AQUARIUM OF THE PACIFIC

# PACIFIC Currents

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## Jelly Dreamscapes

Step into the captivating world of sea jellies, and discover their beauty, diversity, and soul-soothing qualities.

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LETTER FROM THE CEO

# A Strong Commitment to Animal Care and Well-Being

Jeff Flocken looks back on Porkchop the sea turtle's recent release and shares more about our newest sea turtle patient, Meatloaf.

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In March I had the honor of joining the team that released Porkchop the green sea turtle back into the wild. I have participated in animal rescues and releases in the past, but this was my first release with the Aquarium of the Pacific, and it was truly inspiring.

Porkchop was spotted in distress in the San Gabriel River by the Aquarium's volunteers during community sea turtle monitoring program last year.

In the ensuing rescue, Aquarium staff freed her from a life-threatening situation where she was tangled up in garbage on the floor of the river. Unfortunately, we had to amputate her flipper due to the damage done by discarded fishing wire.

But Porkchop, named for her food-motivated personality, healed and recovered under the incredible care of Aquarium staff. She also became a local celebrity after she was featured in the *Los Angeles Times* and *People* magazine.

After eleven months of recovery, she was finally ready to go back out into the river. The release went flawlessly, and the professionalism of the Aquarium team was nothing short of impressive in their care of this sea turtle during her rescue, rehabilitation, and release. Porkchop has since been spotted and filmed thriving in her river habitat, which has a population of nearly one hundred other resident green sea turtles.

While green sea turtles are still protected under the U.S. Endangered Species Act, they were globally downlisted from Endangered to a species of Least Concern last year, after decades of conservation initiatives and mostly rebounding populations. So, while returning Porkchop to the river was probably not essential to help save the species, it was the best choice for her individual welfare.

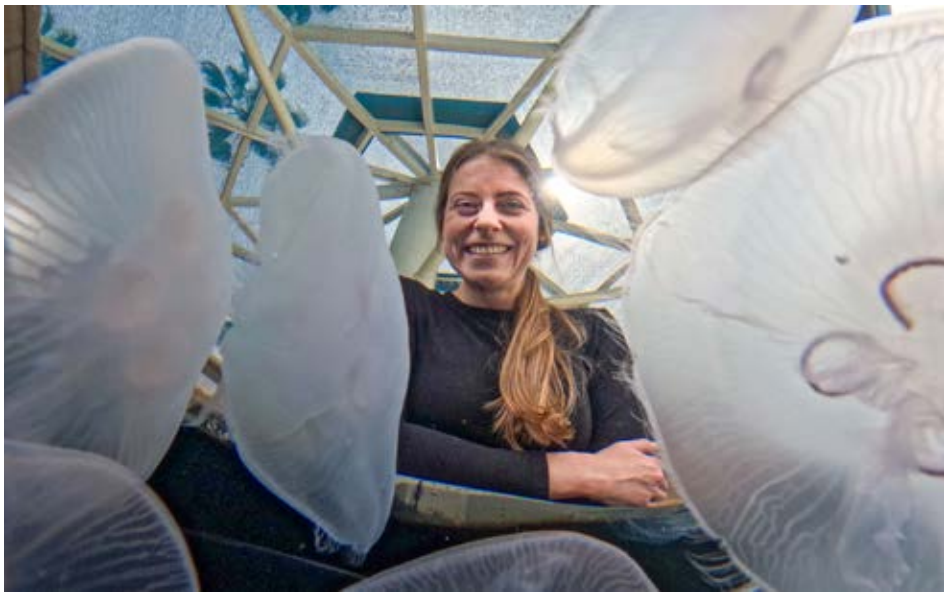
The professionals at the Aquarium make decisions like this on a regular basis—making sure that rescued animals in our care get the opportunity for the best life possible, whether that means a reintroduction into the wild or keeping them at the Aquarium for lifelong sanctuary if they are unable to be safely returned into nature.

Our newest sea turtle patient, Meatloaf—a hearty, over 200-pound green sea turtle—is currently recovering from injuries sustained in the wild before being rescued by Aquarium staff.

If our veterinarians and rehabilitation staff determine that she could survive and do well in the wild once her injuries heal, I am hopeful that I will be able to be a part of her release too.

