Carrie E. Schuman Writing Portfolio

Contact Information:

Phone: cell 603-767-7673

Email: carrie.schuman@gmail.com

THE TRIBUNE

Morro Bay oyster farmers are thriving now — but they face a looming threat

BY CARRIE SCHUMAN

AUGUST 19, 2019 04:45 AM, UPDATED AUGUST 19, 2019 03:08 PM

Business is strong for oyster farmers in Morro Bay, California, who produce shellfish for local and statewide demand. Here's how Grassy Bar Oyster Co. harvests fresh oysters at its SLO County operation. BY LAURA DICKINSON

Often under a blanket of fog, George Trevelyan rises in the early morning hours to lead his team turning oyster bags in the Morro Bay estuary.

The farm tends to a million and a half oysters during the course of a year, raising them from tiny juveniles to the plump delicacy that will be barbecued or served on the half shell after more than a year, sometimes two, of growing time.

It's a job that's been his passion for 10 years since he began farming here in 2009. He is one of the two oyster farmers in Morro Bay who produce shellfish prized by diners both locally and around the state.

For Trevelyan, who owns Grassy Bar Oyster Co., and Neal Maloney, owner of Morro Bay Oyster Co., that business is booming — but there are potential clouds on the horizon.

Among other environmental challenges facing the farmers, a recent study from researchers at UC Davis suggests climate change may increasingly impact the California industry, altering the habitat in the state's estuaries in a way that reduces oysters' preferred "Goldilocks zone" and potentially hinders their growth and survival.

WHO'S EATING MORRO BAY OYSTERS?

Both Trevelyan and Maloney sell only live product, quickly getting their oysters on ice and ready for shipping once they're harvested.

Grassy Bar Oyster Co. and Morro Bay Oyster Co. each sell up to a million oysters a year to two distinct markets.

Grassy Bar Oyster Co. owner George Trevelyan talks about his oyster farm in Morro Bay. Laura Dickinson LDICKINSON@THETRIBUNENEWS.COM

The first is the boutique half-shell market of oyster bars and restaurants looking to sell small, pretty oysters.

The second is fed by buyers who want large, fat oysters for barbecuing and are less concerned about what they look like.

Trevelyan explained that oysters for both markets command the same price, but the first is better for the farm, as smaller oysters are younger and require less labor and growing time.

Maloney — who has farmed the bay since 2004 before starting his company in 2008 — also echoed this sentiment, saying 95% of his farm production is “cocktail” oysters. He used to sell oysters dockside and at farmers markets but has found that restaurants have offered more routine, repeat business.

Both Trevelyan and Maloney said that some of their oysters go to buyers in San Francisco and Los Angeles, but they have such strong local demand for product, it exceeds their production ability.

Maloney credits “the local foodie movement that has really woken up people in California to seafood in general” — diners are more adventurous, ordering oysters more frequently from restaurant menus.

Maloney said harvesting an oyster right out of the water and handing it directly to someone “can change their perceptions about oysters.”

Morro Bay Oyster Co. owner Neal Maloney, left, holds oysters with Chef Daniel Boulud, right, holding caviar, during an event at the Biltmore Four Seasons in Santa Barbara. Courtesy photo

He jokingly likened his role to that of a drug dealer, as once someone tastes his farm's oysters, "my phone rings at all hours," leading him to meet up with people looking for an ice chest full of fresh oysters.

Trevelyan's oysters can be found at Giovanni's Fish Market and Tognazzini's Dockside Market in Morro Bay, while Maloney sells his at locations like Ada's Fish House in Pismo Beach and Morro Bay's Windows on the Water.

WHAT MAKES A GOOD OYSTER?

So much of an oyster's taste is a reflection of its environment, Trevelyan said, in particular "water quality, temperature, and also the phytoplankton that the oysters have been feeding on."

His son, Charles Trevelyan — farm manager for Grassy Bar — described this as the shellfish's "merrior" — the ocean counterpart to the term "terrior" that refers to how influences like soil and climate affect grapes and create the unique arc of flavors associated with particular wines.

"The oysters will taste differently from different bays," Charles Trevelyan said.

Maloney noted the virtues of the estuary.

"We have this very unique bay," he said, adding that the water turns over far faster than in other bays, leading to a nutrient-rich environment that's good for the oysters.

He said that freshwater flow can shift the taste, as his oysters grown in fresher conditions "translate to sweet underpalate," with a "green melon rind finish, kind of like cantaloupe."

Grassy Bar Oyster Co. owner George Trevelyan shucks an oyster in Morro Bay. Laura Dickinson LDICKINSON@THETRIBUNENEWS.COM

For the farmer, one challenge in ensuring good oysters is the inability to always size up their quality without opening them up.

“If they are really super healthy and happy, they grow really plump and they fatten up, and the whole interior of the shell fills up with this really succulent meat that’s really delicious,” George Trevelyan said, “and other times you might shuck up, and open an oyster and it’s just mostly watery, and there’s just a little tiny oyster meat in there, and that’s not a good oyster.”

“We are constantly checking oysters to see how they are,” he said.

HOW DO YOU GROW AN OYSTER (OR A WHOLE LOT OF THEM)?

Like most oyster farms in California, both Grassy Bar Oyster Co. and Morro Bay Oyster Company raise Pacific oysters — Crassostrea gigas — a species that originally comes from Japan and is one of the most widely cultured across the globe.

The two farms aren’t in the business of producing baby oysters to kick things off and instead procure these “seed” oysters from California Fish and Wildlife-approved hatcheries like those in Humboldt, Washington or Kona, Hawaii.

George Trevelyan said a single cooler can hold a half million minuscule juvenile oysters each about an eighth of an inch long.

The young oysters are placed in containers mounted under a dock, where they are nurtured by the tidal waters for about six months.

When they are large enough, the oysters are transferred to bags and raised to adulthood using one of three methods that rely on movement either with human help or from the natural motion of the estuary's tides.

Oyster farmers Carolina Hernandez, left, Raul Tapia, and Jenny Sorto walk among the oyster beds at Morro Bay's Grassy Bar Oyster Co. Laura Dickinson LDICKINSON@THETRIBUNENEWS.COM

Maloney said stress — introduced by time spent out of the water and mechanical actions on the oyster like shaking or tumbling — is the magic ingredient for producing better oysters.

He likened this to an oyster going to the gym — time exposed to the air means it needs to squeeze its muscle closed to form a good seal between top and bottom shell. Agitating the oyster can chip its shell, prompting it to grow new layers of shell that also promote more cupping.

Both ultimately result in an oyster with more and higher quality meat inside its pearly interior.

Grassy Bar uses a bottom culturing method that requires workers to manually flip the bags to promote good growth and remove encrusting sea life.

Morro Bay Oyster Co. uses a modification of the method that lets bags partially move with the tide, but still requires employees to manually shake 4,000 floating culture bags once a week in order to introduce enough stress on the oysters.

But both farmers have been making the transition to a process called tumble farming.

Culture bags are bundled up near the Grassy Bary Oyster Co. processing platform. Carrie Schuman CSHUMAN@THETRIBUNENEWS.COM

Oysters grown this way are in bags suspended by one end from a central line, while each bag sports a buoy at the end to help move them up and down with the tide. The technique relies on the bay's action to do most of the work of sculpting a quality oyster.

Charles Trevelyan — who builds and installs much of the farm's culturing technology — said tumble lines produce oysters "that grow round and deeply cupped,"with "these thick mature shells, and are just packed with oyster, just like to the edges."

Farm owner George Trevelyan further explained the game-changing nature of tumble culture for the farm — only 10 to 20 percent of oysters produced by traditional bottom culture can be used for the lucrative half shell market, whereas tumbling pushes that up to 90 percent while requiring significantly less human labor along the way: "It's totally transforming our oysters."

While the newer methods are a boon to both farms, changes to farming practices have to happen against the backdrop of state regulation and environmental challenges.

Carolina Hernandez, left, and Jenny Sorto preps bags used to hold the freshly harvested oysters at the Grassy Bar Oyster Co. in Morro Bay. Laura Dickinson LDICKINSON@THETRIBUNENEWS.COM

George Trevelyan said that in 2018, the California Coastal Commission started requiring all oyster farmers statewide to apply for a coastal development permit in order to continue farming.

Anytime they want to change their growing activities, including their ongoing addition of new tumble lines, both Maloney and George Trevelyan said they must apply to amend their permit — a process that also requires a period of public comment.

WHAT DOES THE FUTURE HOLD?

To produce high-quality oysters, Maloney and Trevelyan are dependent on the water quality and conditions of the bay.

A UC Davis study published this month in the journal Limnology and Oceanography examined how ideal conditions for oysters, which scientists call the “Goldilocks’ zone,” might be affected by climate change.

Their research at Tomales Bay in Northern California found that oysters' estuary habitats are pressed from changing conditions on two fronts: the ocean and the streams and rivers that feed into it.

Carolina Hernandez and William Hudson prep the oysters for shipping at the Grassy Bar Oyster Co. in Morro Bay. Laura Dickinson LDICKINSON@THETRIBUNENEWS.COM

The UC Davis study found that the ideal growing zone for oysters will shrink based on climate change projections, and that their conclusions hold true for the entire state.

Because farmers' operations are tied to very specifically designated growing areas and can't be easily relocated, that could be a serious threat.

Trevelyan said it's "really special to be here right in middle of California," but incidents like the chalkier rather than pearly shells he's seen on some of his oysters, and large die-off events of larval oysters in the mid-2000s at hatcheries on the Pacific Coast, remind him that the effects of climate change could be hitting closer to home.

For the time being, both Morro Bay oyster farmers will use their years of expertise to evolve their techniques and respond to changes both within regulation and the industry at large, so they can continue to delight local diners who appreciate that certain *je ne sais quoi* of the oyster.

THE TRIBUNE

Climate change may damage oyster habitat up and down California, researchers say

BY CARRIE SCHUMAN

AUGUST 19, 2019 05:00 AM, UPDATED AUGUST 19, 2019 02:19 PM

Business is strong for oyster farmers in Morro Bay, California, who produce shellfish for local and statewide demand. Here's how Grassy Bar Oyster Co. harvests fresh oysters at its SLO County operation. BY LAURA DICKINSON

In California, the native Olympia oyster — nearly wiped out by over-harvesting at the beginning of the 1900s — and the widely farmed Pacific oyster both call coastal estuaries their home.

But the two species may soon be facing a housing crisis prompted by climate change, as new research originating from UC Davis and published in Limnology and Oceanography suggests their habitat may soon shrink, a threat that has implications for oysters grown on the Central Coast, across the state of California and beyond.

RESEARCHERS EXPLORED HOW COASTAL CONDITIONS AFFECT OYSTERS

Both Olympia and Pacific oysters survive in highly variable estuarine habitats — areas with a transitional “brackish” mix of fresh and salty water — while navigating a complex mix of environmental stressors.

Like any living thing, oysters thrive in an ideal set of conditions but start to suffer outside those boundaries.

The Grassy Bar Oyster company in Morro Bay is owned and farmed by George Trevelyan and his son Charles. Oyster farmers Carolina Hernandez, left, Raul Tapia, and Jenny Sorto walk amongst the oyster beds. Laura Dickinson LDICKINSON@THETRIBUNENEWS.COM

Researchers wanted to understand how conditions in different parts of Tomales Bay and at different times of year affected how well both species of oysters grew and survived.

