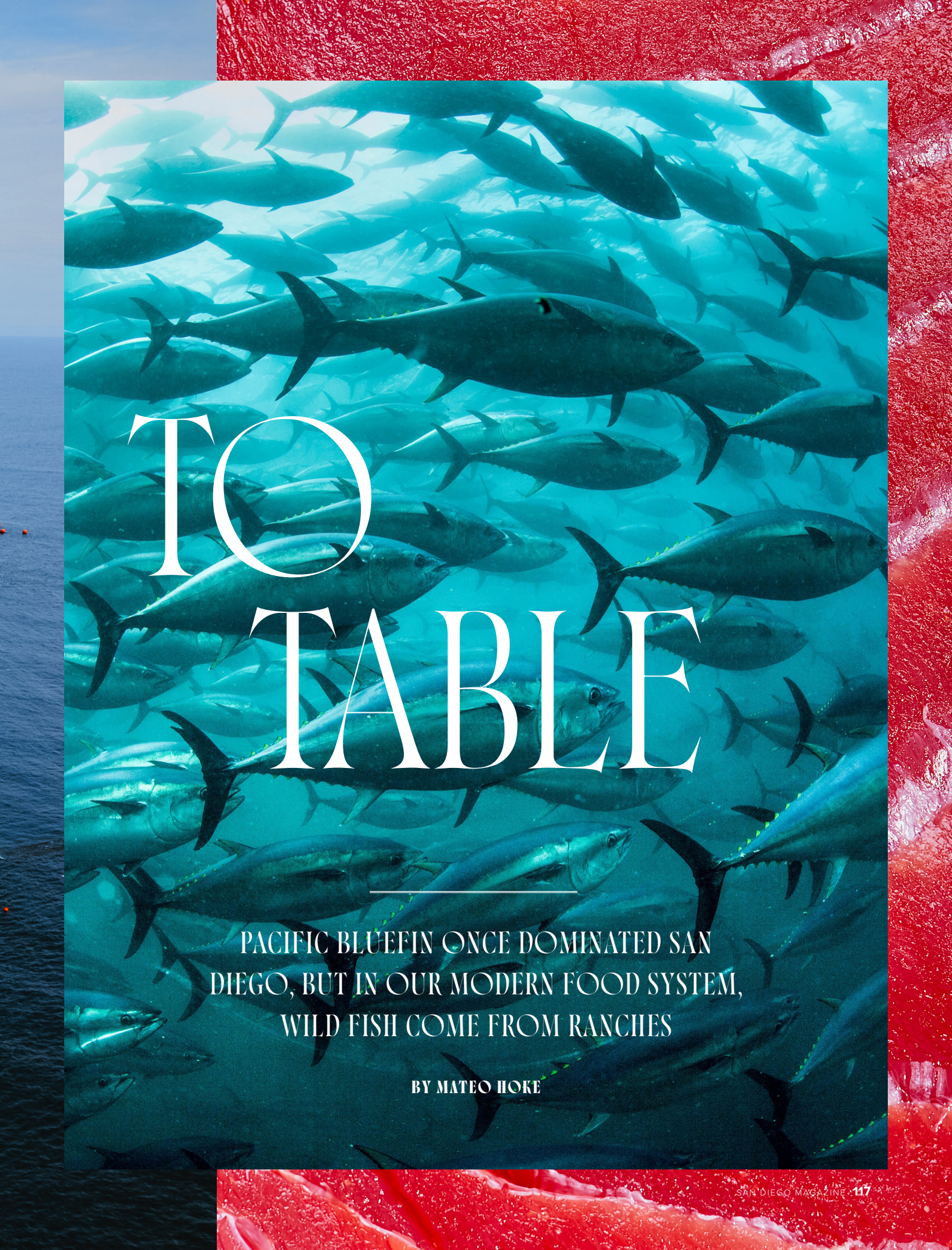


FISH FARM

Anchored in the deep waters of the Pacific, the main feeding vessel at Baja Aqua Farms pumps thousands of pounds of small fish into dozens of net pens filled with slow-circling bluefin tuna.





TO TABLE

PACIFIC BLUEFIN ONCE DOMINATED SAN
DIEGO, BUT IN OUR MODERN FOOD SYSTEM,
WILD FISH COME FROM RANCHES

BY MATEO HOKE

S

Swimming above a thousand bluefin tuna in the deep waters of the Pacific, one feels a dizzying calm. Below, the fish move in endless, unhurried loops, slowly growing plump in their monotony. Weighing around 170 pounds each, the fish in this net pen are *considerable*. Heavy as a man and as wide as a surfboard, they move like hydrodynamic refrigerators, pewter backs reflecting water-filtered light like suncatchers.

Not long ago, these fish were in the open ocean, gunning 18 miles an hour through cold currents, possibly detecting our planet's magnetic field using mineral deposits in their snouts, and tracing ancient migration patterns through the largest ocean on Earth. But here, with a gringo in a wetsuit bobbing above them, the fish merely draw lazy loops inside a giant aquaculture cage tethered far offshore, awaiting their fate as some of the most sought-after and expensive cuts of protein on the planet.