However, if it turns out that she is likely to have a better quality of life staying at the Aquarium under the watchful eye of our animal care specialists, I know that she will be granted the best possible stress-free life for the rest of her days at the Aquarium. And that's something everyone who supports and visits the Aquarium of the Pacific can feel good about.

This commitment to care and well-being extends to each of our 12,000 animals, including the hundreds of sea jellies you will soon see in our new *Jelly Dreamscapes* exhibit, which you can read more about in this issue of *Pacific Currents*.



FRESH VOICES

# Caring for Jelly Cyborgs

Olivia Cleek dedicates herself to the care of sea jellies so that researchers can gain answers about our quickly changing ocean.

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If you've been fortunate enough to stare at a tank of jellies, you understand why they are some of the most popular animals in an aquarium. The gentle, mesmerizing swirl of their gelatinous bodies seems to provide us with permission to slow down and breathe.

Jellies are the ultimate drifters. Without a brain, they are unable to decide on their destination; instead, they exist in a state of readiness to thrive wherever the current takes them.

Though sea jellies are anatomically simple, their care requires a different level of patience and precision. I work with moon jellies (*Aurelia coerulea*), where every maintenance task must be

conducted with a soft touch to avoid damaging their fragile bells. This specific set of skills provides the biological anchor for my current collaboration with researchers at the California Institute of Technology.

Instead of relying on costly underwater robots, the Dabiri Lab has successfully developed the ability to create a biohybrid "cyborg" jelly to gather environmental data about the ocean. They integrate a small microelectronic device with the jelly's natural physiology so that researchers can send electric signals to the jelly's muscles to guide the animal's movement.

The best part? Jellies lack a central nervous system. They do not experience pain and heal rapidly once the device is removed, making them the ideal subject for the job. It is a perfect way to marry biology and technology to help us gain answers about our quickly changing ocean.

While the researchers focus on the pulse of the electronic signals, my role is to maintain the pulse of the animal itself, ensuring that the jelly is healthy. By maintaining optimum health and ideal water conditions, I provide the stable foundation necessary for this cutting-edge research to move forward.

Although I currently work in the world of jelly husbandry, my career has mirrored the versatility of sea jellies.

Raised in a small village in southern Ohio, far from the ocean, I knew from an early age that I wanted to work with animals. That led to earning a bachelor's degree in zoology from Ohio State University with a rigid plan of becoming a zookeeper.

However, a summer internship in Hawaii changed my trajectory completely. I learned the basics of aquatic fish and invertebrate husbandry and knew that I had discovered my calling.

After that, I leaned into the ever-evolving currents of the industry and said yes to all opportunities. I have cared for sharks and rays, raised green sea turtle hatchlings, and managed the delicate life cycles of seahorses and Pacific yellow tangs. From training a Hawaiian monk seal to leading breeding and recovery efforts for endangered white abalone and sunflower sea stars, each role

added a new layer of technical expertise to prepare me for wherever the next current would take me.

Looking back, I realize that by letting go of my original plan to be a zookeeper and allowing myself to remain open to the unpredictable currents of marine biology, I ended up gaining more skills and a more fulfilling career than I had ever envisioned. I'm proud to work with so many animals including sea jellies..

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**Olivia Cleek**
Olivia Cleek is an aquarist at Cabrillo Marine Aquarium, focusing on endangered species and sea jelly care. She recently received her master's degree in environmental science from Oregon State University where she studied the presence and distribution of basking sharks along the west coast of North America using social media posts..

**CONSERVATION CORNER**

# Jellies: Canaries of Change

"Canary in a coal mine" is a phrase that is used to describe when something is an early indicator of trouble.

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The phrase has origins from the late 1800s when canaries were used in coal mining operations to detect toxins. The birds were more sensitive than their human counterparts, allowing humans to quickly vacate the affected areas.

Since then, the phrase has been extended to several other species serving in similar warning capacities. One of them is sea jellies.

Sea jellies, or jellyfish as the public often calls them, are animals that are both relaxing and terrifying to many. Relaxing because of their beauty—their gelatinous bodies more closely resemble works of art than animals. Their pulsing and flowing movements are visually soothing and were a stress reliever for many during a

tense COVID pandemic when live webcams of jellies in aquariums provided a welcome escape.

