrate the 25th anniversary of Chandra, NASA's flagship X-ray telescope operated by the **Smithsonian Astrophysical Observatory** since the telescope launched aboard Space Shuttle Columbia in 1999. They also kick off the Smithsonian's Cosmic Journey, an experience of artistic, cultural, and scientific events, collaborations, and content designed to spark curiosity and inspire learning among diverse communities who share a fascination with space. This national campaign uniquely blends science with education, visual art, music, history, and culture, opening multiple entry points for people to find their connection with the cosmos.

SMITHSONIAN'S DINOSAUR SKELETON BECOMES THE SCIENTIFIC STANDARD FOR PREHISTORIC PREDATOR

The **Smithsonian's National Museum of Natural History**'s fossilized skeleton of the Jurassic dinosaur Allosaurus has officially been named the type specimen for the entire species. This distinction makes the specimen, which is displayed in the museum's "David H. Koch Hall of Fossils— Deep Time," the single physical example researchers will refer to when they describe new fossils of Allosaurus fragilis, one of the most iconic species of dinosaurs in the world.

The museum's fossil specimen of Allosaurus fragilis is perched like a nesting bird guarding a clutch of fossilized eggs. Credit: USNM V 4734, Department of Paleobiology, Smithsonian Institution. Photo by Mike Gaudaur.

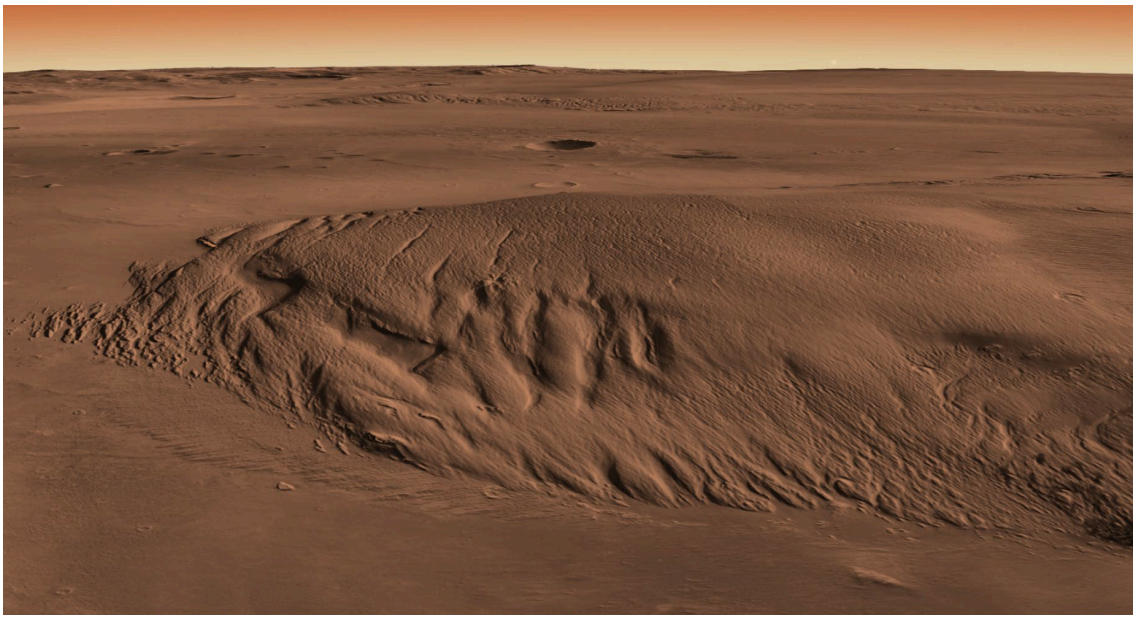
Members of the International Commission on Zoological Nomenclature (ICZN) bestowed the specimen's new status. According to paleontologist Matthew Carrano, the museum's curator of dinosauria, the change was more than a decade in the making and represented a coveted scientific honor.

"In 2010, a petition was made to the ICZN to solve the problem that the very famous and scientifically important dinosaur A. fragilis was based on materials that couldn't really be identified as anything more than a non-descript predatory dinosaur," Carrano said. "This decision really emphasizes how important our specimen is—both historically and in the present—for dinosaur science."

Stretching over 20 feet and sporting a mouthful of dagger-like teeth, Allosaurus terrorized other dinosaurs during the Late Jurassic Period some 150 million years ago. The prehistoric predator lived in western North America alongside well-known species, such as the armored Stegosaurus and other supersized sauropod dinosaurs like Diplodocus.

This summer, the museum is celebrating the fifth-year anniversary of the "David H. Koch Hall of Fossils—Deep Time." The world-class hall, which contains some 700 mounted fossil specimens, including the Allosaurus type, explores the epic story of how Earth's distant past is connected to the present and informs the future. As the anniversary approaches, the museum is also putting a remarkable, rainbow-hued ammonite fossil on display in the museum's "Objects of Wonder" exhibition. The shimmering shell dates back 70 million years to the Late Cretaceous Period and is considered an organic gemstone thanks to its iridescent colors.

New Study Reveals Evidence of an Ice-Rich Layered Deposit on Mars



Perspective view of Lucus Planum part of the Medusae Fossae Formation, a series of thick deposits found along the highland-lowland dichotomy boundary on Mars. The deposit shown here in this false color, Context Camera (CTX) mosaic, is several kilometers thick.