UC Davis environmental science and policy Professor Ted Grosholz led the study — funded by a California Sea Grant — with a team that included first author Jordan Hollarsmith, who is now a postdoctoral fellow at Vancouver’s Simon-Frasier University in Canada.

In a phone interview with The Tribune, Hollarsmith emphasized that although environmental influences on oysters are often studied in lab settings, it was “really

important to take the experiment out to field, where everything is interacting, all impacting oysters at the same time."

The team transplanted lab-reared Olympia and Pacific oysters in locations that varied in distance from the mouth of the bay, while measuring how well both species of oysters grew and survived.

They repeated this during the three distinct seasonal patterns California bays experience.

As a result of its Mediterranean climate, Hollarsmith said, California winters bring an influx of fresh water into estuaries, dry summers coincide with winds that upwell cold, acidic, and oxygen deplete ocean waters toward shore, and early fall represents an in-between Indian summer-like period of calm and warmth, "where conditions are relatively stable."

The Grassy Bar Oyster company in Morro Bay is owned and farmed by George Trevelyan and his son Charles. Oyster farmers Carolina Hernandez and William Hudson prep the oysters for shipping. Laura Dickinson LDICKINSON@THETRIBUNENEWS.COM

In both Olympia and Pacific oysters, growth slowed and more individuals died when they were closer to sources of summer upwelling, and this was amplified even more for oysters closer to pulses of freshwater introduced to the bay during the winter.

Multiple qualities of the water oysters were growing in — like temperature, salinity, oxygen levels and pH — were likely responsible for these negative impacts.

For examples, highly acidic water can make it hard for oysters to grow their shells, while high water temperatures can cook them in the same way that a heatwave earlier in the summer killed masses of mussels in Northern California.

Hollarsmith says this translates to an area of “really crucial Goldilocks conditions in middle of the bay,” where the balance of these factors were just right to support the healthiest oysters.

CHANGES ARE EXPECTED IN THE FUTURE

Current climate projections suggest “upwelling winds will likely get stronger and drive cold upwelled water deeper into bays for longer,” Hollarsmith said, while winter will bring more intense rainfall that brings larger pulses of fresh water into California estuaries.

Barbecued oysters were on the menu at the 32nd annual Morro Bay Harbor Festival.
LDICKINSON@THETRIBUNENEWS.COM

What this means — according to Grosholz — is “the estuarine zone is shrinking due to climate change,” and oysters will continue to be “squeezed on both sides” by changes to ocean and river influences.

Or as Hollarsmith said: the “Goldilocks location gets a little narrower.”

Both Grosholz and Hollarsmith confirmed that these projections apply to not just Tomales Bay, but to estuaries along the entirety of California’s coast.

This can have significant consequences for both wild oysters that can’t relocate once they settle on the bay bottom as larvae, and for shellfish farming operations that are a treasured source of local seafood.

Oyster farmers tend their product on areas leased through the state, and because of the tangle of regulations and other barriers, they can’t easily or quickly relocate operations.

Fresh local oysters are served at Port House restaurant in Morro Bay. Courtesy of Port House

With further respect to shellfish farming, Grosholz also said that increasing water temperatures provides additional threats: “Bacteria and viruses go wild with higher temperatures.”

He pointed to the example of an oyster herpesvirus called OsHV-1 — a “new disease all commercial oyster farmers live in fear of.”

Shirley Baker, an invertebrate biology, ecology, and aquaculture professor at the University of Florida, was not involved with the study but said it “has important implications for the shellfish industry” even in other parts of the country and might give “insight into the inconsistent hatchery production of seed observed in the last few years” around the Gulf of Mexico after heavy rainfall and flooding events.

But when focusing the lens back to the local waters of the Central Coast, Hollarsmith said, “Morro Bay is also in place with pretty strong upwelling and the same intrusions of cold, low pH, low oxygen water” that affect Tomales Bay.

She said that the strengthening of those conditions through climate change “may have consequences for restoration and farming in the area.”

THE TRIBUNE

Tiny pieces of plastic pollute Monterey Bay — and they're likely in SLO County waters, too

BY **CARRIE SCHUMAN**

JULY 05, 2019 09:39 AM, UPDATED JULY 08, 2019 08:41 PM

Microplastics were found at multiple ocean depths and in sea animals off California Central Coast, a recent study shows. Hear a Monterey Bay Acquarium scientist speak about the threat to the ecosystem. BY ALEXA ARD AND MONTEREY BAY AQUARIUM/MBARI

When envisioning the problem of plastic pollution in our oceans, scenes of beaches strewn with single-sue water bottles, cigarette butts and other trash often come to mind.

You may recall viral videos that tug on the heartstrings, such as the clip of biologists removing a straw from the nostril of an olive ridley sea turtle.

But the most damaging plastics in the ocean and other water bodies may be ones that are almost too small to see – and they're even being found here on the Central Coast.

A recent study by researchers at Monterey Bay Aquarium Research Institute (MBARI) and Monterey Bay Aquarium found tiny particles called microplastics at wide-ranging ocean depths and within all marine organisms they examined. The results reconfirm that microplastics can be widespread and are making their way into ocean food webs.

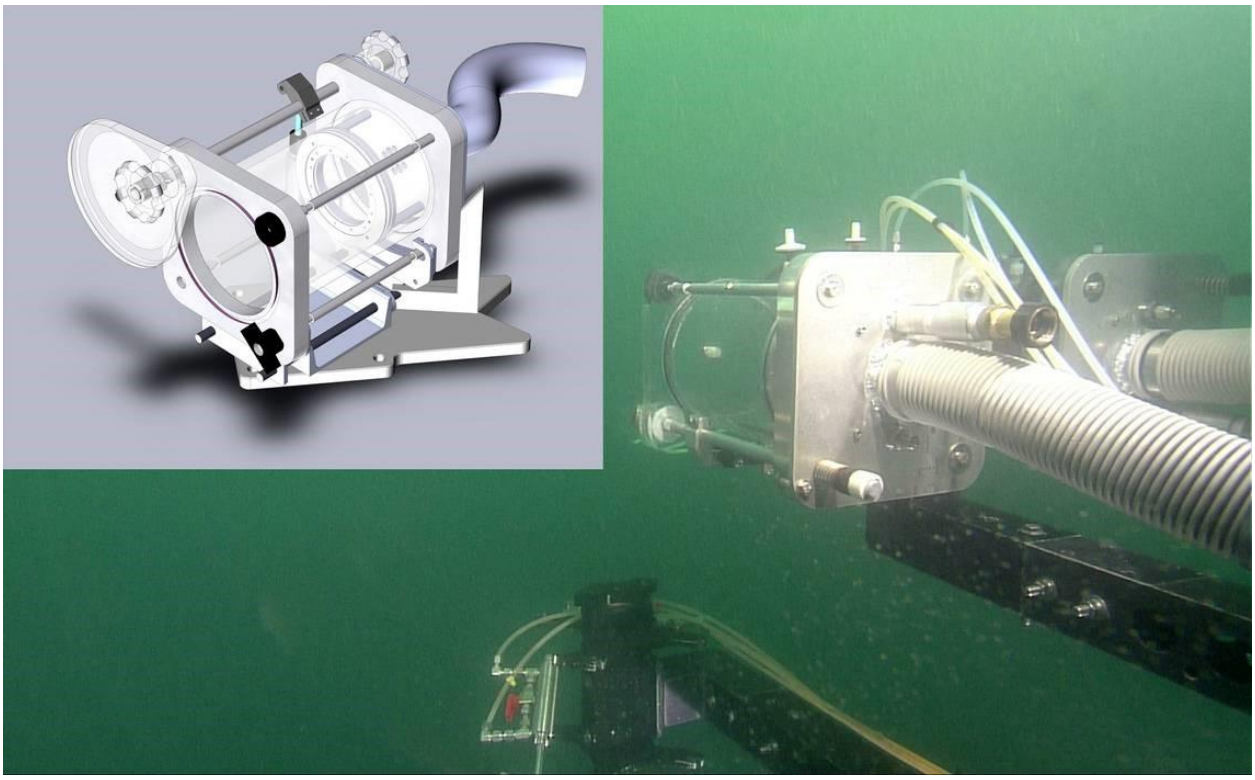
WHAT ARE MICROPLASTICS AND WHERE DO THEY COME FROM?

Microplastics are particles less than 5 millimeters in length — about four times the length of a grain of sand, and they come in two types.

Secondary microplastics are the remnants that are created when larger "macro" plastics break down over time, from the usual suspects like plastic bags, bottles, containers and knick-knacks.

Primary microplastics are those bits of material produced at a tiny size and directly released into the ocean. A well-known example is microbeads, found in "rinse-off" products like shampoo and soap. While the federal 2015 Microbead-Free Waters Act curbed their use in those products, microbeads and other microplastics like glitter can still be present in non "rinse-off" products like makeup and detergents.

Synthetic clothes that shed fibers in your washing machine are another important but perhaps surprising source of primary microplastics. According to a 2019 study published in Scientific Reports, many of these could be just the right size to bypass wastewater treatment and enter downstream aquatic systems.



MBARI engineers spent considerable time and effort developing a device to collect and filter microplastic deep below the surface of Monterey Bay. © 2017 MBARI

WHAT DID THE MONTEREY STUDY FIND?

The team of researchers in Monterey, helmed by lead author Anela Choy, used one of MBARI's remotely operated vehicles, Ventana, to retrieve water samples from intervals ranging from 5 to 1,000 meters.

The scientists found a similar concentration of particles in both the shallowest and deepest depths they sampled, while finding almost four times that occurring between mid-depths of 200 and 600 meters. Weathering of the plastic also suggested it had been adrift in the marine environment for long periods of time.

Gear used by local fishermen was ruled out as a significant source of plastic pollution. Rather, the study described the material as mostly polyethylene terephthalate (PET), polyamide and polycarbonate — components associated with single-use beverage and food containers, nylon clothing and eyewear.

In addition, the team also looked for and found microplastics within two filter-feeding organisms — pelagic red crabs and giant larvaceans, transparent invertebrates that build temporary nets of mucus to filter particles from the surrounding water.

MBARI principal engineer and study co-author Kakani Katija said these particular ocean animals were chosen because “the way they eat brings them in contact with large volumes of water.”

Because these creatures are ingesting microplastics and contribute to food webs at multiple depths in the ocean, they can help move plastic particles from the ocean’s surface to its lower reaches.

While this is not the first study to look at microplastic concentrations across multiple depths, marine scientist La Daana Kanhai, who is unaffiliated with the study but has done similar work in the Arctic, wrote in an email that “studies like this emphasize the pervasiveness of microplastics in the oceans as well as highlight the fact that these particles are interacting with the marine organisms that inhabit our oceans. More than ever, studies like this are a call to action to address the issue of plastic pollution in the oceans.”

The Monterey Bay researchers found microplastics in two filter-feeding organisms: invertebrate larvaceans, left, and pelagic red crabs. Left image © MBARI; Right image © Monterey Bay Aquarium (C) 2002 MBARI

WHAT DOES THIS MEAN FOR SLO COUNTY?

The results from the Monterey Bay study join a body of research documenting the presence of plastic throughout the extent of the world’s oceans and more generally in the environment around us.

This suggests there are likely microplastics in waters adjacent to San Luis Obispo County, but study co-author Katija says it can be difficult to suggest how much and where without further sampling and research.

“I think this local study on microplastics is important because it is easy to be disconnected from this problem,” Chelsea Potter, current chair of the Rise Against Plastics Initiative for the SLO chapter of Surfrider, said in an email. “When we see more local studies, it really

'hits home' and makes us realize that this effects us personally as well as our future generations."