Paradoxically, jellies are equally terrifying to many, perhaps even to the same people. This is due to their feeding mechanisms, which involve nematocysts or stinging cells. The power of the sting varies by species, and many are unpleasant or worse on human skin. A large gathering of sea jellies, also known as a smack, could be a feature of a nightmare.

While this fear is certainly valid, a smack can also be concerning because of what it signals about the ecosystem. A large population burst of jellies shows that the ecosystem is changing rapidly, typically in a negative direction.

This is because jellies can thrive in polluted environments, such as those with excess nutrients from coastal runoff. Runoff areas experience algal blooms, which quickly decrease dissolved oxygen in the water, a key element for most living marine organisms like fish and crabs. However, their lower oxygen demands can allow jellies to thrive in these areas.

Once the jellies have a foothold, they are good at thriving. They outcompete other species by feeding on their larval, planktonic eggs, and juveniles. A positive feedback cycle is underway, further supporting the jelly population. This phenomenon has been seen in many places around the world, including the Mediterranean Sea, the Gulf of Mexico, and Japan.

In extreme examples, the negative impacts of the blooms extend beyond ecosystem impacts to human systems. Several nuclear power plants have been shut down by a jelly bloom interfering with equipment, as has a U.S. aircraft carrier.

While all of this is concerning, there is no reason to panic. There has not been, nor is it imminently forecasted, that we will have a global jelly takeover. Researchers have documented decadal changes in sea jelly populations, suggesting there are natural oscillations. Plus, a sea jelly's life span is short, with some as brief as a few days. So, under the right conditions, a bloom can end as quickly as it takes off.

Bloom cycles are normal in parts of the world. For example, in the Chesapeake Bay, Atlantic sea nettle populations increase in summer months. Jellies thrive under warmer waters, so as the impacts of climate change are felt, the blooms in the Chesapeake are occurring earlier and more intensely. This reminds us of why sea jellies are called 'canaries in the coal mine' – warning us that ecosystem change is underway.

Scientists, including community scientists, are monitoring the changes to sea jelly populations. Regional maps can provide early warning systems to community members and tourists, and they allow us to better track changes over time in populations and their bloom durations.

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**Jennie Dean**
Jennie Dean is the Aquarium's vice president of conservation and policy. She focuses on the amplification and enhancement of the Aquarium's work in species conservation and learning for all audiences. Previously Dean was a program director at the University of California, Los Angeles' Institute of the Environment and Sustainability, where she oversaw programs engaging the private sector on corporate sustainability and consulted with island governments on sustainable development of their blue economy.

**FEATURED ARTICLE**

# Jelly Dreamscapes

Step into the captivating world of sea jellies, and discover their beauty, diversity, and soul-soothing qualities.

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Sea jellies are a beautiful, diverse group of animals. They appear anatomically basic—without major organs such as a brain or heart—yet have complex life cycles and require specifically engineered environments that mimic the open ocean.

Through research and dedication to maintaining the highest standards of care for these animals, the Aquarium of the Pacific has successfully cultured over 40 species of sea jellies. The culmination of years of commitment to these animals has resulted in *Jelly Dreamscapes*, our first immersive exhibit that will bring to life the beauty and tranquility of these gelatinous creatures.

## What are Sea Jellies?

Sea jellies have been around for more than 500 million years, before the time of dinosaurs. They have adapted to every ocean environment on Earth: tropical to Arctic temperatures, deep sea to shallow reefs, and freshwater to saltwater.

Remarkably, these resilient animals only have an average life span of about one year. However, this can vary depending on the species.

Sea jellies come in a multitude of sizes and colors. They are invertebrates, meaning they do not have a backbone. However, unlike most other aquatic invertebrates, sea jellies also do not have a heart, brain, or gills. Their bodies are 95% water, causing some species to be almost completely translucent in appearance. They vary in color from white to green, blue, orange, and more.

There are several types of sea jellies. Scyphozoan, or true jellies, are some of the most recognizable. True jellies have a bell, oral arms, and tentacles. Depending on the species, they may have up to 1,200 tentacles. These tentacles are equipped with nematocysts, which are stinging cells used to defend themselves against predators and immobilize prey.

A sea jelly's diet consists of mostly zooplankton, but they may also indulge in small crustaceans, fish, or even other sea jellies. Once a prey item has been stunned by the nematocysts, the oral arms transport the prey to the mouth at the center of the bell.