This is Baja Aqua Farms (BAF). Located in Mexican waters southwest from San Diego, BAF is, at any given time, home to tens of thousands of tuna worth tens of millions of dollars, making it one of the largest tuna ranching operations in the world and a major player in a modern global fish farming industry that now supplies more than half of the world's seafood.

If one were to, say, fly a helicopter over this operation, the view through the omnipresent cloud of gulls would prove impressive. Thirty Olympic pool-sized net-pens float



Workers separate a select number of tuna from the school and stun them with electricity before bringing them aboard the harvest boat.



BLUEFIN TUNA, RECENT DEVELOPMENTS HAVE SHOWN, IS BOTH A SYMBOL OF PAST OVERFISHING AND A SURPRISING CONSERVATION SUCCESS. AND ITS FUTURE NOW LIES IN OPERATIONS LIKE BAJA AQUA FARMS, WHICH REPRESENT THE NEXT PHASE OF HUMAN SEAFOOD CONSUMPTION.

in an open-water grid, each filled with a single school of a thousand or more bluefin. Some are huge, weighing more than 400 pounds, and some are smaller, around 45 pounds (still a lot of fish). And anchored in the middle of it all is a sizable, computerized central feeding vessel where specialists sit on aging rolling chairs inside an air-conditioned cabin, monitoring each school's food consumption and their pen's water quality on screens 24/7. A ship that thousands of pounds of feeder fish visit briefly each day after being offloaded from sardine boats and before being pumped into the bellies of tuna.

I ventured here on an educational mission. As a lover of both the ocean and tuna, I wanted to find out how bluefin—an animal fished nearly to extinction within my lifetime—makes its way into the tartares and chirashi bowls of today. My search led me here, face down in the water, listening to the sound of my breath through a snorkel and contemplating the vast machinations that keep these incredible fish churning through the global food system.

Silent as they are, these tuna tell a story about the future of fish and the future of how we interact with the ocean.

All of which we'll get to.

But first, let's eat.

By the time the bluefin arrives on my plate as glistening, fatty slices of pink otoro at Ophelia restaurant in Ensenada, it has already crossed oceans, boundaries, and moral terrain.

This fish was part of a school of tuna born in the open Pacific from eggs laid off the coast of Japan, captured as juveniles in Mexican waters by BAF boats in vast purse seine nets, towed for months to the BAF ranch, and fattened for many more months with feeder fish harvested from our coastal ecosystem by the BAF sardine fleet, then efficiently and bloodily killed, refrigerated, and brought to shore here in Ensenada to be packaged and driven over the border to LAX, where they either get exported—mostly to Japan—or eaten in high-end omakase and strip-mall sushi joints throughout San Diego, once the world's tuna fishing capital.

Bluefin tuna, recent developments have shown, is both a symbol of past overfishing and a surprising conservation success. And its future now lies in operations like Baja Aqua Farms, which represent the next phase of human seafood consumption.

With me at the table, talking tuna, is Rodrigo Armada Tapia, the head of sustainability at BAF. Having grown up in Ensenada, Tapia speaks with pride about the region's food culture—where tuna is often a star ingredient. Before taking me to the farm the next day, he wanted me to try the product, which BAF packages under the name Bluefiná.

"You can't understand the fish until you taste it," he tells me.

Ophelia is Michelin-recognized. It sources bluefin from BAF, as do some notable restaurants in San Diego.

This is because BAF fish is some of the best bluefin money can buy. Fast-swimming wild

tuna store fat in their bellies; the rest of the meat is relatively lean by comparison. But with the caged and portly BAF tuna, pillowy fat veins run throughout the entire fish, like a spider got inside and spun a web of tallow.

Dishes arrive, highlighting meat from various parts of the fish—akami from the side, a pile of flesh scraped from the ribs. Bluefin tuna is not frozen for transport (it can make it from the ranch to Japanese markets in 72 hours), and the freshness of the fish combined with the high fat content translates to a peach-skin, custardy episode on the palette. It's distinctive, delightful, and somewhat disorienting. I love tuna, but I don't always love eating it. For my entire adult life, the stakes have felt too high. Every fish consumed was one fish closer to zero.

But that story is changing. Fished nearly to extinction from the mid-1900s to the early 2000s, today's Pacific bluefin populations are back to near-heyday levels.

"Not only have we met the rebuilding targets, but we've actually already exceeded them," says Josh Madeira of the Monterey Bay Aquarium Global Ocean Conservation team. The bluefin population rebound is a full decade ahead of schedule, thanks to international conservation efforts.

For the first time since the Monterey Bay Aquarium Seafood Watch program began telling consumers in 1999 which fish are ocean-friendly to eat and which should be avoided, consuming certain Pacific bluefin populations—like those caught in California waters—is considered only a moderate environmental risk. That may not sound like much, but it signals a major step for bluefin.

"This is a great success story," Madeira says. "But there's much more work to be done."