Though there continues to be large data gaps in study around the effects of microplastics on aquatic organisms, according to a 2018 Science of the Total Environment research review, scientists have documented impacts on sea life ranging from neurotoxicity in fish to reduced survival and fertility of marine zooplankton.

Concentrations of micro-pollutants can also be amplified when larger animals, such as fish, load up on smaller plastic-containing organisms. A 2019 Environmental Science and Technology study characterizes seafood as one of the top three contributors to human consumption of microplastics.

The United Nations Food and Agricultural Organization advises this is more of a concern in seafood that is typically consumed whole, as is the case for shellfish, crustaceans, and small fish like sardines. For example, Belgian researchers estimate that European shellfish consumers may be ingesting up to 11,000 microplastic particles every year when eating cultured blue mussels and Pacific oysters.

Potter also wrote in her email that "In human and animal studies, different types of plastic exposure have been associated with certain cancers, hormonal disruptions and other serious health problems. Continued research is important to further understand the detrimental effects of plastics on human health."

WHAT CAN YOU DO TO REDUCE MICROPLASTICS?

On the legislative side, California has already begun to focus on reducing microplastic pollution via Senate Bills 1422 and 1263, both signed in 2018 by then-Gov. Jerry Brown.

The first adds microplastics to the California Safe Drinking Water Act and requires that the State Water Resources Control Board adopt a standard methodology by July 2020 to test for microplastics in drinking water for four years while disclosing the results publicly. The second directs the state's Ocean Protection Council to develop and submit a Statewide Microplastics Strategy to the Legislature by December of 2021.

Katija found the fact that the study team measured plastic in locations both easy and difficult to access makes the "idea of removing plastics from the ocean much more challenging." She suggests it is important these plastics don't make it into the water supply, and ultimately the ocean in the first place.

Katija urges people to consider other materials for single-use needs. SLO has already embraced this notion in the form of two city ordinances enacted last year regulating singleuse plastic bottles, straws and cups, as reported by The Tribune.

Carlie Herring from NOAA advises being a selective consumer, including searching for ingredients like “polyethylene” on labels to help identify products that still contain plastics. She also recommends disposing of larger plastic debris when out at parks or the beach “so we remove them before they become microplastics.”

Consumers can further make choices related to the types of textiles they buy or turn toward products, like those Ocean Clean Wash describe on their website, that capture fibers during the wash cycle. Industry is also tackling the program as evidenced by a 2017 summit held in California that brought together producers of apparel and outdoor goods, scientists, nonprofits and other groups associated with microfiber pollution.

Responding by email, Ximena Waissbluth, Monterey Chapter coordinator for Surfrider, thinks more needs to happen at the commercial level: “We can each do better at the consumer level with our choices, but as, if not more, importantly, the companies who make this stuff need to step up and go full bore into the world of truly compostable materials, returnable systems, thoughtful design.”

THE TRIBUNE

Have you seen fewer sea stars lately? Scientists are still working out why

BY **CARRIE SCHUMAN**

JULY 09, 2019 04:39 PM, UPDATED JULY 16, 2019 06:32 PM

Take a look at the underwater life of a Cayucos tide pool. A Pacific Ocean intertidal zone may teem with life but sea star populations have been falling from California to Alaska due to wasting syndrome that turns the starfish into goo.BY DAVID MIDDLECAMP

Starfish populations decimated by the onset of a wasting syndrome six years ago continue to make a comeback in parts of California, but recovery remains stilted along the Central Coast.

And while sea star wasting syndrome is “probably the best studied marine disease ever,” researchers still don’t definitively understand the causes behind it, said Peter Raimondi, a professor in the Ecology and Evolutionary Biology Department at UC Santa Cruz.

WHAT IS SEA STAR WASTING SYNDROME?

According the Multi-Agency Rocky Intertidal Network (MARINe) website, sea star wasting syndrome was noticed first by researchers in Washington state in June 2013 as masses of sea stars began dying on the Pacific coast.

Melissa Douglas, an intertidal associate research specialist at UC Santa Cruz, recently described the affliction.

“Usually we first see lesions on the star,” Douglas explained in a recording she made for high school students. “Often they begin to lose arms, and many times they turn into mush and basically look like they are disintegrating — all over a quick span of time, sometimes just a few days.”

More than 20 different species of sea star ranging from Southern California to Alaska have been affected by this wasting event.

A bat star on the rocks at low tide, only three were observed in a recent informal survey of Cayucos tide pool. Once commonly found in tide pools sea stars have been impacted by wasting syndrome from Alaska to Southern California reducing their numbers. 7-8-2019 David Middlecamp David Middlecamp DMIDDLECAMP@THETRIBUNENEWS.COM

UNDERSTANDING THE CAUSE OF THE DISEASE

Raimondi was part of a team that published research in 2014 in the Proceedings of the National Academy of Sciences that first suggested a virus could be at fault for the wasting syndrome — perhaps one that had impacted sea stars in the past.

The same team completed further work and found that explanation didn't apply for most of the affected species. "There's less certainty about what the cause was," Raimondi said.

While bacteria has been confirmed as the ultimate cause of death for many sea stars with the wasting syndrome, it's unclear what makes the sea stars so susceptible in the first place.

Raimondi suggested there may be possible environmental influences — such as temperature or other bacterial infections that create more sensitivity to this current bout of wasting. But, he said, it's likely complicated.

There have been similar sea star die-off events in past decades, but Raimondi said the current instance is unusual in geographic scale.

Past occurrences of wasting in Southern California often haven't extended beyond Point Conception in Santa Barbara County. These prior events were more obviously connected to warming waters, and didn't impact so many sea star species.

Intertidal species, like the ochre sea star, can be found in tide pools like this one — though they are harder to find after the onset of sea star wasting syndrome. David Middlecamp DMIDDLECAMP@THETRIBUNENEWS.COM

HOW ARE STARFISH DOING IN SLO COUNTY?

Though results are still incoming from monitoring efforts in 2019, Raimondi provided a general overview of the state of sea stars in San Luis Obispo County. While survey efforts range from Mexico to Alaska, local recovery continues to be patchy.

In intertidal areas within San Luis Obispo County, numbers of the ochre sea star remain low. This species is an important control of mussels that can overwhelm tide pool habitats when ochre stars aren't present.

Influxes of baby sea stars, including the ochre sea star, documented all along the Pacific coast in the year or two after the start of the wasting event gave Raimondi hope that local populations would see more recovery. "But that really hasn't manifested," he said.

According to Raimondi, survival for these little starfish can be a struggle even in the best of times.

A crab patrols the tide pools of Cayucos. Once commonly found nearby, sea stars have been impacted by wasting syndrome from Alaska to Southern California, reducing their numbers. David Middlecamp DMIDDLECAMP@THETRIBUNENEWS.COM

In rocky shore areas that remain under water and are home to habitats such as kelp forests, there has been “no recovery at all” of sunflower stars except in Washington state and locations father north, he said.

To his knowledge, Raimondi said, there has been no recent reports of sunflower stars found in this area.

That sea star, which has a radial crown of 16 to 24 arms and can be a half meter or more across, is a “voracious predator,” Raimondi said.

Raimondi said some in the scientific community attribute the loss of some kelp forests to the absence of sunflower stars and their control of sea urchins.

Sea urchins are efficient grazers on kelp, and can mow kelp forests down to leave areas referred to as “urchin barrens,” which disrupts the existing ecological community.

HOW TO HELP MONITOR SEA STARS

Because the scientists and organizations who monitor and study the syndrome in sea stars have limited resources and personnel, people visiting tide pools are an important source of data.

Raimondi said that kids are especially adept observers and were instrumental in alerting scientists to the presence of juvenile sea stars seen soon after the onset of wasting syndrome.

Want to contribute to monitoring efforts? Submit your observations to the Sea Star Wasting Syndrome Observation Log at gordon.science.oregonstate.edu/sea_star_wasting/observation_log/new.

THE TRIBUNE

Morro Bay lost 90% of its eelgrass. Here's how scientists are trying to save the key plant

BY **CARRIE SCHUMAN**

JULY 22, 2019 04:45 AM, UPDATED JULY 23, 2019 11:00 PM

The Morro Bay National Estuary Program is working to restore eelgrass, which was decimated in recent years. Here's a closeup, underwater look at the aquatic plant, which is a key habitat and home to sea otters. BY DAVID MIDDLECAMP

Near Coleman Park, Rachel Pass of the Morro Bay National Estuarine Program points out patches of eelgrass, whose unassuming blades sway with the waters of the bay.

Closer to the South T Pier, a sleeping sea otter naps in a floating eelgrass bed and stirs occasionally to scratch its belly.

Both are valuable parts of the bay's nearly 20 acres of the aquatic plant, a remnant of what was once closer to 350 acres in the past.

And while the habitat is still a far cry from its historic scope, work to replant eelgrass in recent years appears to have stabilized the decline and is supporting new growth, local conservationists say.

The National Estuary Program in Morro Bay continues to lead the way for local restoration efforts, leveraging a rich network of scientific expertise and elbow grease from the local community.

During their struggle to keep and expand the grass that's left, program staff have been learning what works and what doesn't when it comes to restoration.

A sea otter rests in eel grass, rubbing his face. Morro Bay eelgrass is a foundation flora for the health of the bay. After a massive die off, new techniques are helping restore the vital plant. 7-10-2019 David Middlecamp David MiddlecampDMIDDLECAMP@THETRIBUNENEWS.COM **THE IMPORTANCE OF EELGRASS**

Eelgrass is one of those aquatic species that is both an organism and a habitat — think of oyster and coral reefs.

According to Lexie Bell, executive director of the Estuary Program, eelgrass is "the foundation for how the bay functions."

The grass provides a home for and sustains a wide community of living things.

“It supports some species that people care particularly about,” Bell says, including coastal birds migrating through the Pacific Flyway and species of fish like steelhead trout.

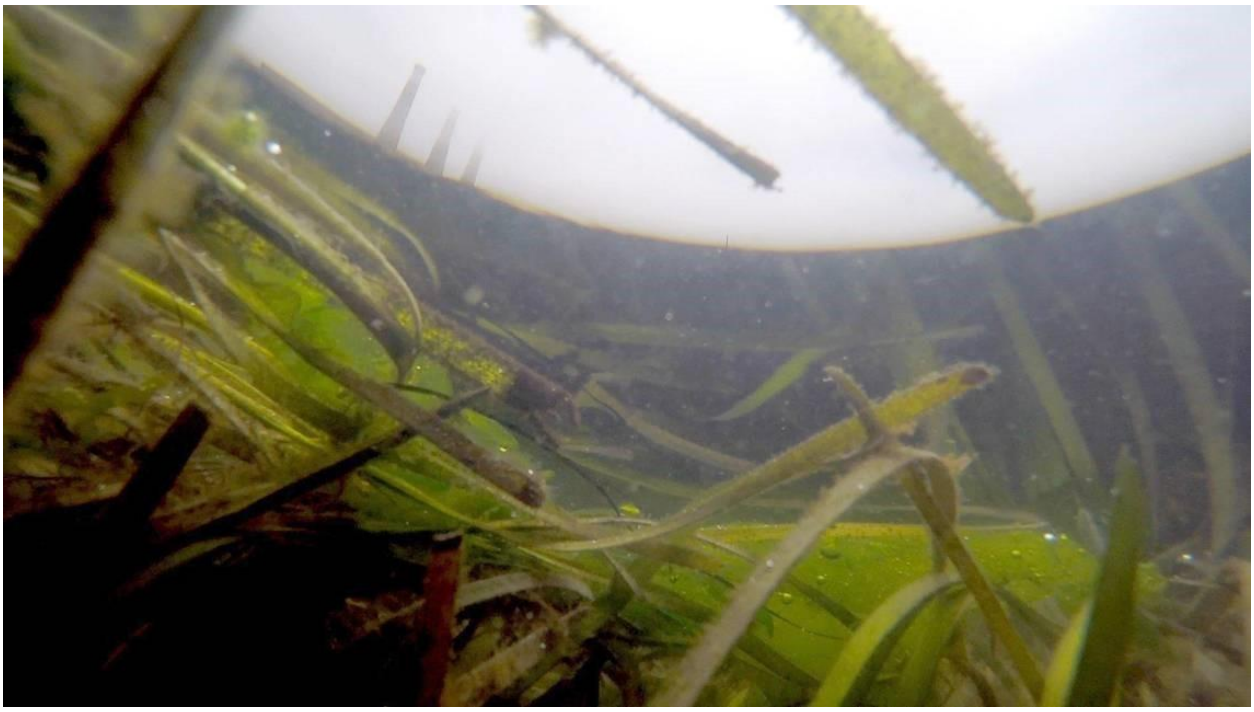
Indeed, one of the more visible examples of the loss of eelgrass has been on black brandt geese, which feed on the vegetation and have long used Morro Bay as a migratory stop.