Findings from a recently published paper, led by **National Air and Space Museum** senior scientist emeritus Thomas R. Watters, reveal evidence that the vast Medusae Fossae Formation (MFF) deposits may contain a significant volume of water ice. The paper, "Evidence of Ice-Rich Layered Deposits in the Medusae Fossae Formation of Mars," published in the journal Geophysical Research Letters on January 18, presents new radar sounder data that show the similarity between the MFF deposits and the ice-rich polar layered deposits at the north and south poles of Mars. Modeling of the compaction behavior of proposed ice-free geologic materials shows that none of them can account for the inferred electrical properties of the MFF deposits without pore-filling ice.

"Finding evidence of layering in all the major units of the MFF makes a compelling case that the deposits are similar to the ice-rich polar layered deposits," Watters said. "An ice-rich MFF deposit has important implications for the paleoclimate of Mars and could be potentially of great value to future human exploration of Mars. The MFF deposits are located at the Martian equator along the boundary between the northern lowlands and the heavily cratered highlands—an ideal landing spot for spacecraft as the lower elevation provides more atmosphere to slow a spacecraft's decent."

The MFF deposits remain one of Mars's most enigmatic and least understood geologic units. Data from the Mars Advanced Radar for Subsurface and Ionospheric Sounding (MARSIS) instrument onboard the European Space Agency's Mars Express spacecraft revealed that the MFF deposits' electrical properties were very similar to ice-rich polar layered deposits. New MARSIS data shows that similarities go beyond the electrical properties. Detection of interior subsurface reflectors indicates pervasive layering like that found in the North Polar Layered Deposits (NPLD) and the South Polar Layered Deposits (SPLD), known to be ice-rich.

Ice-rich MFF deposits, less a dry, insulating cover material, possibly volcanic ash, represent a large reservoir of water in the equatorial zone of Mars. The estimated volume of water is up to 50% of that of the NPLD, much more than the total volume of water in the Great Lakes of North America. The volume of water is enough to cover the surface of Mars to a depth of about 1.5 to 3 meters (about 5 to 10 feet). The ice-rich MFF deposits were likely left at the Martian equator during periods of high obliquity when the present-day equator would have been much colder and the polar regions much warmer.

Watters is a senior scientist emeritus in **the Center for Earth and Planetary Studies** at the Smithsonian's **National Air and Space Museum** and a member of the MARSIS science team.

Decades of Research by Smithsonian Scientists Help Shape Deeper Understanding of Corals

In 1980, the **National Museum of Natural History** made history by exhibiting an active research project from under the sea. In a world first, they put a living coral reef on display.

The project started more than a decade earlier when National Museum of Natural History paleobiologist Walter H. Adey began studying algae growth. Instead of growing algae by itself in a laboratory, he thought it would make more sense to see how it grew among other reef organisms and environmental conditions that mimicked real life. So, he took a 350-gallon tank and shined high-intensity light on it to simulate the sun, and he used a generator to create a current in the water.

By 1979, Adey scaled up his experiment to a 3,000-gallon system that went on public display the following year in a space now occupied by the Kenneth E. Behring Family Hall of Mammals. The exhibition featured over 200 species of coral, algae, fish, mollusks, and other marine life. And like the FossiLab today, the space featured a marine lab where visitors could watch scientists at work. The exhibition was displayed for 20 years until it was moved to the **Smithsonian Marine Station** in Fort Pierce, Florida. Meanwhile, the National Museum of Natural History's Sant Ocean Hall features a smaller, 1,500-gallon Indo-Pacific coral reef tank.

New Coral Species Discovered

Smithsonian's marine research continues. In collaboration with global partners, researchers at the **Smithsonian Tropical Research Institute** have sent remotely operated vehicles beneath the waves. These vehicles photograph the sea floor and take samples, helping researchers discover there is as much life underwater as there is above it. In 2019, Héctor M. Guzmán and his colleagues discovered a new coral species over 200 feet below the ocean surface. Called *Psammogorgia pax* ("pax" meaning "peace" in Latin), the fan-shaped coral is just one of many species of corals that live in the area; its discovery will help researchers complete the picture of marine biodiversity at Hannibal Bank and inform leaders on how best to preserve these species.

Exploring Corals of the Deep Sea

Many of Panama's corals are like the ones you picture in your head: colorful and sundrenched. However, not all corals are colorful (P. pax is white), and not all are found near the ocean surface. Some reside in the deep sea, where sunlight is scarce. Further, some of these corals are black, which makes them hard to spot.

That challenge led Andrea Quattrini, a researcher at the National Museum of Natural History, on an expedition in collaboration with the National Oceanic and Atmospheric Administration to the deep, largely unexplored waters off Puerto Rico. She and her team deployed a remotely operated vehicle that could reach depths of 4,000 feet below the surface. Over seven dives, the team mapped an area of the sea floor the size of Chicago and collected a suite of biological samples, plus hours of footage.

Among the footage, they spotted a patch of dark, gangly coral that they had never seen before. It was likely that no human eyes had ever seen it. Since the team discovered the coral species, they got to name it and chose *A. puertoricoensis*, after the nearby island.

New Methods for Protecting and Conserving Coral

Researchers at the National Museum of Natural History are progressing in staving off a pandemic among Florida's coral reefs. A mysterious ailment that has devastated the state's coral reefs since 2014 and rapidly spread through the Caribbean.

In 2023, Valerie Paul and her colleagues at the Smithsonian Marine Station discovered the first effective bacterial probiotic for treating this disease, called stony coral tissue loss disease. In several tests, the team found a bacterial species that successfully stopped or slowed the progression of the disease in most cases and prevented the sickness from spreading to nearby healthy corals. Next, they will work on a system to deliver this treatment more widely.

In the meantime, the Smithsonian's United Nations-endorsed Coral Reef Sentinels program might allow conservationists to obtain near real-time data on coral reef health. Thanks to autonomous aquatic robots, we can keep a closer eye on the little critters.