## A Sea Jelly Story

Sea jellies can reproduce through both sexual and asexual methods. The most studied reproduction methods belong to true jellies like moon jellies.

The first stage of their life starts after a fertilized egg (sexual reproduction) develops into a planula larva. A planula larva is a small, flat, free-swimming or crawling organism. The planula larva travels around, looking for a suitable surface to settle on, like a rock, shell, macroalgae, or a piece of driftwood. Once settled, the larva transforms into a polyp.

The polyp stage closely resembles a small sea anemone, feeding by capturing prey in its tentacles. When the polyp has eaten and grown enough, and if environmental conditions are right, the polyp will begin to divide. The polyp will clone itself into a stack of small discs, one on top of the other. These small discs pulsate and eventually detach, becoming ephyra. This is a form of asexual reproduction. Each ephyra from the same polyp is genetically the same.

As the ephyra grows, it begins to look like a small adult sea jelly, which is known as a medusa. The medusa stage is what is typically seen at the Aquarium.

Jelly Culture Coordinator Josh Wagner leads members of the jelly care team at the Aquarium in the best methods for sea jelly culture. The team has become experts in the requirements for each stage of life for all jelly species cultured at the Aquarium.

The jelly care team maintains clean environments for jellies, taking particular care during their polyp stage when they are more susceptible to environmental stressors. Each exhibit and culture habitat is wiped and siphoned daily to remove algae and waste. This helps to ensure optimal water quality for the animals to thrive.

The jellies are fed four times a day, including two brine shrimp meals and two specialty meals. The specialty meals can be a variety of different foods that are tailored to each species being fed, such as blended-up seafood, like mahi-mahi or krill. The specialty meal chosen often depends on which life stage the jelly is in; for example, ephyra may be offered a different species of zooplankton, like rotifers, due to their small size.

“We have to make sure that their diet is perfect for them,” said Wagner. “They’re so small that if you feed them something too large, they’ll become negatively buoyant, sink to the bottom.”

Sea jellies reside in open water, often drifting with the ocean’s currents. At the Aquarium, most sea jellies are housed in Kreisels, which is a specialized habitat that has no corners, creating a continuous circular flow mimicking an open ocean environment. The word Kreisel comes from the German word for gyroscope or

spinning top; named after the gentle spin the water creates in the tank.

"A jelly's bell is so sensitive that if it were in a regular fish tank, if it gets stuck in the corner, it can't get out," Wagner explains. "Kreisels keep jellies moving towards the center of the tank, so they're constantly pulsing."

## Our Sea Jelly Lineup

*Jelly Dreamscapes* will allow guests to explore the beauty and diversity of hundreds of colorful sea jellies at the Aquarium. It will showcase one of the most diverse collections of sea jellies in the United States. Species of graceful sea nettles, quick-pulsing blubber jellies, and shimmering rainbow comb jellies will only be some of the animals seen throughout the gallery.

A mainstay at the Aquarium is the moon jelly (*Aurelia coerulea*). This jelly reaches around two inches in length and is one of the most widely distributed species of sea jelly found in our World Ocean. This species will be seen in Jelly Dreamscapes, and will continue to be found at the Aquarium's outdoor Moon Jelly Touch Lab on Harbor Terrace, where guests can touch and experience moon jellies up close.

Spotted lagoon jellies (*Mastigias papua*) will be returning. This species ranges from a greenish blue to golden-brown color with yellow, white, or brown spots. The color variations are attributed to the symbiotic algae that lives inside the jelly, similar to a coral polyp and zooxanthellae algae.

The most common sea jelly found in the Mediterranean, the barrel jelly (*Rhizostoma pulmo*), will make its debut at the Aquarium. This species is a white to pale yellow jelly, with a striking purple to blue fringe around the base of the bell. They are members of the Rhizostomae order, which also includes the spotted lagoon jelly.

Various species of sea nettles will be found throughout the gallery. They can grow many feet long, making them some of the largest species of sea jelly. The South American sea nettle (*Chrysaora plocamia*) can grow six feet or more in length, while the

Pacific sea nettle (*Chrysaora fuscescens*) can grow as long as fifteen feet or more.

The number of exhibits dedicated to comb jellies will increase, starting with the California sea gooseberry (*Hormiphora californ-ensis*). This species of comb jelly, or ctenophore, has tiny hairlike structures called cilia running down its sides. When light refracts off their cilia, it causes a glowing rainbow effect. These little jellies have an oval-shaped gelatinous body that can reach up to an inch in length and two long tentacles.

