

 AMERICAN MUSEUM OF NATURAL HISTORY

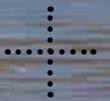
ROTUNDA

Member Magazine
Summer 2017 Vol. 42 No. 3



THE GREAT FLAMINGO COUNT

*Summer
Stargazing*



*Superpower
Senses*

From the President

Ellen V. Futter



In science, conclusions are drawn from evidence. At the Museum, that evidence is our collection of over 34 million specimens and artifacts, one of the world's largest and most scientifically significant natural history collections extant.

This evidence is the springboard from which our body of knowledge about the world grows—its species, including humans, and habitats, and the forces that shape our planet and universe. Museum scientists of the past who collected and curated these collections almost certainly would never have dreamed of the questions that our researchers would be posing today—questions key to climate change, emerging disease, and the precarious balance of ecosystems. Nor could they have predicted the extraordinary ability that we now have, through technology, to unlock the secrets contained deep within those collections.

Our collections are also the training ground for tomorrow's scientists and science teachers—from high schoolers in our Science Research Mentoring Program to the Gilder Graduate School's Ph.D. and Master of Arts in Teaching candidates. And, of course, they are the foundation for our exhibitions, halls, and public programming. No surprise, then, that one goal of our new Gilder Center is to bring visitors closer than ever to the majesty and significance of our collections.

Today, our scientists continue to collect and curate traditional specimens like dinosaurs and meteorites, and newer collections as well—frozen-tissue, DNA, and vast databases of genomics and astrophysics data. These collections are inestimably important to our shared future because evidence is patient. Properly conserved, it will hold the answers until we are ready and able to discover them.

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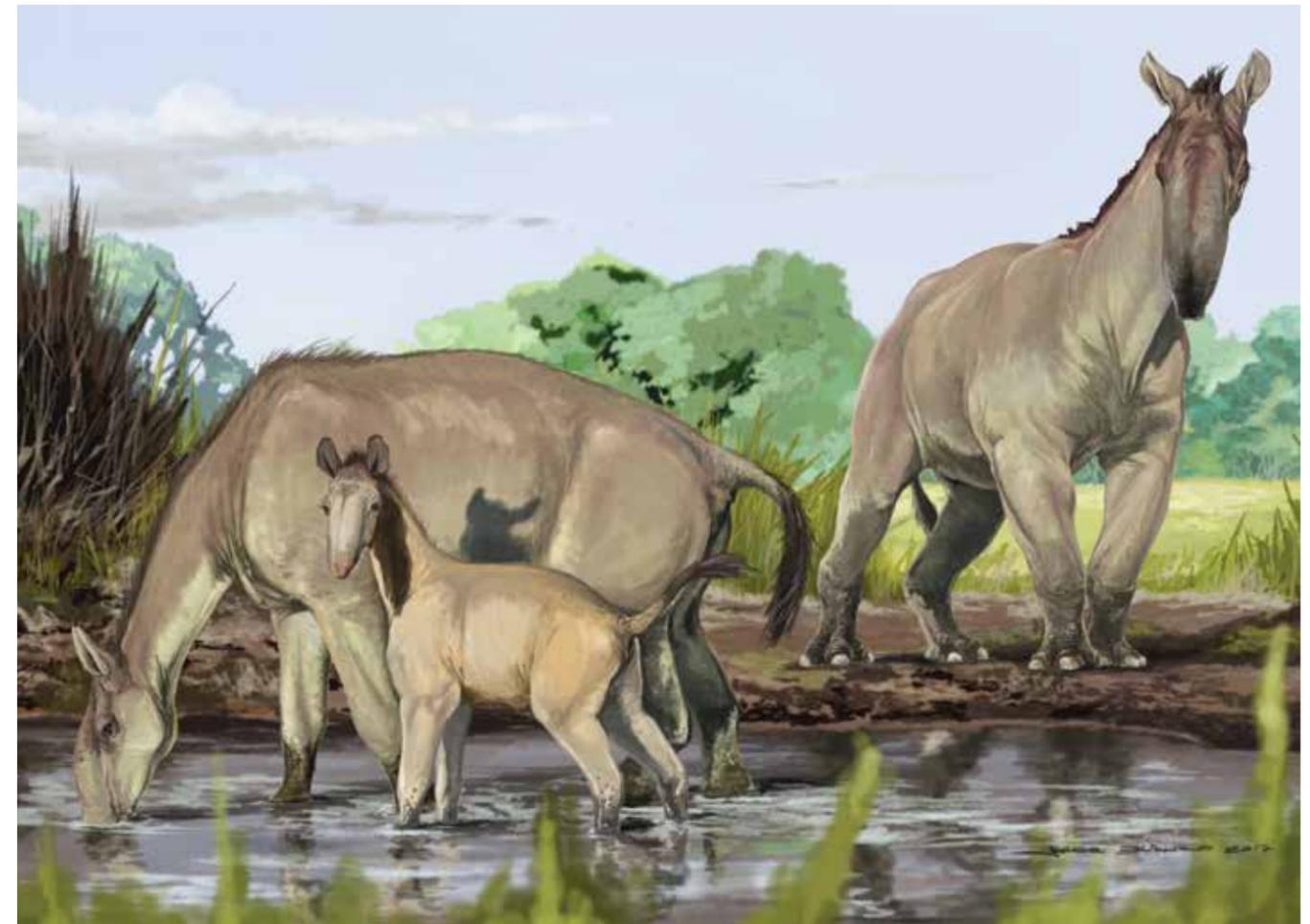
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Researchers Pin Down Ancient South American Mammal



After baffling naturalists for years, these ancient South American ungulates take their place on the tree of life thanks to Museum researchers.

Research using ancient DNA has allowed a team of scientists led by Museum Curator Ross MacPhee to firmly establish the relationships of one of the strangest mammals in the known South American fossil record. Their study of this unusual species, *Macrauchenia patachonica*, was published last month in the journal *Nature Communications*.

"*Macrauchenia* was the last of its kind, part of a hugely successful group of ungulates that had ranged over much of South America for tens of millions of years. One of its early relatives even made it to what is now part of Antarctica," says MacPhee.

Charles Darwin found the first fossils of *Macrauchenia* in southern Argentina in 1834, while on the five-year voyage of the *H.M.S. Beagle*. Sensing its importance, he gave the material to the renowned British paleontologist Richard Owen for study and description. But Owen found the animal's unusual mix of physical features so puzzling he could not identify it.

Weighing as much as 1,100 pounds, *Macrauchenia patachonica* was long-necked, with a body shape vaguely reminiscent of a camel's. Its most distinguishing trait was its weirdly placed nasal opening, situated high on the skull, between the eye sockets. To some scientists, this feature

suggested an elephant-like trunk.

Since morphology hadn't solved the riddle of *Macrauchenia's* relationships, the team came up with the solution of using ancient mitochondrial DNA, extracted from an 11,000-year-old *Macrauchenia* fossil found in a cave in southern Chile.

Because of its damaged condition, ancient DNA generally requires researchers to use the genomes of a species' close evolutionary relatives to fill in gaps. In this case, though, there was a big problem with this tried-and-true method, as *Macrauchenia* doesn't have any close living relatives.

Instead, the team developed a new technique that utilizes the genetic codes of numerous living species as reference points, allowing them to reliably predict the fossil's likeliest genetic sequences.