“They teach their next generation where to stop,” Bell said, and “the next generation is not learning to stop here.”

Eelgrass provides a slew of other benefits, as well.

When it comes to water quality, the grass slows the flow of incoming water, which allows sediment to drop out and improves clarity. It assists with the job of removing extra nutrients that could otherwise lead to overgrowth of algae.

Eelgrass also “allows fish and all other critters to have oxygen to breathe underwater,” Bell said.



The smoke stacks of the power plant are in the back ground, eelgrass is in the foreground in this underwater photo. 7-10-2019 David Middlecamp David Middlecamp DMIDDLECAMP@THETRIBUNENEWS.COM

And the plant helps maintain the vitality of the bay and its value as a tourism destination.

The city needs “a healthy bay that’s functioning, with otters floating in the eelgrass, and birds that are feeding on fish — and a bay that looks clean and smells clean,” Bell added.

EELGRASS IN DECLINE

So when eelgrass suffered a major die-off here a few years ago, alarms sounded.

From 2007 to 2012, Morro Bay lost about 90% of its eelgrass.

“We have a community that is out on the water all the time,” Bell explained. “People notice — ‘Oh, there’s not as much eelgrass as there used to be. What’s happening?’”

Multiple factors might have led to the eelgrass loss and could be hindering its recovery — some environmental and some associated with human activity.

In order to understand which are important, the Estuary Program has collaborated with scientists at Cal Poly.

For example, research led by Cal Poly assistant physics professor and physical oceanographer Ryan Walter, in collaboration with Jennifer O’Leary (CA Sea Grant) revealed that parts of the bay experience very different water quality conditions including temperature, salinity, and ability of light to reach deeper water, all of which could influence eelgrass growth.

Meanwhile, the program has also led aggressive efforts to replant eelgrass, starting in 2012, while at the same time working to further understand the problem.

“We didn’t want to lose it all,” Bell said.

Morro Rock in the background with eelgrass visible in foreground. In Morro Bay, eelgrass supports the health of the bay. 7-10-2019 David Middlecamp David Middlecamp DMIDDLECAMP@THETRIBUNENEWS.COM

Results are still incoming, but what they can say about the current state of eelgrass in the area now, Bell said, is that the acreage still is small, but “it has been relatively stable since 2013. We don’t appear to be losing anymore and we might be gaining a small amount.”

To evaluate progress, the Estuary Program conducts regular mapping, but it can be inherently challenging to tell how much eelgrass is actually in the bay.

Different mapping technologies can give conflicting results, and the weather and tide conditions need to be just right for the flights they typically use to gather data every other year.

RESTORATION EFFORTS

The effort to replant eelgrass in the bay has definitely helped, and the Estuary Program said it continues to test how to best restore the habitat.

In the most recent phase of restoration which started in 2017, the Estuary Program has planted just under 6,000 plants at 16 different sites.

Restoration work in a given year can take 30 to 40 hours spread out over multiple days and weekends and has to be timed for the right tide. A particular day of restoration can involve 10 to 15 volunteers that help set the plants out in the muddy bottom of the bay.

Bell described a great variety of nationwide network because they want to help restore the eelgrass. Teachers, former scientists, kayakers, students, AmeriCorps members, and oyster farmers are just some who have joined the ranks.

This year's efforts include more sites than they've had in the past — about 15 instead of the 7 or 8 that were the focus of 2017 and 2018.

"We scaled up quite a bit in 2019, just based on the overall success of the past years," said Karissa Willits, the program's monitoring coordinator.

Volunteers sort eelgrass into small bundles to be replanted in Morro Bay in 2014. Joe JohnstonJJOHNSTON@THETRIBUNENEWS.COM

Currently, the program is employing two types of restoration methods.

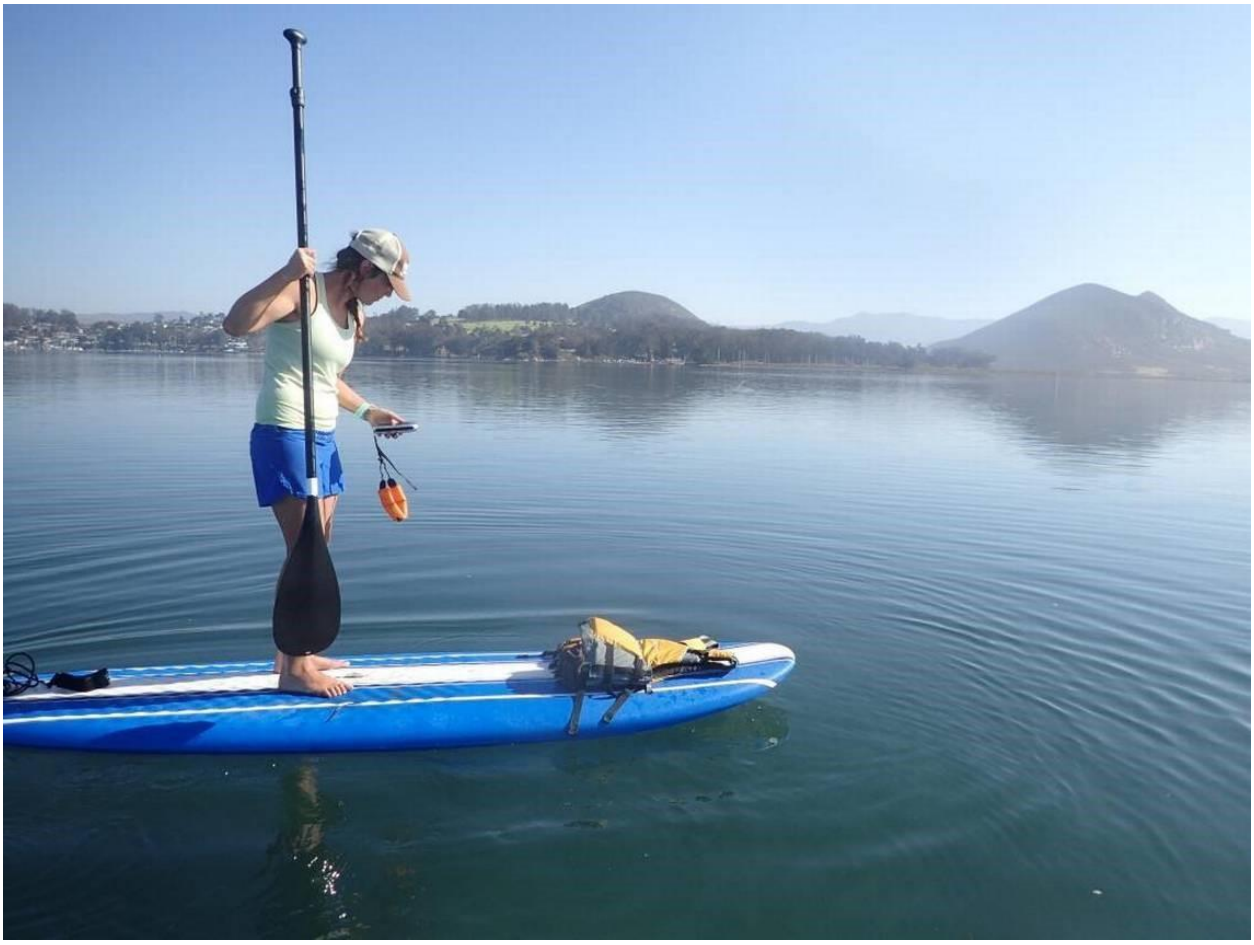
One, used more sparingly in places that are harder to access, involves tying eelgrass to a piece of rebar bent into an L-shape that can be anchored to the bay floor and removed when the grass sets.

In most plots, however, eelgrass rhizomes — the thick underground stem of an eelgrass plant — are criss-crossed and secured with garden stakes.

During the replanting process, the team has made discoveries about the bay's eelgrass that can help instruct and sometimes boost their efforts.

For example, when comparing planting during spring and summer, it's clear spring plantings thrive more. This may be because the grass is released from competition with the algae that pops up in local waters during summer heat.

Willits explains that eelgrass can either be more seasonal in harsher environments or persist year round. Though staff thought their grass was around all the time, observations they've made of restoration projects revealed both types exist in the bay.



A Morro Bay National Estuary Program staff member uses a GPS unit to find transplanted eelgrass in 2016. Staff members monitor areas where eelgrass was re-planted to determine survival rates. Courtesy of the Morro Bay National Estuary Program

“We were testing the season, the location and the method,” Willits said.

Cal Poly researchers have also confirmed that the bay’s population of eelgrass is genetically distinct from outside locations.

This means transplanting from places other than Morro Bay could result in ill-adapted plants that fail during restoration attempts.

It’s also a reason why restoration efforts can take a little longer — the low acreage of eelgrass present means fewer beds to borrow from in order to cultivate more.

The program benefits from being part of a Morro Bay National Estuarine Program that includes 27 other sites, and the group has had opportunities to get feedback from experts across the country.

This has helped fuel experimentation around restoration within the bay, with the ultimate goal of giving eelgrass the advantage it needs to re-establish itself.

Editor's note: An earlier version of this story misidentified Jennifer O'Leary as the person who led an eelgrass research project at Cal Poly. The project leader was Ryan Walter. The error has been corrected.

THE TRIBUNE

How do carnival rides work? Former Disney Imagineer, Cal Poly educator share secrets

BY **CARRIE SCHUMAN**

JULY 23, 2019 02:37 PM

Watch visitors to the California Mid-State Fair in Paso Robles enjoy carnival rides on July 17, 2019. It was the first year that people attending the fair's opening day could enjoy rides for free BY **LAURA DICKINSON**

Fair season is upon us — which means lots of cotton candy and carnival rides.

As you soar through the air on the Wave Swinger or plummet toward the ground on the Super Shot, have you ever wondered who is responsible for those thrilling rides?

Credit the physicists and engineers who use science to make us squirm, scream, and laugh — all while keeping us safe.

TAKING CARNIVAL RIDES FROM IDEA TO REALITY

David Collins, a self-described "fast learner, and dreamer," was once an aerospace engineer. He transitioned into the amusement ride industry 36 years ago, and spent a stint as a Disney Imagineer.