Other species of sea jellies that will be drifting their way to the Aquarium in the near future include spotted comb jellies, can-nonball jellies, and more.

## The Future of Jelly Species at the Aquarium

Wagner's work with sea jellies has given him the opportunity to learn from other aquarists and researchers from across the country and around the world, even as far as Japan. In the future, he hopes to increase the diversity of species at the Aquarium of the Pacific and share the successful techniques he has discovered with aquariums around the world.

"It's fun to get new species that other aquariums haven't had before, and be the first ones to display them," said Wagner. "But it's just as fun to share that knowledge and help other aquariums out as well."

These unique and delicate creatures are beloved members of our World Ocean and the Aquarium family. As our jelly collec-tion evolves, guests will be able to enjoy their soothing nature amidst meditative lighting and dreamlike soundscapes in *Jelly Dreamscapes*. Guests will even get the opportunity to see how the animals receive state-of-the-art animal care from staff.

**BENEATH THE SURFACE**

# Caring for Sea Jellies

Josh Wagner has chartered new waters in our care of sea jellies, making possible the largest and most diverse jelly exhibit in our history.

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When Josh Wagner started at the Aquarium in 2011, he had no idea he would later become the Aquarium's resident sea jelly expert. Fifteen years and many a sting later, he has been instrumental in blazing new territory for the care of sea jellies and making *Jelly Dreamscapes* a reality.

Wagner started his journey at the Aquarium growing food for sea jellies, eventually transitioning to their care. What began as

a general interest in marine animals quickly became a passion for everything sea jelly. He fell in love not just with the jellies themselves, but also the science behind their care. His dedication led him to become the Aquarium's first official Jelly Culture Coordinator.

Wagner quickly found that taking care of and breeding jellies comes with challenges and even some lessons in chemistry. Their short lifespans and different life stages required careful observation, testing many habitat and water modifications, and developing adaptations for each specific species and in each of their life stages. Both these challenges and the joys of success fueled his passion for jellies.

Wagner's love for sea jellies also comes whenever new species arrive that are collected from blackwater dives, which are in the open ocean at night. Tethered to a boat, our dive team goes down about thirty feet and uses floodlights to attract the jellies. These night dives allow the team to find rare or interesting species to share with Wagner for breeding and culturing that they otherwise wouldn't be able to find during the day.

Raising and nurturing jellies at the Aquarium has allowed them to live longer than their lifespan in the wild—and is producing lots and lots of jellies! So many that we have been able to provide some to other aquariums and, most importantly, allowed us to create the largest and most diverse jelly exhibit in the Aquarium's history. At any one time, we may be raising behind-the-scenes up to 40 species of jellies in their various life stages.

With the opening of *Jelly Dreamscapes*, Wagner and his team are working with many species that he is thrilled to put a spotlight on. One is a colorful Japanese species of moon jelly that lives in the deep sea.

All this work with sea jellies has led Wagner to his fair share of stings. All true jellies and hydrozoan jellies have nematocysts, which are stinging cells. They each look like a tiny venomous harpoon, and it'll fire upon touch. Jellies sting to catch prey or for self-defense.

His biggest defense against stings is wearing latex gloves. But sometimes the tentacles can reach up his arm, leaving him with a burning sensation and a welt as a souvenir. According to Wagner, "The stings don't hurt too bad anymore—or maybe I've just gotten used to them."

Despite the occasional sting and all the challenges of raising them, the jellies are his favorite coworkers to greet every day. "Their delicate nature makes them unique from any other marine animal and helping them thrive makes every sting worth it."

As you explore *Jelly Dreamscapes*, take a moment to reflect on the passion and dedication of Josh Wagner and our entire animal care team who made this remarkable experience possible for both us and the sea jellies themselves.

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**Josh Wagner**
Josh Wagner is a senior aquarist who specializes in sea jelly culture and care. He has made several groundbreaking achievements in this field, including introducing the aquarium world to sea jelly reproduction using chemistry and propagating species of jellies, which have never been done before in North America. Wagner has presented his work at several conferences across the country over the past ten years. He earned his bachelor's degree in zoology from California State Polytechnic University, Pomona.