The new technique permitted recovery of almost 80 percent of the predicted mitochondrial genome of *Macrauchenia*. That proved to be enough information to place it in its proper phylogenetic position as a member of the larger grouping now called Panperissodactyla, which includes living species like horses, rhinos, and tapirs.

© J. Blanco

FAR AND WIDE

The Blue Dasher is not just a native New Yorker. This species inhabits much of the continental United States and ranges from Mexico, Cuba, and Belize to Ontario and British Columbia.

TINY TERRORS

Most dragonflies spend the bulk of their lives in the larval stage as water-bound nymphs, some for years. These larvae are accomplished predators too, using jet propulsion to pursue prey. To move, a larva draws water into its abdomen to aerate its gills, then squeezes it out quickly for a burst of speed.

HUNTING HABITS

Like most dragonflies, Blue Dashers catch their food on the fly, perching in trees and shrubs between forays. While most dragonflies seem disoriented at night, Blue Dashers have been seen munching on moths at lights.

ANCIENT HISTORY

Unlike their relatively diminutive counterparts today, fossil evidence shows that some ancient dragonfly species had wingspans more than 2 feet in length. One theory is that such super-sized insects resulted from an exceptionally oxygen-rich environment—50 percent higher than today—during the Paleozoic era.

Flying Phenoms

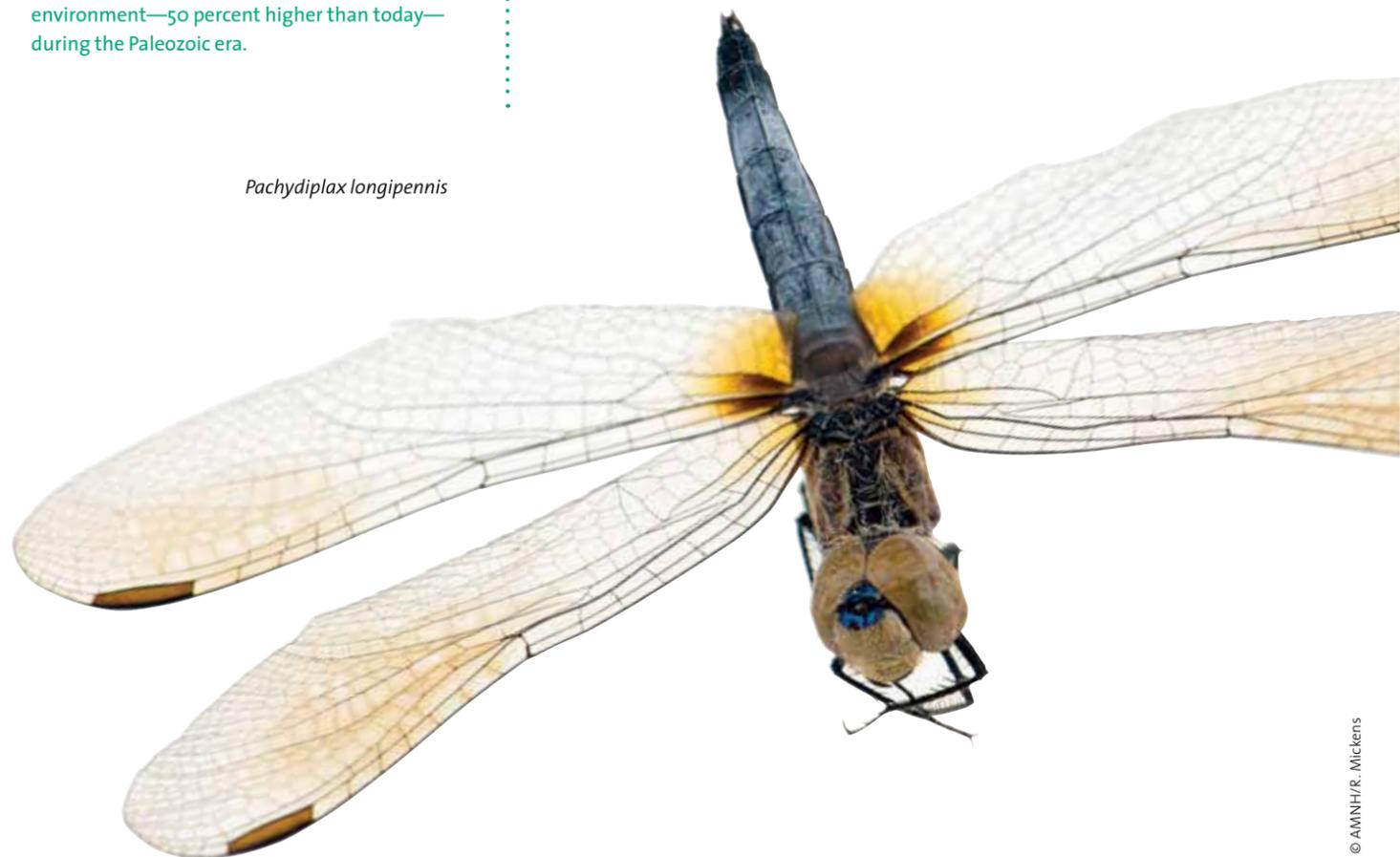
Is there a more evocative symbol of the lazy, hazy days of summer than the dragonfly? Take the male Blue Dasher pictured here. It was collected on Long Island, where residents and vacationers alike are no doubt hearing the soft whirr of dozens of dragonfly wings this very minute.

But don't let those whispering wings fool you: these insects are among the world's fastest predators, and some of the most fearsome to boot. Darting over the surfaces of ponds, lakes, marshes, and streams, they can reach speeds of up to 50 miles an hour. They're not just fast—dragonflies handle like a dream, too. Using separate sets of muscles for their four wings, these hunters can hover in one place for as long as a minute at a time. They can also fly backward, turn upside down, and pivot 360°—maneuvering in ways human helicopter pilots can only envy. Dragonflies' aerial skills are so well developed that mechanical engineers are looking to these animals for clues on how to design small drones.

Fast and furious, dragonflies also have exceptional eyesight. They boast what's thought to be the largest compound eyes of all insects—30,000 facets full of photoreceptors make it possible for them to see everywhere except directly behind them. They also have a highly developed fovea, an area of the eye with such high resolution that it acts as built-in binoculars. Researchers have determined that dragonflies have the capacity to pick out individual prey—mosquitos, moths, and other flying insects—within a crowd.

These attributes combine to give dragonflies a hunting success rate that puts most other predators to shame: they capture up to 95 percent of their prey!

See more dragonfly specimens in the Hall of Biodiversity.



Pachydiplax longipennis

© AMNH/R. Micklens



Pendant: catalog no. 41.2/7511

Paracas Pendant

The Paracas people, who lived in ancient Peru starting nearly 5,000 years ago, left no written record. Researchers can only infer details about them by analyzing the things they left behind. This golden figure, seemingly crowned with a head of spiky hair, was buried with a Paracas man in about 150 BCE, part of an elaborate mummy bundle that fixed his body in a seated position, wearing a feathered headdress and wrapped in more than 60 finely woven textiles.