Currently, he guides companies through the design and development of new amusement park rides, also serving as a safety inspector and expert witness.

Via phone, Collins discussed the role of engineering in designing rides.

Ferris wheels are classic rides that invoke nostalgia for many fairgoers. Laura Dickinson LDICKINSON@THETRIBUNENEWS.COM

Engineering skills come into play with designing the “pneumatics, electronics, and mechanics” of each ride, Collins said.

“There are hundreds of pieces and bits that you have to understand when you run the controls and make sure everything works properly,” he said.

Ride developers are also guided by 19 published safety standards developed by the American Society of Testing and Materials.

The first part of the actual design process involves a meeting that includes people involved with designing, inspecting, and buying the ride to see if anything needs to be tweaked “before any metal is bent, steel is cut, or wires connected,” Collins said.

That’s understandable, he added, since the next step of creating a ride prototype — the first version ever produced by the factory — can cost between $200,000 and $400,000.

Fairgoers enjoy free carnival rides on opening day of the California Mid-State Fair, Wednesday, July 17, 2019. Mutale Malama, 14, front, Ava Buschur, 15, hidden, and Olivia Buschur, 13, rear, all of San Luis Obispo, scream as they fly down the Big Splash log ride. Laura Dickinson LDICKINSON@THETRIBUNENEWS.COM

Collins recalled a recent trip to Italy to audit a “naked version of a ride.” “All brakes, sensors, computers, controls, and the ride vehicles were on the track,” he said, but the steel hadn’t yet been painted.

Collins worked with the manufacturer to make sure the ride operated without incident — running it continuously over the course of two weeks — part of an in-depth auditing process that also includes making sure a ride is properly maintained, operated, and documented.

Rides without immediate buyers can also be showcased at trade shows such as the International Association of Amusement Parks and Attractions’ yearly expo in Orlando, where everything from attractions to inflatables and plush toys are on display, according to Collins.

There, rides may end up in the hands of amusement parks and firms that specialize in supplying attractions for temporary events such as county and state fairs. Collins said these firms also handle all aspects of running and maintaining their rides.

While there are many classic rides — such as roller coasters, carousels and Ferris wheels — that Collins said “have been around for 25, 30, 40 years,” there’s still plenty of innovation in the ride industry.

This is because of what Collins called a ride’s “novelty life”: the three to five years where riders are excited enough to buy tickets to experience a ride after its introduction.

Helm & Sons Amusements, for instance, brought a number of new rides to the 2019 California Mid-State Fair in Paso Robles, including Insomniac, a high-speed spinning ride, and Crazy Dumbos, which features flying elephants.

Fairgoers enjoy free carnival rides on opening day of the California Mid-State Fair in Paso Robles, Wednesday, July 17, 2019. Uri Torres-Granados, 4, of Paso Robles really enjoys the Baja Buggies ride. Laura Dickinson LDICKINSON@THETRIBUNENEWS.COM

THE SCIENCE THAT MAKES RIDES FUN

Ride developers owe the excitement of amusement park rides, with all their moving parts to physics, a branch of science that focuses on the study of matter and energy, and the interaction between them.

You can divide carnival rides into three types, according to Kevin Coulombe, an instructional support technician in Cal Poly’s Physics Department — the ones that whoosh you along, the ones that drop you, and the ones that spin you.

Coulombe, who has taught at the San Luis Obispo university since spring of 2018, explained that thrills are created when resting energy and moving energy “play a ballet on a roller coaster.”

The mechanisms that tote cars to a coaster’s peak are imbuing the car with stored potential energy.

When the cars go over that first hill, that energy is quickly transformed into moving, kinetic energy and then back to potential energy when climbing up the next one.

Coulombe said this process can repeat itself again and again unless a subsequent peak is higher than the first the cars were launched from. In that case, riders will need an extra bit of mechanical lift to keep on going.

Sonia Marin, center, and friend Luis Maya, left, scream as the Super Shot ride zooms down the tower. Both are from Santa Maria. The Super Shot is an example of a ride that capitalizes on the effect of gravity to deliver thrills. Laura DickinsonLDICKINSON@THETRIBUNENEWS.COM

Rides that drop you are capitalizing on free falling and the effect of gravity.

When you’re cranked up to the top of one of these rides, you start out at rest. Gravity is what does the job of getting you to the bottom.

Regardless of weight, riders will all increase their speed at a the same rate — a cool 9.8 meters per second squared. Coulombe said this process of going faster, similar to having your foot on the pedal of a car, is part of a concept called “gravitational acceleration.”

If people are dropped from a greater height, they have more time to gain speed during their fall. If nothing else like air resistance interferes, then riders only under the influence of gravity are in free fall.

It's this transition between being completely at rest, then in free fall, that creates the "whoop-dedoo feeling in your stomach" Coulombe explained.

Last are the spinning-style rides, ranging from those that plaster you to the side of the drum to the more demure teacups.

Riders on the Happy Swings enjoy a breezy ride partly controlled by centripetal force. Laura DickinsonLDICKINSON@THETRIBUNENEWS.COM

Newton's first law of motion, Coulombe said, is sometimes referred to as the "law of lazy bodies." This refers to the fact that "all bodies with mass, like a person, will tend to resist changing what they are currently doing," even if that means traveling in a straight line.

Coulombe explained that ride designers use centripetal force to prevent riders from flying off rides that use circular motion.

This is similar to the idea of someone swinging a ball on a string round and round. The tension of the string is what provides the centripetal force that keeps the balls movement reined in towards the center of the circle instead of it flying away on a straight path.

Faster movement on a circular ride or a decrease in how far riders are from the center can increase centripetal forces acting on the rider that keeps them in circular motion.

At the same time, Coulombe said, the sensation riders feel as “lazy bodies” that simultaneously want to resist those forces also increases — a feeling some carnivalgoers live for.

THE TRIBUNE

California sea lions are being poisoned by toxic algae. Why this year is more concerning

BY CARRIE SCHUMAN

JULY 28, 2019 05:15 AM, UPDATED JULY 30, 2019 09:14 PM

Every year, California sea lions with domoic acid toxicity are rescued from beaches in San Luis Obispo County. Here's how the Marine Mammal Center's Morro Bay facility cares for the animals BY LAURA DICKINSON

On a beautiful Friday in July, a dehydrated young sea lion was rescued from the Harford Pier by the Marine Mammal Center's San Luis Obispo County rescue team.

Pier visitors noticed the curious sea lion had been lounging on a floating dock for a suspiciously long time.

This California sea lion, later dubbed “Landing,” represents one of the hundreds the center cares for every year, including a large number suffering poisoning from an algal toxin called domoic acid.

Dr. Cara Field, one of the center’s veterinarians, said this year is especially alarming because the algal blooms responsible for producing domoic acid have started earlier than usual — just in time to target “adult female sea lions making their way to the Channel Islands to give birth” and “a whole second generation” of unborn sea lion pups.

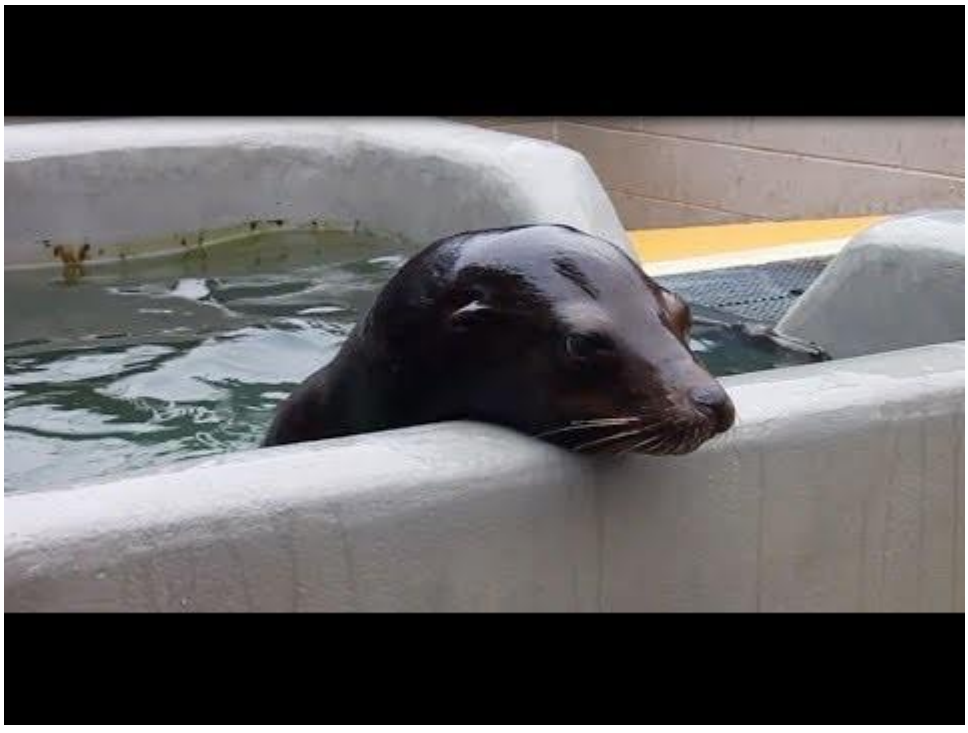
SEA LIONS HARMED BY TOXIC ALGAE

The source of domoic acid — a potent neurotoxin — is a microscopic plant-like organism called phytoplankton.

When one particular species called Pseudo-nitzschia finds just the right sweet spot of conditions, it can rapidly reproduce and form a “bloom.”

People unfortunate enough to be exposed to domoic acid by eating tainted shellfish can develop amnesic shellfish poisoning. Severe cases of the condition, as described by the California Poison Control Network website, includes “short-term memory loss, seizures, coma or shock” — although these cases are rare thanks to precautions taken by the state Department of Public Health.

Marine mammals are also susceptible to poisoning but don’t have a warning system in place like we do.



Guadalupe fur seals and sea otters are just some species that can be impacted, according to an email from Giancarlo Rulli, marketing and communications associate at the center, but it is primarily the California sea lion that bears the brunt of domoic acid toxicity on the Pacific Coast due to its diet.

Sea lions accrue the toxin in their body because they preferentially eat large amounts of small fish like sardines that have also been exposed, Field explained during a phone call.

Sea lions showing signs of gastrointestinal distress may have been exposed to low doses of toxin. Those with more serious seizures and neurological symptoms have likely been exposed to higher levels of domoic acid, Field said, and can suffer permanent brain damage and end up in an epileptic state.

"It depends on the amount of domoic acid that ends up in their systems," Field said when asked how these poisoned animals would fare without intervention. "Those animals with neurological symptoms would be much more likely to die."

California Marine Mammal Center volunteers rescue a one-year-old dehydrated sea lion found in Avila Beach and bring it back to their Morro Bay facility. Assistant site manager Aliza Meza and two volunteers log information on the sea lion rescue. Laura Dickinson LDICKINSON@THETRIBUNENEWS.COM

Field further explained that when pregnant females are exposed to domoic acid they don't clear the toxin from their system in one to two days like other sea lions. Instead, the domoic acid is retained in amniotic fluid where it recirculates in the animal's body for days to weeks, continually exposing mom and unborn fetus to its affects.

The resulting pups may survive the ordeal, but could later starve to death if their mothers succumb to the effects of domoic acid toxicity while out searching for food.

ARE MORE SEA LIONS BEING POISONED BY DOMOIC ACID?