How the dead were treated—and objects which accompanied them to the grave—offer archaeologists important clues about long-gone cultures, as the special exhibition *Mummies* explores. This curious figure from the Museum's collection, which is on permanent display in the Paracas case in the Hall of South American Peoples, is revealing. Shaped from a thin sheet of gold alloy, it shows the Paracas were skilled metalworkers. Its shape—human-like, with spikes, rays, or feathers appearing to burst out from its head—turns out to have been widely used by the Paracas, and to have persisted for hundreds of years beyond them. A very similar image appears on objects made by the Nasca, a later ancient Peruvian group who absorbed aspects of Paracas culture.

This particular figure appears to be holding two different objects: a staff and a weapon, the real versions of which have been found at several Paracas burial sites. "Slings, obsidian-tipped knives, and cane spears are found with male burials," says Ann Peters, an archaeologist at the University of Pennsylvania who has worked with the Museum's South American collections for decades. "The hand-held weapons and feathered headdress seem to indicate a male identity for the gold figure." Perhaps it also marked its wearer as a mighty warrior, for his afterlife and for all who might meet him there.

Find out more about ancient Peruvian burial practices in *Mummies*, open now and free for Members.

Rotunda / Summer 2017 / AMNH.org

TELLING DETAIL

The other prominent feature on the gold figurine—a bump on its abdomen that looks very much like a belly button—may be a nod to the link between death, burials, and rebirth in ancient Andean cultures.

THE MAN HIMSELF

The deceased was a man between the ages of 40 and 50 with an artificially elongated skull, a Paracas characteristic. His bundle included a gourd bowl beneath his chin to "feed" him, a turban with long feathers from an Amazonian Blue and Yellow Macaw, staffs, other headdresses and golden ornaments, and a feathered fan.

ENDURING CONNECTION

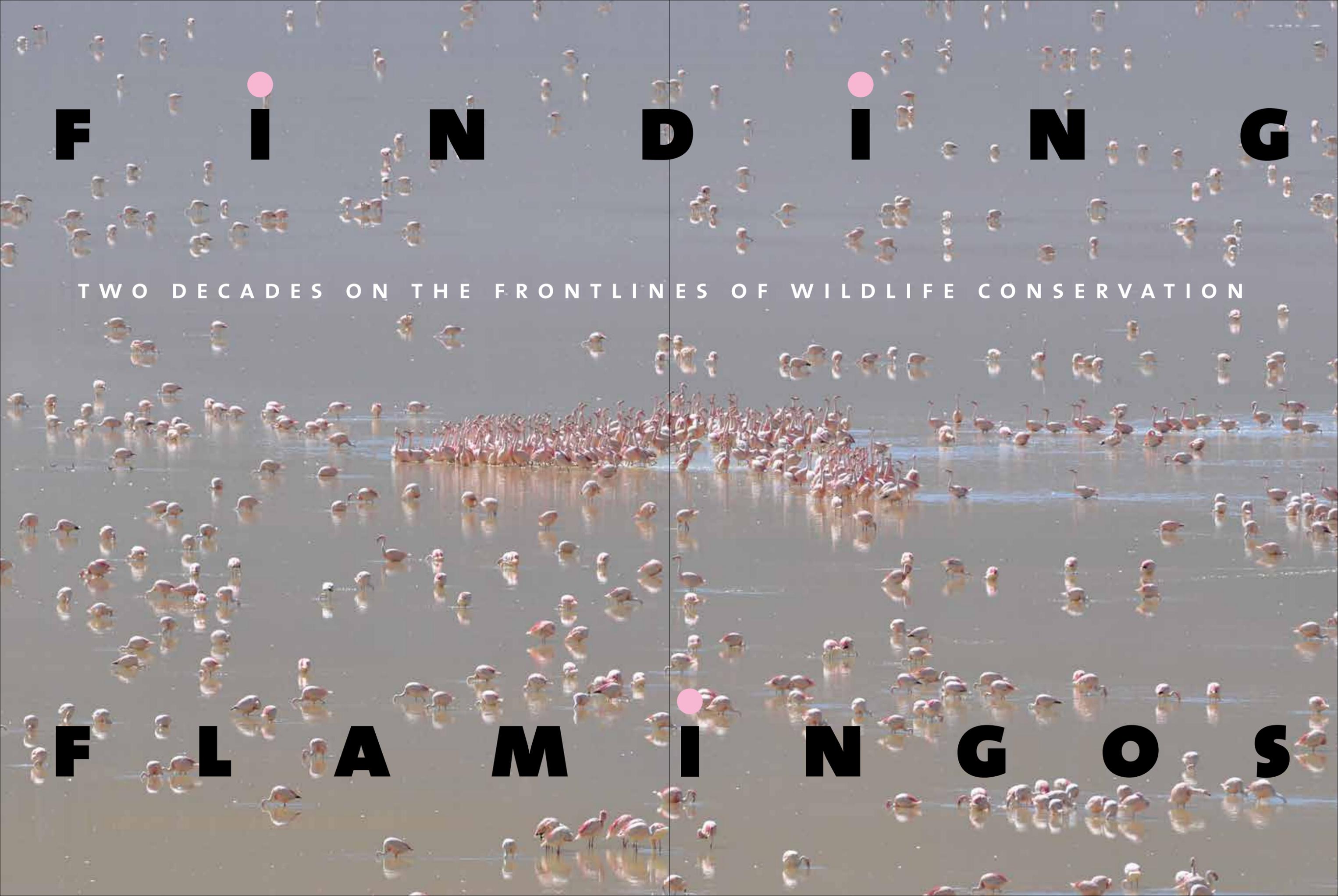
In ancient Peru, mummification allowed the living to remain connected with the dead. Burial sites were accessible, allowing relatives to refresh the food or drink at their loved ones' graves. "There was this feeling that the ancestors continued to have a relationship with their descendant community," says Peters.

IMPORTANT FIND

This pendant was discovered in the 1920s, in a mummy bundle buried in a hillside overlooking the Bay of Paracas on the Pacific coast of Peru. It was one of hundreds collected by Julio C. Tello (1880–1947), known as the father of Peruvian archaeology.

LOOKING INSIDE

From 1927 to 1928, Tello and his team unearthed hundreds of Paracas mummy bundles in the burial site he came to call the Necropolis of Wari Kayan. In 1937, three of these bundles came to the Museum, where they were unwrapped for study. Today, scientists leave such bundles intact, using CT scans to reveal the contents.



F I N D I N G

TWO DECADES ON THE FRONTLINES OF WILDLIFE CONSERVATION

F L A M I N G O S



Felicity Arengo (far left) trains volunteers to identify flamingo species.

Dr. Felicity Arengo (pictured above) is the associate director of the Museum's Center for Biodiversity and Conservation. Here, she details her work monitoring flamingo populations in South America for nearly 20 years.

Looking at the Andean plateau's landscape of red clay, brown sand, and black volcanic rock dotted with salt flats and soda lakes, you might not expect it to be a thriving habitat for some of the world's most iconic birds. But glacier-fed streams loaded with minerals trickle down these mountains, forming shallow wetlands that teem with algae and invertebrates—a buffet for thousands of flamingos from three species that call this region home.

I have been working in these wetlands for nearly 20 years, arriving first in 1998 to participate in a workshop organized by the newly formed Grupo de Conservación Flamencos Altoandinos (GCFA), or High Andes Flamingo Conservation Group. These researchers and conservationists, hailing primarily from Argentina, Bolivia, Chile, and Peru, monitor the status of flamingo populations and threats to their wetland habitats.

When I first started working in the GCFA, we didn't

know it would be the start of a collaboration spanning two decades. We also didn't know much about flamingo populations in the region, like how many individuals of each species—Chilean, Andean, and Puna—there were or where we would find them.

Previous population estimates were haphazard, based on counts at one or two lakes. We knew that flamingos, though restricted to salty wetlands, were widespread and nomadic, moving unpredictably from one wetland to another in search of food. What we needed was a reliable snapshot in time of as many flamingo habitats as possible. That meant we needed a team that could cover a lot of ground, and return to search out flamingo groups year after year.



Andean flamingos feed on tiny invertebrates and algae in South America's wetlands.

HOW TO COUNT FLAMINGOS

In the late 1990s, GCFA began working with guides to find flamingo habitats at unknown lakes and training volunteers to distinguish among the three species of flamingos found in the region. We also began equipping field teams for expeditions that would cover the flamingos' range throughout Argentina, Bolivia, Chile, and Peru, launching regular surveys of the region.

While flamingos are easily identifiable for their iconic look, differences among species are subtle. To tell them apart, we compare body size, leg color, bill shape, and the amount of black on the wings. This requires some skill, and being close enough to the birds to detect these details.

Over the last 20 years, these censuses have helped us develop robust estimates for populations of Andean and Puna species. They've let us detect trends among flamingo populations and determine which wetlands are most important.

Volunteer counters who trek to remote habitats to perform census work are essential to our efforts. But since the beginning, we've also put technology to great use. Our efforts began by using familiar animal trackers: GPS units with small, efficient batteries capable of relaying data via satellite to our computers gave us accurate location information about these birds.

This data allowed us to trace flamingos to places we never expected to find them, including a dam in Peru and cattle farms in Argentina. This new information wasn't just a novelty; it helped us focus our research and allocate resources more effectively.

Recently, we introduced another new tool that promises to revolutionize how we conduct our surveys. Flamingo groups can be large and

densely packed, making them hard for observers to count from a distance. This past January, we tested a new way of monitoring flamingo groups: piloting a quadcopter drone over flocks and recording video footage, as well as still images.

Since it doesn't disturb the birds, a drone allows us to bring a camera closer to the group than ever before and offers a new perspective for easier, more accurate counts. Drone footage we captured on this most recent census should allow us to make more finely tuned population estimates and promises to be a valuable new tool in our kit.

SHALLOW, SALTY WETLANDS TEEMING WITH INVERTEBRATES ARE A BUFFET FOR FLAMINGOS.



Youngsters learn about flamingos at a GCFA sponsored event.

TURNING DATA INTO ACTION

The information we gather isn't just for the books. Like other research conducted by scientists in the Museum's Center for Biodiversity and Conservation, we use our data to inform important decisions about wildlife management and conservation. Studies we've conducted about flamingos and their habitats has proved critical in securing the designation of nine



Flamingos dot the landscape in the shadow of Cerro Tres Quebradas in Argentina.

wetlands throughout South America as Ramsar Wetlands of International Importance since 2000, encouraging their conservation and thoughtful use of their resources. Our work has also led to the establishment or expansion of numerous other provincial, state, and national protected areas in Argentina, Bolivia, Chile, and Peru.

Protected areas aren't all we're creating. We've also spent the last few decades building relationships with local partners, from backcountry guides to school teachers. These ties to local communities, based on many seasons of collaboration and information sharing, are critical to understanding and respecting local needs and perspectives and working together towards common goals.

Today, there's a special urgency to that work. As climate change places wetlands around the world under threat, working effectively with our partners to protect flamingo habitats is more important than ever. Experts predict that the tropical glaciers, which provide much of the lake water for flamingos and nearby villages, will shrink or disappear in the coming decades. The streams that

feed South America's wetlands are already shrinking, being diverted to provide water for homes, irrigation, and industry.

In fact, industry is a special concern near these flamingo habitats. Some of the world's largest lithium deposits sit near the shared borders of Bolivia, Chile, and Argentina—the very same region where our 20-year data set shows the highest concentrations of flamingos. Mining companies are already prospecting in several salt flats in Argentina, even in wetlands basins that are part of our flamingo monitoring circuit.

Thanks to our relationships in the community and years of collected data, we're well placed to work with many stakeholders, including government agencies, local businesses, community organizations, and mining companies to promote principles of sustainability and conservation in these wetlands. We're hopeful this collaboration could even make the area a model of sustainable resource use that puts biodiversity conservation and long term well-being of communities at the forefront. 🌱

Partial support for flamingo and wetland monitoring is provided by Disney Conservation Fund.

SUPERPOWER SENSES

THE ASTONISHING WAYS ANIMALS NAVIGATE THE WORLD

LIKE ALL ANIMALS, humans depend on our senses to understand their environment. But those senses pick up just a fraction of the frequencies and sensations present in the world around us.

“We can learn an immense amount about our own senses by studying super-sensing animals,” says Rob DeSalle, curator in the Division of Invertebrate Zoology and for a special exhibition on the senses opening in November. “When we do, we realize our limitations and our uniqueness in sensing the world around us.”

So, what are some of these senses? Here’s a quick primer.

ULTRAVIOLET LIGHT VISION

THE SENSE

While you may have seen it in a blacklight poster, ultraviolet (UV) light exists in a spectrum that is normally invisible to humans. Many pollinating insects—think bees and butterflies—see this spectrum of light just fine.

WHY IT'S SUPER

A rose by any other name may smell as sweet, but the same flower viewed with ultraviolet looks a lot different! Under UV light, many wildflowers (like the one pictured above) look like they're wearing bullseyes. These patterns may serve as landing pads, ensuring that pollinating insects where to get a meal for themselves—and help the plant reproduce.

HOW WE KNOW

UV light is around us all the time—it's just at a higher wavelength than humans are normally capable of seeing because of filters in our eyes. That's why we can catch glimpses of the spectrum under blacklight. Some people who have had parts of their eyes removed or damaged can see narrow bands of the ultraviolet spectrum all the time!

INFRASOUND HEARING

THE SENSE

The same way most humans can't see UV light, we generally can't hear infrasound, which is defined as any sound with a frequency under 20 Hz. These low-frequency sounds do show up often in nature, from the rumble of earthquakes to the songs of whales.

WHY IT'S SUPER

In species that can sense infrasound, these low-frequency tones are put to many uses. Whales use infrasound songs to communicate over long distances. Infrasound is also common in mating calls, including the “bellows” that are part of crocodilian courtship rituals.

HOW WE KNOW

While our ears can't pick them up, humans can sometimes “feel” infrasound vibrations. We've also put these low frequencies to work in geological work, where infrasound helps prospectors probe for oil and researchers monitor earthquake activity.

ELECTRORECEPTION

THE SENSE

With infrasound and ultraviolet light, we at least have frames of reference for the kinds of things that other animals might be seeing or hearing. Some animals, though, experience the world in ways we can't imagine—for example, by interacting with the electrical fields that surround them.

WHY IT'S SUPER

Electroreception is found far and wide in the animal kingdom, present in the nose of the sawfish and the bill of the platypus. Electroreceptors in these organs can detect tiny changes in the voltage around them—a sensation more useful than sight when it comes to hunting for food on darkened seafloors or muddy river banks.