The average number of statewide yearly sea lion domoic acid cases is between 65 and 70, according to Rulli, but there's already been at least 54 poisonings treated as of June — in a season that will continue well into the fall.

There may have been more than 54, said Field, as they're still trying to confirm the diagnosis for some of the animals they've treated.

She indicated this is more challenging in the case of younger sea lions that come in for care with "reasonable body condition" but don't seem quite right. These animals might appear to improve, and then "boom, they get a seizure."

While these events are regularly occurring, and there's some annual variability, Field also said she believes there has been an increase in incidents of domoic acid toxicity in sea lions over the past 20 years, since the center first diagnosed a case in 1998.

A 2012 overview of trends in toxic algae along the West Coast — published in the journal Harmful Algae — notes a body of evidence suggesting toxic blooms off of California have been worsening in the past 10 to 15 years. A 2018 study published in the same journal further identifies Southern California as a domoic acid hotspot.

Blooms could worsen by showing up earlier than they have in the past, persisting longer or covering more geographic area.

For example, David Caron, a USC biological sciences professor and co-author on the 2018 Harmful Algae study, talked about 2015 as the "year of the blob," with a Pseudo-nitzschia bloom extending along the entire West Coast, making "everything red hot from Santa Barbara to Alaska."

Caron cautioned that it can be difficult to understand long-term factors that affect where Pseudonitzschia will turn up.

Beach-goers gather around a dead fish that washed up on the sand in Shell Beach. Fish are just one of the possible animals impacted by harmful algal blooms. Joe Johnston JJOHNSTON@THETRIBUNENEWS.COM

Further clouding the waters is the fact that more toxic algae doesn't always equal more toxin. As Caron explained, even though Pseudo-nitzschia can produce domoic acid, it doesn't always.

According to Caron, some algae might produce toxins to poison their competitors.

"There is scientific information to suggest that if Pseudo-nitzschia run out of elements they need to grow, they may induce this response," Caron said.

However, domoic acid's effects on marine mammals remain a conspicuous symbol of conditions in nearby coastal waters, and as Rulli noted, an important marker of ocean health — especially important when we are eating the same food as sea lions.

HOW DO YOU TREAT A SEA LION?

The Marine Mammal Center operates out of multiple locations across California — the main headquarters in Sausalito, along with field operations in five different counties.

California Marine Mammal Center volunteers rescue a one-year-old dehydrated sea lion found in Avila Beach and bring it back to their Morro Bay facility. Assistant site manager Aliah Meza weighs the young sea lion with the help of volunteer Kerry Cox. Laura Dickinson LDICKINSON@THETRIBUNENEWS.COM

San Luis Obispo County's facility in Morro Bay acts as a triage center and has two full-time staff members — including head of operations Diana Kramer — and a brigade of local volunteers essential for supporting day-to-day operations, including animal care and transport.

When team members respond to public calls about sea lions and other marine mammals, they use the pictures and video that often accompany them to determine the condition and size of the animal, along with the difficulty of rescue conditions.

Kramer said trained responders can then go see the animal and ask, "What are we seeing? Are we seeing signs that might indicate domoic acid toxicosis to us? Are we seeing injuries? Are we seeing thinness?"

"We have to weigh all the time how much stress are we going to put on the animal versus the assistance we can provide. And if the balance of assistance outweighs the stress, then we go ahead and rescue," Kramer said.

Diana Kramer is head of operations at the California Marine Mammal Center's Morro Bay facility. Laura Dickinson LDICKINSON@THETRIBUNENEWS.COM

After bringing in a sea lion, staff make the animal comfortable, assess their general health and then confer with the Sausalito headquarters' veterinarians about future treatment, which sometimes includes giving animals "sea lion Gatorade" and fish milkshakes.

Rescues are given a name, like "Landing," to help staff distinguish triage patients during care. Kramer said it's really useful in instances when the center has multiple patients and "we're trying to make sure we that give each patient the correct medication, and the correct feed, and all of that."

Kramer said the rescue team also doesn't want their patients to become accustomed to humans, as this can hurt their chances of survival after treatment and release.

For example, the herding boards used to safely corral patients have holes drilled into them, so if staff need to watch animals during feedings, they can curtail associating food with people. Kramer described this as "one extra step to keep patients wild, as they should be."

WHAT YOU CAN DO TO HELP MARINE MAMMALS

Field said one thing the public can do for marine mammals in general is to keep from crowding them.

“Humans getting too close can cause more stress to already physically stressed animals who are stranding with health conditions,” Field said.

California Marine Mammal Center volunteers rescue a one-year-old dehydrated sea lion found in Avila Beach and bring it back to their Morro Bay facility. A newly rescued sea lion named “Landing” looks forlorn inside its crate. Laura Dickinson LDICKINSON@THETRIBUNENEWS.COM

She suggests people use zoom lenses to take photos and videos as a possible solution.

People can also struggle with identifying an animal in distress. For instance, though some pups are assumed abandoned, it can be common for sea lions and seals to leave young on shore while off foraging.

This is why Rulli says, “We want to make sure people feel they have proper tools (and understand) that we are experts in the area when it comes to this, and they have our number in their back pocket.”

It can then be determined if an animal needs attention in the form of observation or care from the center or one of its partners.

Members of the public can report sightings of marine mammals they think might need assistance to the Marine Mammal Center’s 24-hour hotline at 415-289-SEAL (7325).

THE TRIBUNE

If towering wind turbines come to Central Coast ocean waters, how visible would they be?

BY CARRIE SCHUMAN

AUGUST 02, 2019 04:45 AM, UPDATED AUGUST 06, 2019 09:28 PM

See how wind turbines capture and convert wind energy to generate clean electricity BY McClatchy

San Luis Obispo County could one day see large collections of behemoth floating turbines spinning off its shores as the federal government explores the ocean's potential as a source of wind energy generation.

The idea of possibly hundreds of turbines as tall as 700 feet has attracted interest from several companies, while the U.S. Navy considers whether the industry is compatible with its operations off the coast.

Many questions remain to be resolved before anything is built, but there's one in particular of interest to anyone who lives along the North Coast or enjoys visiting there: Just how visible would an offshore wind farm likely be here?

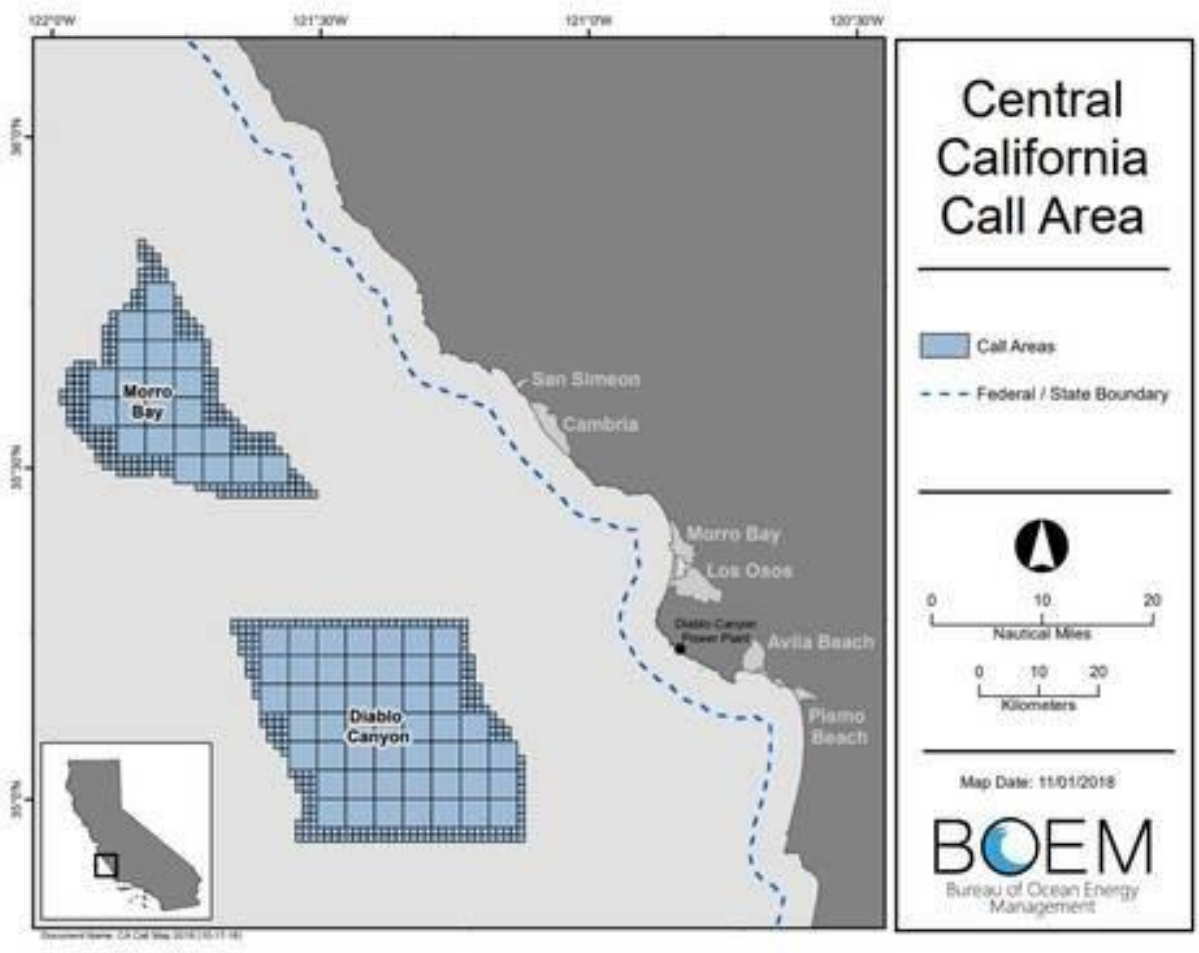
WHAT DO WE KNOW ABOUT THE PROPOSED TURBINES?

The effort to explore building wind turbines off the California coast is being managed by the U.S. Bureau of Ocean Energy Management.

Three possible locations in federal waters have been identified to date: two off SLO County and one off Humboldt County.

One area off Morro Bay — located in waters closer to San Simeon — begins 24 miles offshore, while another off Diablo Canyon nuclear power plant begins 22 miles offshore.

To put that distance in perspective, the turbines would be located about four to five times farther away than structures like the oil platforms in the Santa Barbara Channel.



A map shows two potential sites off the San Luis Obispo County coast where future wind farms could be developed. COURTESY OF BUREAU OF OCEAN ENERGY MANAGEMENT

In 2018, the agency issued a Call for Information and Nominations to "confirm interest in potential offshore wind leasing and development," according to John Romero, BOEM's Pacific region public affairs officer.

Though two companies — Trident Wind (now part of Castle Wind, a joint venture with EnBW) and the Redwood Coast Energy Authority — included some possible details in unsolicited lease requests submitted previously to BOEM, at this point in the process it's not exactly clear how many turbines might be installed and how tall they would be if a wind farm is cleared for either of the current locations.

Romero said that BOEM has not recommended any exact project specifications. Instead, it's having interested companies provide a general description of what they are "thinking in the way of a possible future project. An actual project plan comes to BOEM for review only after a lease is issued."

A cursory look at BOEM's website shows that most of the nominations from the 14 interested companies describe the energy generation potential of possible projects but do not suggest specific numbers, models or heights of turbines.

WHAT MATTERS WHEN IT COMES TO THE VISUAL IMPACT OF OFFSHORE TURBINES?