HOW WE KNOW

The first demonstration of electroreception in platypuses came during a 1986 experiment. A team of researchers found that platypuses could seek out a particular kind of prey in a tank, even when it was thoroughly hidden under layers of muck. That prey? A battery. 🦘

SAVE THE DATE: Member Preview Days for the fall special exhibition are November 17–19.

© Clockwise from top left: Shutterstock / kc. film, istockphoto/miblue5, Pixabay/maxidiaz, Shutterstock/1.Lang, Shutterstock/worldswildlifewonders, Pixabay/oldiefan

Programs and Exhibits

For more programs and to purchase tickets, visit amnh.org/calendar.

For updates and reminders, sign up for monthly Calendar Highlights for Members by sending your membership number and request to subscribe to members@amnh.org. The Museum does not trade, rent, or sell this information.

Tickets

Tickets are available by phone at 212-769-5200, Monday–Friday, 9 am–5 pm, or by visiting amnh.org. Please have your membership number ready.

Availability may be limited. Please purchase tickets in advance.

Please be aware that ticket sales are final for all Member programs. All programs go ahead rain or shine. There are no refunds unless the program is canceled by the Museum.

Please check amnh.org for Member ticket prices for live animal exhibits and giant-screen 2D and 3D films.

Information about programs is current as of June 1, 2017. Please check amnh.org/calendar for updates.

JULY

Evening Bat Walks in Central Park
Fridays, July 7, 14, 21, or August 4
Rain date: Saturday, August 5
8 pm

\$40 (\$25 children ages 12 and under)
At dusk, bats leave the warm spaces under city roofs to feed on flying insects. Join **Bradley Klein, Danielle Gustafson**, and other members of the New York City Bat Group for a walk through Central Park to encounter and catalog the species that call New York City home.

You Ask, Astronomers Answer
Tuesday, July 11
7 pm

\$12
See amnh.org for details
Take control of your journey through the universe and ask your biggest questions about the cosmos! Astronomers **Jackie Faherty** and **Emily Rice** will provide answers while **Brian Levine** illustrates using datasets from our Digital Universe software. Attendees can submit their questions ahead of time, and we'll take some questions day-of as well. Try to stump us!

Fun with Fossils
Saturday, July 15
9 am–5 pm

\$95 per person
Pack your collecting bag, old sneakers, and lunch, and travel back in time with Museum fossil expert **Paul Nascimbene** for an expedition to Big Brook in Monmouth County, New Jersey. Uncover the hidden secrets of the Late Cretaceous, learn how Museum scientists identify and excavate fossils, and start your very own collection!

Feel free to bring your own collecting equipment; transportation provided. This program includes about 45 minutes of walking.



Vacation Guide to the Solar System
Tuesday, July 18
7 pm

\$12
Ever wanted to take a vacation to another world? **Olivia Koski** and **Jana Grcevic**, authors of the *Vacation Guide to the Solar System*, take you on a tour of fascinating vacation destinations on other worlds. Plan your astronomical itinerary while flying over the canyons of Mars, moon-hopping the satellites of Jupiter, and skiing the pink slopes of Pluto.

A book signing will follow.

Summer Star Sail
Friday, July 21
7:30–9:30 pm

\$95 per person
Set sail on the Hudson River with astrophysicist **Charles Liu** and watch the Sun set while learning the science and star lore that surround the summer sky.

Appropriate for children ages 10 and up. Children must be accompanied by an adult.

Hall Tour: Big Things
Saturday, July 22
1–2:30 pm

Free
Registration required; call 212-769-5200.
Take a closer look at some of the Museum's largest and most iconic treasures. Join a Museum tour guide and view such giants as the Ahnighito meteorite, the blue whale, and our newest and largest dinosaur on display: The Titanosaur.

Stars of Summer
Tuesday, July 25
7 pm

\$12
The summer sky sizzles with an abundance of bright planets and the brilliant Milky Way crossing from north to south. Join **Joe Rao** as he highlights the wonders of summer nights, from Saturn and its spectacular rings to Jupiter gleaming in the south as darkness falls to Venus' magnificent predawn show.



AUGUST

Come Fly with The MARSBAND
Tuesday, August 1
7 pm

\$12
Join Director of Astrovisualization **Carter Emmart** and the musicians of **The MARSBAND**, including **Keith Patchel** and **Kento Iwasaki**, for an immersive exploration of the Red Planet. Experience the Martian landscape up close, accompanied by a live performance, as you fly around the planet in an educational, musical meditation.

Sail on the Clearwater
Friday, August 18
6–9 pm

\$95 per person
Enjoy a Members-only sunset sail aboard the historic *Clearwater*, a wooden sloop modeled after 18th-century Dutch cargo ships. Take in the sights of the city and learn more about the history and ecology of the Hudson while you join the crew in activities like hoisting the sail, net-fishing, and navigating this majestic river.

Appropriate for children ages 10 and up. Children must be accompanied by an adult.

SEPTEMBER

Hall Tour: Theodore Roosevelt, Conservation President
Sunday, August 20
10:30 am–noon

Free
Registration required; call 212-769-5200.
Explore the Theodore Roosevelt Memorial and the Bernard Family Hall of North American Mammals with a tour guide to learn more about our 26th President's role in placing more than 250 million acres under federal protection. Visit the magnificent caves, lush forests, and vast expanses of America's most beloved national parks and discover the thriving ecosystems and diverse wildlife in your own back yard.

Total Solar Eclipse
Monday, August 21
Noon–3 pm

Free
On the afternoon of August 21, the Moon will pass between the Earth and the Sun, completely blocking out the Sun for about 3 minutes in a swath of North America. Join us in the Rose Center for Earth and Space for NASA's live broadcast of the Total Solar Eclipse and learn more about this rare celestial event.



Early-Morning Bird Walks in Central Park

Eight Tuesdays, September 5–October 24 7–9 am
Eight Wednesdays, September 6–October 25 7–9 am
Eight Thursdays, September 7–October 26 7–9 am
Eight Fridays, September 8–October 27 9–11 am

\$85
Observe the exciting fall migration of birds in Central Park with ornithologists **Paul Sweet** (Tuesdays, 7 am, and Fridays, 9 am) and **Joseph DiCostanzo** (Wednesdays and Thursdays, 7 am). Learn how to use field marks, habitat, and behavior as aids to identify warblers, thrushes, sparrows, and raptors as they pass through Central Park.

Exhibitions

Admission is by timed entry only.

Mummies

Free for Members

Discover when, how, and why ancient Egyptians and Peruvians were mummified, and find out who they were in life. This show features rarely exhibited mummies, as well as interactive touch tables, rare artifacts, and cutting-edge imaging.



¡Cuba!

Free for Members

Explore the extraordinary biodiversity across the island's remote forests, mysterious caves, expansive wetlands, and dazzling reefs, as well as its culture, its people, and its history.



CLOSES 8/13

Humpback Whales

Set in the spectacular waters of Alaska, Hawaii, and the remote islands of Tonga, this ocean adventure offers audiences an up-close look into the mysterious world of one of nature's most awe-inspiring marine mammals.

Captioning devices are available.