Bob Sullivan, a self-described "visual resource scientist" from the U.S. Department of Energy's Argonne National Laboratory, has extensively studied the visual impact of renewable energy sources like wind turbines.

Sullivan said it could be difficult to characterize what people gazing out from the coast will see without a more formal analysis, but we can get a general idea of what an offshore wind farm might look like here.

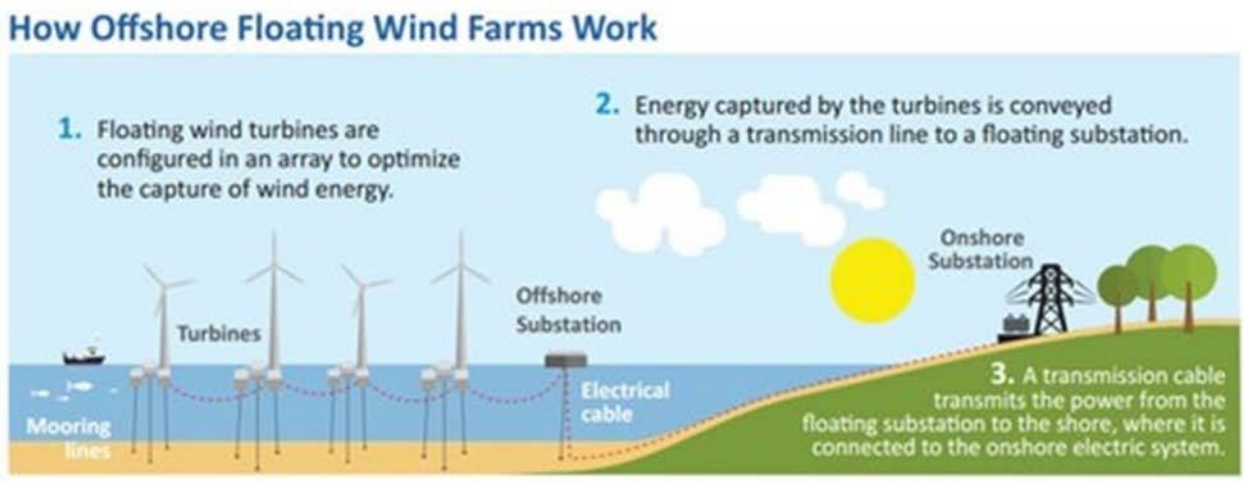
When asked what influences the visibility of turbines, Sullivan says he's identified at least 20 factors.

Some of the obvious ones are the distance, size, color and height of the turbines, along with the elevation of the observer looking out to sea.

Sullivan pointed out a statement on Castle Wind's FAQ site that says "400-feet-tall structures will not be visible by an observer at the sea level at distances greater than 23.4 nautical miles."

This detail — originating from a Coast Guard document that describes aids to marine navigation like buoys and beacons — assumes a person looking at those structures has their

feet planted firmly at sea level and that an object of that height is obscured by the curvature of the earth.



Energy captured by offshore wind turbines on the Central Coast would be transmitted by cable to shore, where it could connect to California's grid through either the Morro Bay Power Plant or Diablo Canyon nuclear power plant, which is scheduled to close in 2025. Floating turbines would be connected by cables and anchored to the ocean floor. U.S. Bureau of Ocean Energy Management

There's a good chance, however, that turbines will exceed that height, making them more visible.

As Sullivan notes and Vox described in a recent May article, the industry continues to produce larger and more powerful turbines in order to more effectively harness available wind and create extra energy.

For instance, General Electric is currently developing the Halaide-X, which it describes as the "most powerful offshore wind turbine in the world to date." The gigantic 12-megawatt turbine will stand at 853 feet from base to tip of blade — about four-fifths the height of the Eiffel Tower.

Also, not everyone taking in the ocean view from the SLO County coastline will be at sea level.

HEARST CASTLE VIEWS COULD BE AFFECTED

One widely visited location that definitely offers higher-elevation views is Hearst Castle, which sits at 1,600 feet.

Any potential change to the view visitors see from the iconic Castle is already on the mind of Stephen Hearst, the vice president and general manager of Hearst's Western Properties. "They walk to the window and say, 'You've got to be kidding!'" he said in an October Tribune story, referring to how visitors' experiences could change. "It's the view … one of

the most valuable attributes of the Castle. I don't think impairing it is in the best interests of the state or the Central Coast."

At 1,600 feet above sea level, Hearst Castle offers sweeping views of the coast and Pacific Ocean. Joe Tarica JTARICA@THETRIBUNENEWS.COM

Describing turbines that could be shorter than those proposed here, he said, "I have seen them out to 27 miles at sea, on land I have seen them beyond 35, and have verified that they can be seen beyond 40 miles."

But, at those extremely long distances, the turbines appear tiny, and unless someone is "really scrutinizing the horizon," they are very unlikely to see them, he said.

Sullivan also noted that "people tend to focus on visibility during the day," when actually the turbines' lighting at night can be just as or more noticeable.

A wind turbine was installed 20 kilometers off the coast of Naraha, Fukushima Prefecture, in northeastern Japan in 2013. Off-shore wind turbines could pop up across the Central Coast of California if the U.S. Bureau of Ocean Energy Management gets enough public support. Koji Sasahara ASSOCIATED PRESS

Turbines typically have two sets of lights: at the top of the tower to caution local air traffic and closer to the base for marine navigation. The top lights are more visible at longer distances.

Sullivan also said that how noticeable the lights from an offshore wind farm appear depends on “whether the horizon has a lot of existing lights or not.” That’s not likely too much of a factor with these proposals.

In any case, he said, a formal viewshed analysis will be essential to determining just how visible any particular offshore wind project might be, because there are “a lot of factors beyond just the simple issue of geometry.”

For its part, Castle Wind LLC has already taken some initial steps to study this impact, as described in its nomination for BOEM.

The developer contracted DNV GL, an independent renewable energy consultant, to simulate the expected views from Hearst Castle under typical visibility conditions using information recorded by the Morro Bay Harbormaster’s Office.

Based on the results, Castle Wind has concluded that “the proposed project site will rarely be visible from onshore locations such as Hearst Castle and the Piedras Blancas Light Station, given the site’s distance from shore and the area’s typical weather conditions.”

Whether that’s true won’t be determined until more precise turbine sizes and distances offshore can be analyzed.

THE TRIBUNE

Central Coast marine protected areas — once considered a flop — may now be helping fish

BY **CARRIE SCHUMAN**

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A fishing program created by two Central Coast researchers pairs local recreational fishermen with scientists to collect data about how marine protected areas benefit fish populations in the Pacific Ocean. BY LAURA DICKINSON

Ed Gomez felt a jerk on his hook and then reeled in his catch, a lively rockfish that slapped against the side of the boat as it was pulled aboard.

The angler was out on a sampling trip off Morro Bay with the California Collaborative Fisheries Research Program, which pairs anglers with researchers to gather information about fish populations in marine protected areas. Gomez has been a volunteer since the program began taking local recreational fishermen on the water in 2007.

Since the research program's start, it has forged connections with people who have a stake in the local fisheries while collecting more than a decade worth of local data on fish populations in marine protected areas.

And while it was once unclear whether local marine protected areas were giving depleted fish stocks the boost they need, researchers say they're starting to see positive results.

CHANGES TO STATE MARINE PROTECTED AREAS

The World Wildlife Foundation broadly describes marine protected areas — often abbreviated as MPAs — as locations designated and managed for "marine ecosystems, processes, habitats, and species, which can contribute to the restoration and replenishment of resources for social, economic, and cultural enrichment."

In 1999, California passed the Marine Life Protection Act, which said marine protected areas in the state at that time lacked a "coherent plan and sound scientific guidelines," creating "the illusion of protection while falling far short of its potential to protect and conserve living marine life and habitat."

Science crew member Rose Dodgen prepares to release a copper rockfish into Morro Bay Harbor on Aug. 2, 2019, during a California Collaborative Fisheries Research Program trip to conduct research on the Central Coast fish population. Laura Dickinson LDICKINSON@THETRIBUNENEWS.COM

These earlier marine protected areas were small and often focused on a specific user group or very particular area or habitat, according to Rick Starr, a research faculty member at Moss Landing Marine Laboratories and former director of the California Sea Grant Extension Program.

According to the Stanford Report, the Marine Life Protection Act directed that marine protected areas should instead “extend protection to entire ecosystems, thus preserving endangered and threatened species and habitats they need to survive,” and should be managed as a connected statewide network instead of in the previous piecemeal manner.

During this overhaul process, the boundaries of older MPAs were sometimes dissolved or expanded, and in some cases entirely new ones were created. Within the new MPA system, the share of protected California state waters went from 1% to almost 20%.

Starr said two previous failed attempts by the state to implement the act led to the decision to roll out newly restructured MPAs region by region, rather than all at once.

The first restructured MPAs were established in 2007 along the Central Coast, with 18 percent of its state waters split between 28 marine protected areas and one marine recreational management area.

Bridges to Baccalaureate scholar Juan Aviles measures a blue rockfish before releasing it into into Morro Bay Harbor on Aug. 2, 2019, during a California Collaborative Fisheries Research Program trip to conduct research on the Central Coast fish population. Laura Dickinson LDICKINSON@THETRIBUNENEWS.COM

Marine protected areas are further classified in ways that influence how people can interact with them.

For example, 13 Central Coast protected areas are also categorized as state marine reserves, restricting anyone from taking or harming “any living, geological, or cultural marine resource” — such as fish, petroleum or historical artifacts from shipwrecks — except for permitted activities like research and restoration.

These reserves are sometimes also called “no take” areas, which in practice means commercial and recreational fishermen can’t cross into these boundaries and fish.

Starr said one of the purposes of these reserves is “to provide safe haven for reproduction of fishes.”

The conventional thinking has been that an increase in fish production in a marine reserve might “spill over” MPA boundaries and could enhance nearby fishing opportunities.

Volunteer fishing prepare their poles early Friday morning before departing Morro Bay on Aug. 2, 2019, on a California Collaborative Fisheries Research Program trip to conduct research on the Central Coast fish population. Laura DickinsonLDICKINSON@THETRIBUNENEWS.COM

WHAT IS THE CALIFORNIA COLLABORATIVE FISHERIES RESEARCH PROGRAM?

Starr and Dean Wendt, dean of Cal Poly's College of Science and Mathematics and a biological sciences professor, created the California Collaborative Fisheries Research Program to assess the effectiveness of these newly created marine protected areas as a fisheries management tool.

When developing the program, both recognized the fishing community was especially affected by no-take areas. They decided to bring anglers together with scientists to help decide where to fish and how to collect data.

Starr and Wendt continued to extend this partnership to sampling trips on the water by using commercial charter boats to get to study locations and by using volunteer anglers to help them collect data on fish.

"If everyone's involved in collecting and interpreting information," Starr said, "any disagreements in future meetings are related to policy and not actual data."

Though the program started between Cal Poly and Moss Landing Marine Laboratories,

Wendt said an infusion of funds let them expand the program statewide in 2017 to include partners Humboldt State University, Bodega Marine Lab, UC Santa Barbara and the Scripps Institution of Oceanography.

Each institution in the fishing program uses the same sampling methods in their respective locations, producing data that can be compared across the state.