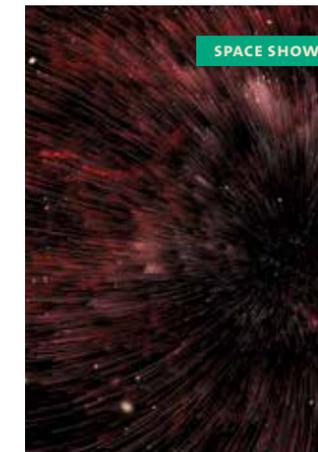


2D AND 3D
CLOSES 9/14

Dark Universe

Narrated by **Neil deGrasse Tyson**, this Space Show celebrates pivotal discoveries and the cosmic mysteries that remain. Gaze up at the Milky Way from Mt. Wilson Observatory in California, plunge into Jupiter's atmosphere with a NASA probe, and find out what scientists are learning about dark matter and dark energy.

Captioning devices are available.



SPACE SHOW

Lunchtime Bird Walks in Central Park

Session 1: Four Tuesdays, September 5–26

Session 2: Four Tuesdays, October 3–October 24
Noon–1:30 pm

\$50

Glimpse owls, hawks, and woodpeckers in the woods, finches and sparrows in the fields, and ducks and gulls in the lakes as ornithologist **Paul Sweet** guides you through three Central Park habitats to observe the many bird species that make New York City their home.

Walks begin across from the Museum on the northeast corner of Central Park West and 77th Street. Enrollment is limited to 20 people per series. For more information, call the Bird Walk Hotline at 212-313-7579.



Animal Drawing
Eight Wednesdays,
September 13–November 1

7–9 pm
\$175
\$160

The celebrated dioramas, dinosaur skeletons, and other iconic Museum exhibits serve as the setting for an intensive after-hours drawing course with illustrator and naturalist **Patricia Wynne**. Learn about the gifted artists who created the world-class dioramas as you sketch subjects in their “natural” environments.

Materials not included. Enrollment is limited to 25 people.

Why? What Makes Us Curious with Mario Livio

Monday, September 18
7:30 pm

\$12
Hayden Planetarium Space Theater

Enter at 81st Street

The ability to ask “Why?” is uniquely human. Curiosity drives basic scientific research, powers the creativity in disciplines from the arts to technology and is a necessary ingredient in every form of storytelling. Astrophysicist and bestselling author **Mario Livio** describes cutting-edge research about the origins and mechanisms of human curiosity.

A book signing will follow.

Hall Tour: Tyrannosaurus rex

Saturday, September 23
10:30 am–noon

Free
Registration required; call 212-769-5200.

Join a tour guide to explore the Museum’s world-renowned dinosaur collections and learn the history of the Museum’s iconic *T. rex* fossil.

COMING SOON

Rhoda and the Fossil Hunt

Premieres Fall 2017 in the Hall of Saurischian Dinosaurs
See amnh.org for details

Join Rhoda as she hunts for missing fossils throughout the Hall of Saurischian Dinosaurs! Created in partnership with the On Site Opera, this world-premiere work by composer **John Musto** was written specifically for the hall and based on the real-life experiences of Rhoda Knight and her grandfather Charles R. Knight, the famous naturalist illustrator whose paintings and sculptures are still on display at the Museum today.



Credits

Support for Hayden Planetarium Programs is provided by the Schaffner Family and the Horace W. Goldsmith Endowment Fund.

Credits

Mummies was developed by The Field Museum, Chicago.

The Museum gratefully acknowledges the Richard and Karen LeFrak Exhibition and Education Fund.

Mummies is proudly supported by Chase Private Client.

iCuba! was developed in collaboration with the Cuban National Museum of Natural History.

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Significant support for iCuba! has been provided by the Ford Foundation.

Generous support for iCuba! has been provided by the Dalio Ocean Initiative.

iCuba! is proudly supported by JetBlue.

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Dark Universe was developed by the American Museum of Natural History, New York (www.amnh.org), in collaboration with the California Academy of Sciences, San Francisco, and GOTO INC, Tokyo, Japan.

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JULY

7

FRIDAY
Evening Bat Walks in Central Park
Nature Walk

11

TUESDAY
You Ask, Astronomers Answer
Hayden Planetarium Program

14

FRIDAY
Evening Bat Walks in Central Park
Nature Walk

15

SATURDAY
Fun with Fossils
Member Program

18

TUESDAY
Vacation Guide to the Solar System
Hayden Planetarium Program

21

FRIDAY
Summer Star Sail
Member Program

Evening Bat Walks in Central Park
Nature Walk

22

SATURDAY
Hall Tour: Big Things
Member Program

25

TUESDAY
Stars of Summer
Hayden Planetarium Program

AUGUST

1

TUESDAY
Come Fly with The MARSBAND
Hayden Planetarium Program

18

FRIDAY
Sail on the Clearwater
Member Program

20

SUNDAY
Hall Tour: Theodore Roosevelt, Conservation President
Member Program

21

MONDAY
Total Solar Eclipse
Hayden Planetarium Program

4

FRIDAY
Evening Bat Walks in Central Park
Nature Walk

SEPTEMBER

5

TUESDAY
Early-Morning Bird Walks in Central Park Begin
Nature Walk

Lunchtime Bird Walks in Central Park Begin
Nature Walk

13

WEDNESDAY
Animal Drawing Begins
Special Program

18

MONDAY
Why? What Makes Us Curious with Mario Livio
Hayden Planetarium Program

23

SATURDAY
Hall Tour: *Tyrannosaurus rex*
Member Program

INSIDE YOU

LOCATED IN THE AKELEY GALLERY ON THE SECOND FLOOR

Inside You is proudly supported by the Janssen Pharmaceutical Companies of Johnson & Johnson.
This exhibition is made possible by the generosity of the Arthur Ross Foundation.

Your body is teeming with bacteria, viruses, and other microbes—and that’s a good thing! Come and meet your microbiome!

Your body is home to **VAST NUMBERS** of microbes—more than all the stars in the Milky Way

They help your digestive system, immune system, and brain **WORK PROPERLY**

Most cells and genes found in your body are microbial, **NOT HUMAN**

Life in the Lab

The Science Research Mentoring Program give students a chance to try real research.



In the past 10 months, Elena Rubiera and Sebastian Bahos have put in hundreds of hours in the Museum's invertebrate zoology collections, searching for species that haven't yet been described by science.

And that's on top of weekend jobs, school dances, and SAT prep. You know, regular high school stuff.

Elena and Sebastian are part of the latest class of the Museum's Science Research and Mentorship Program (SRMP), which each year offers approximately 60 high school students throughout the city the opportunity to get a taste of life in the laboratory and beyond. Each team of two or three students works closely with a Museum researcher to carry out a scientific study on topics that might include the genetics of starlings, the feeding habits of jaguars, human evolution, fossilized termites, or cosmic rays.

"SRMP focuses on the whole person and the breadth of the research experience," says SRMP manager and conservation biologist Mark Weckel. "Our students develop cutting-edge research skills, but they also practice public speaking, communicate their results through scientific posters, attend

conferences, and network with peers and professional scientists as they explore whether a STEM career is right for them."

Launched in 2009, SRMP has proven to be such a successful model for getting students involved in scientific research that in 2015 the Museum helped launch an expansion at five New York State science institutions, including Cold Spring Harbor Laboratory, New York University's Polytechnic Institute, Wave Hill, City University of New York-Lehman, and Columbia University's Mind Brain Behavior Institute. Today, the consortium includes 20 programs at 14 institutions around New York and serves more than 550 students every year.

During their year in SRMP, Elena and Sebastian have focused on deep-sea-dwelling anemones that were collected off the coast of Brazil. Working alongside their advisor, marine biologist Luciana Gusmão, the teens began examining anemone specimens early last fall. These invertebrates, which look more like plants than animals, may appear simple, but they're ruthlessly efficient carnivores that hunt their prey using devastating biological weapons known as nematocysts.

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Elena and Sebastian examine histology slides (left) and even make their own using a microtome (above) to cut thin cross-sections of anemones. (right)



These specialized cells serve as tiny harpoons, sometimes filled with poisonous compounds, that an anemone uses to disable unwary animals that wander into its grasp. But these microscopic munitions aren't just offensive tools. They also serve as defensive countermeasures, ensuring that predators who try to munch on an anemone get a mouthful of painful pokes instead.

In Gusmão's lab, the nematocysts of anemone specimens get put to another use altogether: species identification. Viewed under a

"The world is a puzzle, and science is just helping connect the pieces."

— SRMP STUDENT ELENA RUBIERA

microscope, nematocysts can differ widely, meaning that scientists can differentiate between species that look similar to the naked eye.

"Before I started working on this project, all I knew about

anemones was from *Finding Nemo*," says Sebastian. "Once you start looking at them more closely, you see a lot of diversity and find they're really interesting."

By comparing these and other physical attributes against known specimens, Sebastian and Elena began helping to determine what species of anemone are present in this set—and trying to figure out if any species they can't identify turn out to be new to science. The idea of aiding these kinds of discoveries is what attracted Elena to the program.

"What I like about science is that it helps the world become a more complete place," says Elena, a junior at Manhattan's NYC iSchool. "The world is a puzzle, and science is just helping connect the pieces."

Week after week, the students worked to understand a little more about the anatomy and taxonomy of the deep-sea dwelling anemones. Since the anemones in this region have not been extensively studied, says Gusmão, there was a fairly good chance that some of the species Elena and Sebastian were examining had yet to be described.



Dr. Luciana Gusmão supervises Elena and Sebastian in the lab.

“If you look at Antarctica, we know a lot about anemones there, because that’s where a lot of researchers from the United States and Europe have gone to study,” Gusmão says. “Places like Argentina and Brazil didn’t have as many homegrown researchers, so there’s been less research done in this region.”

One promising candidate for description is an anemone found living on a sponge in Brazil’s coastal waters, more than 1,800 feet below the surface of the Atlantic. In some ways, it looks like a species that has previously been described living in undersea caves near Japan. Whether the specimen they’ve been analyzing turns out to be a new species or not, though, its presence in the deep waters of the Atlantic raises fascinating questions for further research.

“If it’s a new species then it’s great, because we’re identifying the new species,” says Sebastian, who graduated from the High School of Health Professionals and Human Services last month. “And if it’s not, then it’s also great, because we could see that it’s the same exact anemone capable of living in a cave in Japan and the deep sea of Brazil. Then, we get to figure out exactly what has been going on with it.”

For all the research SRMP students like Elena and Sebastian help produce—some of which even gets published, with the students as co-authors—the program isn’t just about the thrill of discovery. It’s about jumpstarting science careers. A year-long stint in a laboratory offers teens exposure to tools and techniques they may not encounter in high school—but will need to succeed in college science courses. “I didn’t really know how to use a microscope before, because my school doesn’t have real high-tech microscopes, so I’ve learned how to find things using a microscope,” says Elena.

By pairing students directly with working researchers, the program also demystifies careers in the sciences—not to mention lab work, which can be by turns exciting and excruciating, and fieldwork, often a muddy, sweaty, uncomfortable business.

The guidance mentors provide doesn’t end when the experiments do. For many students, their SRMP mentors offer invaluable advice on life outside of the lab, too.

“Luciana read my college essay, and she gave me some feedback, and it made it completely better,” said Sebastian, who was accepted at eight colleges and will be attending CUNY City College this fall.

And it’s not just the students who benefit from the program. “Watching Elena and Sebastian become more comfortable and confident in the lab is inspiring,” says Gusmão. “The experience has pushed me to look for different ways to understand and interpret our findings.”

Support for the Science Research Mentoring Program at the American Museum of Natural History is provided by Christopher C. Davis, The Shelby Cullom Davis Charitable Fund; The Pinkerton Foundation; the Bezos Family Foundation; the Doris Duke Charitable Foundation; the Solon E. Summerfield Foundation, Inc.; and the Adolph and Ruth Schnurmacher Foundation.

Complimentary test preparation and college admissions support for program participants is generously provided by Kaplan Test Prep.

All-Ages Education

From toddlers to teens, the Museum’s educational programs have something for students in every grade. Here are just a few of the many programs available for avid learners in K–12.



Adventures in Science

For kids in grades K–5, Adventures in Science programs introduce young learners to a variety of scientific fields. Participants get primers on topics from the Earth’s core to the vastness of space, tailored to pique their curiosity about science.

Middle School Institutes

For students in grades 6–8, Middle School Institutes provide opportunities for interactive, investigative activities. Archaeological expeditions, coding camps, and even the opportunity to navigate the Hayden Planetarium’s Digital Universe Atlas are all on the docket as these programs leverage the Museum’s resources and researchers for educational experiences available nowhere else.

After School Program

High-schoolers interested in pursuing SRMP projects first have to complete courses in the Museum’s After School Science Research Program—six-week-long study sessions that dive deep into topics across life and physical sciences.

To learn more about programs available at the Museum and about opportunities for increasingly challenging—and rewarding—scientific studies, visit www.amnh.org/learn-teach



Meet Spider Expert Cheryl Hayashi

New Curator is Unraveling Mysteries Behind Spider Silk

Cheryl Hayashi, who joined the Museum this year as a curator in the Division of Invertebrate Zoology, professor in the Richard Gilder Graduate School, and the Leon Hess Director of Comparative Biology Research, is one of the world's top experts on spider silk. We recently sat down with Dr. Hayashi to talk about how she began studying spiders, how her research has changed over the years, and why spider silk may be coming soon to a retail aisle near you.

When did you first become interested in studying spiders?

As an undergraduate in college, I was very fortunate to work with a professor who allowed me to feed her colony of animals. It turned out those animals were spiders. And that was really fun. I would shake or weave flies right into their webs, so they could find the food later, or I would actually hand-feed flies to them.

Interacting with them in that way changed my life. I started noticing things about these organisms that had never occurred to me before.

“This is a really exciting time to be a biologist because of the revolution that's been going on in DNA sequencing.”

— DR. CHERYL HAYASHI

What do you like most about spiders?

They are a great system for asking questions about diversity and evolution. How they are related to each other is a big puzzle.

And what's the focus of your research?

I study the characteristics of spider silks, as well as the relationship between spider genomes and their ability to make silks. And looking at that relationship provides information about how we might be able to harness spider silks for human applications.

Most of us don't think much of brushing away a cobweb. What is it that makes spider silk so impressive?