The charter boat Rita G, owned and operated by Virg's Landing in Morro Bay, is docked and ready for the crew to come aboard for a California Collaborative Fisheries Research Program trip to conduct research on the Central Coast fish population on Aug. 9, 2019. Laura Dickinson LDICKINSON@THETRIBUNENEWS.COM

WHAT HAPPENS ON THE WATER

At 5:30 a.m. on a recent August morning, anglers and a Cal Poly science team crowded aboard the charter boat Rita G, owned and operated by Virg's Landing out of Morro Bay. The surrounding seas were choppy and socked in by fog.

During the trip, the group worked at four different reference sites outside of Piedras Blancas marine protected areas. Grant Waltz, a research assistant who works with Wendt, oversaw the day's operations.

The boat stopped at points within each 500-by-500-meter sampling location, where anglers continually baited and recast their rods for a total of 45 minutes. This "catch rate" of fish caught over a known period of time using the same fishing techniques can be used to compare how populated reserves are to reference locations.

Every time a fishermen landed a fish, the boat erupted into a flurry of activity. A member of the science team quickly took the fish — or sometimes two on an especially successful cast — to the sampling station they previously set up.

Fish were laid out on plastic measuring board so their length could be recorded, occasionally escaping the researchers' hands to briefly flop around before being retrieved.

At the same time, according to Waltz, researchers collected samples for associated studies, tagging healthier specimens and noting other details such as species and condition — all before carefully releasing the fish back into the water.

The day's activities were an example of what occurs during the program's frequent trips to either collect samples within one of the local marine protected areas or outside reference sites. That can help researchers compare the difference in populations of fish between both places.

The research program relies on charter boats like the Rita G to shuttle the science crew along with anglers to help sample fish.

WHAT SUCCESS LOOKS LIKE

Both Starr and Wendt were authors on a 2015 study published in the journal Public Library of Science One that examined the first seven years of data gathered by the California Collaborative Fisheries Research Program.

The study suggests there wasn't much change in fish populations during that time frame within more recently established marine protected areas.

Student science crew member Meghan Fox measures and identifies a fish before releasing it as research technician Grant Waltz records data aboard a boat in Morro Bay Harbor on Aug. 2, 2019, during a California Collaborative Fisheries Research Program trip to conduct research on the Central Coast fish population. Laura Dickinson LDICKINSON@THETRIBUNENEWS.COM

One of the challenges for seeing measurable impacts of newer MPAs, Wendt said, is that it "takes a long time for these systems to respond, especially in cold temperate waters with slow-growing species."

"For five years we would go out and present, saying so far, there's no discernible difference between MPAs and reference sites," he said.

It wasn't until the past few years, Wendt added, that researchers have seen "characteristic marine MPA responses."

Starr said grant money the researchers recently received from California Ocean Protection Council will allow them to more formally analyze their entire 14-year data set. But he said that "MPAs in the Central Coast are for the most part harboring a higher abundance of fish than nearby reference areas."

While more definitive results are still incoming, the program does appear to have successfully fostered positive relationships within parts of the fishing community.

Bruce Harwood, Virg's Landing general manager, said the business is happy to take out researchers and anglers to collect data as "it's in our best interest to see healthy fish populations."

The California Collaborative Fisheries Research Program's vessel departs Morro Bay Harbor on Friday, August 2, 2019, to conduct research on the Central Coast fish population. Pictured are, from left, charter boat deckhand Manny and Cal Poly research technicians Grant Waltz, Alicia Ellingson, Theresa Bersin and Grace Willett. Laura DickinsonLDICKINSON@THETRIBUNENEWS.COM

He also appreciates the exchange of information the program fosters.

"Every year they invite everyone who's been involved with those trips to a review meeting that lasts for a couple hours after they produce their graphs and data, so can see how fish populations have remained the same, gone up a little or down a little," Harwood said.

Wendt said anglers are recruited to the program mostly through occasional announcements and by word of mouth. It appears that there's no shortage of extra hands; the volunteer database across the state contains the names of more than 1,000 people.

When asked what he gains from volunteering with the program since its inception, Gomez said it gives him the "opportunity to get back to a sport I enjoy, and I learn something while doing it." He's gained a better understanding of fisheries and his impact on them, he said.

Gomez, who's fished since he was 5 years old, said he wants the fisheries to be there for future generations.

Want to become a volunteer angler with the California Collaborative Fisheries Research Program? Email your name, contact information and preferred sampling region to CCFRP@mlml.calstate.edu or find more information at www.mlml.calstate.edu/ccfrp/volunteer-anglers.

What Oysters Have to Say

Carrie Schuman

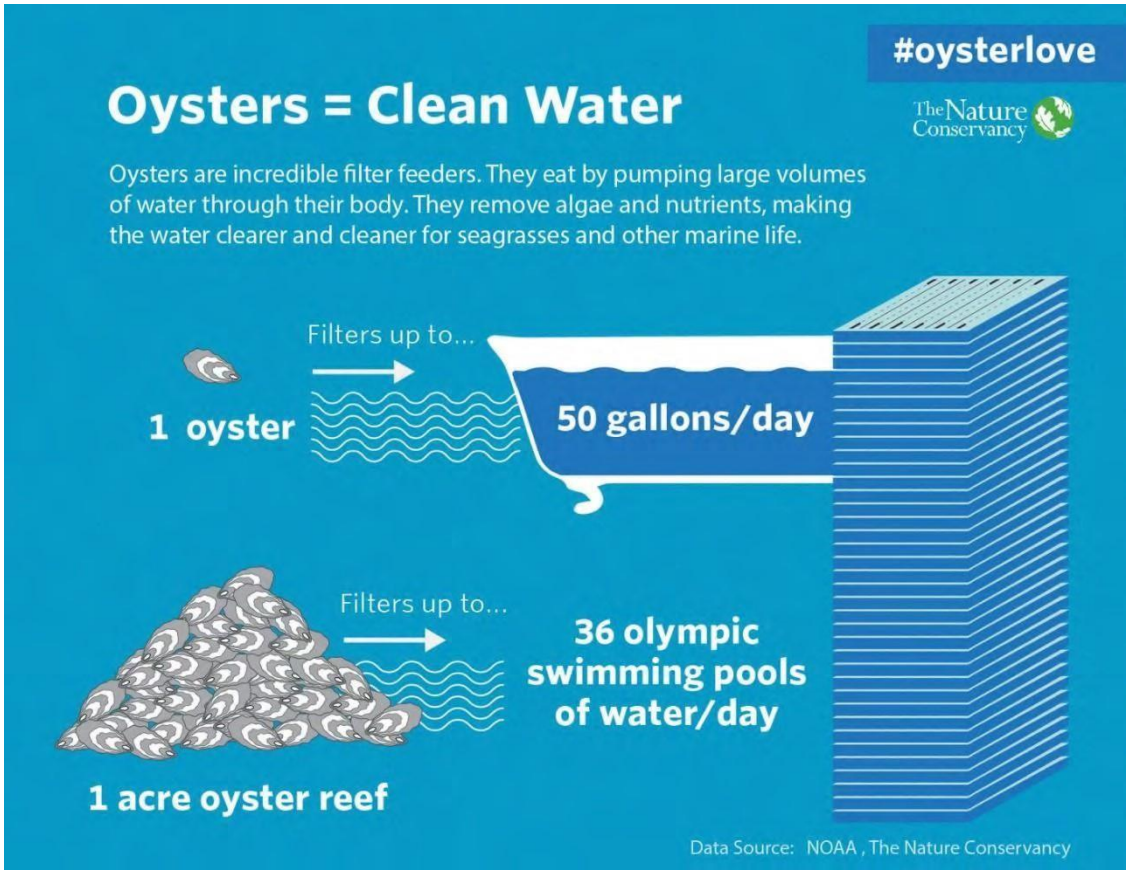
Blog Post Published on "Wanderlust: A Blog about Life, Science, Travel and all the Bits Inbetween"

July 2017, and cross-posted on "NERRds on the Water" August 2017

Full disclosure, I was once not the oyster devotee I am now. As a proper native New Englander and marine biologist, I of course was acquainted with them. But it wasn't start a PhD program at the University of Florida with molluscan biologist Shirley Baker, that until I trekked across the eastern coast of the United States and wound my way down to I began to suspect there was something more salient about my study organism.

In the great assemblage of all the graduate students that ever were, many a person has chosen a dissertation topic out of convenience and as a means to an end. Things may have started out in a similar vein for my own research. Currently it seems oysters are a sexy topic, and ecosystem services – the benefits of nature that directly influence human wellbeing, an even sexier one. But as I began to work on my research I began to realize the uniqueness and gravity of *Crassostrea virginica*, the American Oyster.

Like most people with a glancing familiarity with oysters, I knew they were filter feeders, making them unknowing proponents of positive water quality in many an estuarine region. Under this premise, I started field research at the Guana Tolomato Matanzas National Estuarine Research Reserve (which we call the GTM NERR for brevity's sake) in the St. Augustine region of Florida to examine clearance rates of oysters within the system. So far I'm learning interesting lessons that I continue to explore. While the Nature Conservancy posts the following graphic about the filtration capacity of a single oyster, I'd like to provide the caveat that this indicates what an oyster *could* do, not necessarily what it *does* do:



Within the reserve, oyster clearance rates are often lower than lab studies might estimate. But this can often be attributed to the complexities of the natural environment and their influence on the biological processes of organisms. Oysters feeding rates can be influenced by qualities like temperature, salinity, and the nature of the particles in the water they are feeding on. Within the GTM NERR, we've also found evidence that tidal cycles may be hugely influential in how much time certain parts of reefs have available to feed.

But while I continue to reveal information on oyster filter feeding within the reserve, I had less initial insight about the full worth of the expansive reefs I was seeing. I did not know how much of a refuge oysters provide until I started to find the squidgy, pinchy little creatures while working on reefs. If you grab a cluster of oysters and rotate it in your hand, you'll see the craggy irregular patches of barnacles interspersed with often minuscule ribbed mussels hanging on dearly by their byssal threads. Porcelain crabs will flatten themselves against shell in a desperate effort to avoid detection. While collecting oysters, you may also spot sea cucumbers and oyster toadfish while sheepshead and blue crab loiter nearby.

I also didn't fully appreciate the bastion of strength reefs are against the storms that regularly visit Florida coastlines. It's suggested oyster reefs have the ability to pace themselves with sea level rise, making them a common and ideal constituent of living shoreline designs which are meant to function as hardier and more effective alternatives to grey infrastructure historically used for shoreline armoring.

The title of my post then refers to the measure of what oysters can teach us about the sometimes-unexpected ways we are tied to our environment. But if we attune ourselves to

what oysters have to say about the health of our coastlines, we should also listen to one another about the values and concerns we imbue these natural resources with.

In St. Augustine, oysters also provide a source of harvest both directly for oystermen and for fishermen who recognize reefs' ability to foster good fishing grounds. However, ability to access reefs and to harvest oysters depends on regulation especially in relation to water quality; oysters need to be gathered in locations where they are deemed safe enough to eat. Resource managers are often trying to balance providing positive harvest experiences with optimizing the other services oysters provide.

Information on how fishermen and oystermen currently use reefs, how they would like to use reefs, and how things have changed can then be crucial for the decision-making process around managing oysters. We can try and gather those details indirectly or we can talk to these groups directly – a route I am currently tapping into. Through one-on-one interviews, people are telling their stories, revealing vital information about oyster use in the area, and teaching me about the fascinating culture and relevance of oysters within their coastal experiences. I hope study results will lead to more targeted management recommendations and provide opportunities for public outreach, education, and local engagement. Simultaneously, I am quickly learning to embrace my burgeoning love for human dimensions and social science research. All because of oysters. Who would have thought?