Spider silk has been evolving for hundreds of millions of years, so natural selection has fine-tuned those molecules to the point that they can achieve incredible feats with a very minimal amount of material.

That's largely because spider silks are made of protein, and proteins are expensive for organisms to make. Spiders have evolved a system that allows them to catch large prey, produce webs that persist in wind and rain over long periods of time, and accomplish many other useful things very, very economically.

How has technology changed the way you work?

This is a really exciting time to be a biologist because of the revolution that's been going on in DNA sequencing and DNA analysis technology, which lets us very easily decipher the genetic code of every organism. For much of my career, it would take me a lot of long hours in the lab to identify a single gene from a single spider. With new genomic technologies, I can now catalog all the genes of a single spider, and I can do that for multiple species.

So now, we can compare the genomes of different spiders, and we can look at the qualities of the silks those species produce, and we can ask how the genome affects the silk. What changes to a genome, for instance, make for a better dragline silk? That's the kind of question it wasn't even possible to ask before this technology.

How do the Museum's collections help you ask those questions?

Well, thanks to some of these new techniques, we can extract proteins and genetic materials from these specimens, which gives us a great window into the past. But it's also important to maintain these specimens for tomorrow's researchers. When people started making collections here, they had no idea what we'd be able to do with them using genomic sequencing and CT scanners. By the same token, we can't envision all the technologies people will be using to explore these collections in the future!

You mentioned the potential for human application of spider silks. What might some of those applications look like?

Any application that you can think of that would benefit from a green material that is lightweight, incredibly tough, strong, and can stretch would benefit from spider silk. Textiles are an obvious match, but it could also be used in making components for vehicles like planes and spacecraft. There are also biomedical applications. Studies have shown we don't generally have immune reactions to spider silk, so it could play a role in medical implants as well. 🕸



Spectacular Spider Facts

Silk for Yards

A cooperative spider can produce dozens of yards of silk per day, says Hayashi. But that cooperation is dependent on factors like how well a spider has been fed—and whether it feels like being a team player that day.

Live Long and Prosper

“People might not know that some spiders are incredibly long-lived,” says Hayashi. “For instance, many tarantulas can live longer than a dog.”

They're Afraid of You, Too

“Spiders are very sensitive animals with all these very fine sensory hairs, and they can detect any motion in vibration or air current,” says Hayashi. “They're very easily spooked. We actually have to sneak up on black widows to catch them.”

Want to learn more about spider silk? Find Dr. Hayashi's TEDtalk online at bit.ly/1CB2Akv.

Your Guide to the Summer Night Sky



Astronomer Charles Liu has simple advice for summer stargazers: start big!

"I always tell people to look for the Summer Triangle," says Dr. Liu, a resident research associate in the Museum's Department of Astrophysics. "Three bright stars that make an isosceles triangle covering half the night sky. Each marks a major constellation."

Vega, the most visible of the three, is in the constellation Lyra, or the lyre; the star Altair is in Aquila, the eagle; and Deneb is part of Cygnus, the swan. This last constellation also has another big visual clue within it: the so-called Northern Cross, formed by the body and shoulders of the swan.

Such clear points of orientation are especially important for astronomers in the New York City area, where the night sky is "so highly polluted by artificial light," says Dr. Liu, who is also an astrophysics professor at the City University of New York's College of Staten Island.

Once you've located these, use a star chart to find other stars and constellations in relation to these celestial landmarks as the night progresses.

"They will move over the course of the night," explains Liu. "Just like the Sun, they rise in the east and set in the west, but their relative position to one another doesn't change. At 9 pm, they will

Moon Shadow: Solar Eclipse

On August 21, mile by mile across the contiguous United States, the Moon will completely obscure the Sun, blocking out its light for as long as two minutes and 40 seconds. On a cloudless day, places directly in the path of the "totality," or dark central shadow, will see stars shining as if it were the dead of night.

This total solar eclipse—the first to cross the country from the Pacific to the Atlantic since 1918—will start in Oregon at 10:16 am PDT and end in South Carolina at 2:48 pm EDT. Locations outside the direct path, including the New York metropolitan area, will experience a partial solar eclipse.

"Here, even if it's bright and sunny, for a little while it will feel oddly like a cloudy day," says astronomer Charles Liu. "The light won't seem quite right."

The outer edge of the lunar shadow will leave the United States at 4:09 pm EDT. The next total eclipse affecting the continental United States will occur on April 8, 2024.

Want to follow this event in real time? Come to the Museum on August 21 for NASA's live broadcast of the total solar eclipse. See page 13 for details.

The Summer Triangle is a good example of an asterism, a star pattern that helps viewers orient themselves to the night sky.

be in the same location relative to each other as at midnight."

In summer, expect to find such familiar figures of the zodiac as Taurus, Gemini, and Leo the Lion, whose mane and front paw resemble a backward question mark with a very bright star—Regulus—at the bottom. The Big Dipper and the Little Dipper, with its North Star, will be visible, each forming the tails, respectively, of the two bears, Ursa Major and Ursa Minor.

One useful trick, says Liu, is to start early, near sunset, when the Summer Triangle and Northern Cross will not be lost among the many stars that are visible in the later, darker sky. The phases of the Moon must be factored in, too, because bright moonlight will wash

out some stars. This summer, the Moon will be full on July 9 and August 7—so take a stargazing pass on those evenings.

Moonlight can obscure meteor showers too, although two of the best—the Delta Aquarids on **July 28 and 29** and the Perseids on **August 12 and 13**—should still be visible at their peaks. Best viewing for meteor showers? A dark location after midnight.

Of course, the biggest celestial event this summer will be the total solar eclipse in August (see sidebar), but scanning the heavens on any given summer night offers ample reward.

Says Liu, "It gives you a sense of where you are in the universe." 

Central Park West at 79th Street
New York, New York 10024-5192
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Andean Flamingos are among the three species monitored by Museum conservation biologist Felicity Arengo, who has been conducting censuses of these birds for nearly two decades. For more, see p. 6.

General Information

HOURS

Museum: Open daily, 10 am–5:45 pm;
closed on Thanksgiving and Christmas.

ENTRANCES

During Museum hours, Members may
enter at Central Park West at 79th Street
(second floor), the Rose Center/81st Street,
and through the subway (lower level).

RESTAURANTS

Museum Food Court, Café on One,
Starlight Café, and Café on 4 offer
Members a 15-percent discount.
Hours are subject to change.

MUSEUM SHOPS

The Museum Shop, Dino Store,
Planetarium Shop, Cosmic Shop,
¡Cuba! Shop, Mummies Shop,
and Online Shop (shop.amnh.org)
offer Members a 10-percent discount.

PHONE NUMBERS

Central Reservations 212-769-5200
Membership Office 212-769-5606
Museum Information 212-769-5100
Development 212-769-5151

TRANSPORTATION AND PARKING

Subway: **B** (weekdays) or **C** to 81st Street;
1 to 79th Street, walk east to Museum
Bus: M7, M10, M11, or M104 to 79th Street;
M79 to Central Park West
Parking Garage: Open daily, 8 am–11 pm;
enter from West 81st Street. Members can park
for a flat fee of \$10 if entering after 4 pm.
To receive this rate, show your membership card
or event ticket when exiting the garage.

ACCESSIBILITY



For information on accessibility,
email accessibility@amnh.org
or call 212-313-7565.