Tuna, of course, means a lot to San Diego. And to understand how we got here, it helps to look back.

Throughout most of human history, tuna were seasonal, wild, and revered—an oceanic mystery glimpsed briefly, then gone. For millennia, various peoples chased tuna with harpoons and caught them in elaborate stone weirs. Aristotle wrote of their migratory patterns hundreds of years before Christ was multiplying fishes, marveling at their strength, speed, and uncanny navigational sense. It wasn't until the 20th century, when canned tuna became a pantry staple, that the fish transformed into a mass-market American commodity.

In San Diego, bluefin were hauled in by immigrant fishermen from Portugal, Japan, and Italy; packed in salt; and canned—cheap protein for various war efforts and school lunches. Forty-thousand San Diegans worked in the tuna trade. Communities lived off it; entire neighborhoods came to be defined by it. Two of the largest canneries in the country were here. The city smelled, quite literally, like tuna.

But overfishing soon led to declining populations. By the 1980s, the canneries were gone. Tuna didn't disappear, though. It simply went upscale.

Sushi—once an exotic, niche cuisine—became not just popular but aspirational. Bluefin prices soared. By 2012, Pacific bluefin populations had plummeted to around two percent of historic levels.

Which is where strict regulations came in.

As Tapia tells it, today's tuna industry is largely controlled by a complex system of catch quotas heavily regulated by international agencies referred to by five-letter acronyms. Only certain countries are permitted to commercially fish for

bluefin. Japan—which consumes 80 percent of the world's bluefin tuna—gets the highest quotas. Mexico's quotas are respectable, higher than those of the US.

It's a system that's imperfect, controversial, and not overly friendly to American fishermen in San Diego and beyond, but something about it is working to contribute to species recovery. In the US, catch limits for commercial Pacific bluefin tuna vessels increased almost 80 percent for the 2025–26 season. Bluefin, it seems, are back. The question is, will they last?

To better understand how tuna farms play into this, I cast a line out to the Scripps Institute of Oceanography in La Jolla. Soon, I was talking with Luke Gardner, an aquaculture specialist at California Sea Grant, a state-federal partnership that funds coastal and marine research.

According to Gardner, tuna ranching operations like BAF and other similar operations in Japan, Spain, and Australia are able to abide by catch-weight quotas while still providing large amounts of fish. Essentially, they catch skinny and sell fat.

"Tuna aquaculture means that people still get to eat bluefin tuna without fishing the stock to commercial extinction," he says.

But tuna farms are not without their problems. BAF, and other smaller, seasonal Mexican operations, rely on wild tuna stocks to fill their pens (closed-loop, egg-to-plate tuna ranching is still in its nascent stages, with only one company in Japan claiming to have figured it out), and the ranches require large amounts of wild feeder fish stocks to fatten their fancy fish once they're caged. Concentrated waste can negatively impact nearby habitats.

All this means that, despite the potential benefits of tuna ranching, as of its last report in 2021, Seafood Watch categorizes Mexican net-pen tuna as a fish to avoid eating. But that, too, could change soon when the next Seafood Watch report comes out, Madeira suggests.

"We have an update in progress, and we do know there's a lot of new information," he says.

Crunching a Bluefin tuna tostada, Tapia explains that BAF is doing all it can

"THEY CALL IT TUNA RANCHING, AND THERE ARE DEFINITELY PEOPLE [AT THE RANCH] YOU COULD ASSOCIATE WITH A KIND OF COWBOY MENTALITY. YOU HAVE TO BE A LITTLE BIT OUT THERE TO DO IT."

to improve its sustainability, working with a staggering number of regulatory and certification bodies.

“Everything that we catch at sea, we report. You can trace every single catch. We have observers on board all our tuna boats and cameras that are audited by a third party,” he says. “It would be borderline insane to not make sure that the tuna and sardine resources are there for the prolonged future.” He adds that BAF is also working closely with the Marine Stewardship Council toward a certification for its sardine fleet and is certified dolphin-safe by the Friend of the Sea program and the International Marine Mammal Project.

“I know Baja Aqua Farms is working hard to try to make improvements and is paying close attention to things like the Seafood Watch assessment,” Madeira says. “Consumers are saying that sustainability matters. I’m encouraged by that.”

Finally, the otoro—the benchmark of bluefin—hits the table. Served as sashimi, rosé-colored and ribbed with blubber, it dissolves like a pat of cold butter dipped in the sea. For a moment I turn off my mind, allowing myself to simply and blissfully enjoy one of the ocean’s greatest gifts.

“Quality-wise, Bluefiná tuna is [expletive] amazing,” one highly regarded SD chef of a Michelin Bib Gourmand restaurant tells me. “It’s crazy fat, even on the top loin. Every sushi chef’s dream.”

But, he adds, he doesn’t want to be associated with Bluefiná fish, no matter how chubby.

“As a Southern California restaurant owner who believes in sustainability and buying local, farm-raised bluefin is not in line with our ethos,” he says. “We wait for our wild bluefin to come in, and we know where it was caught and when.”

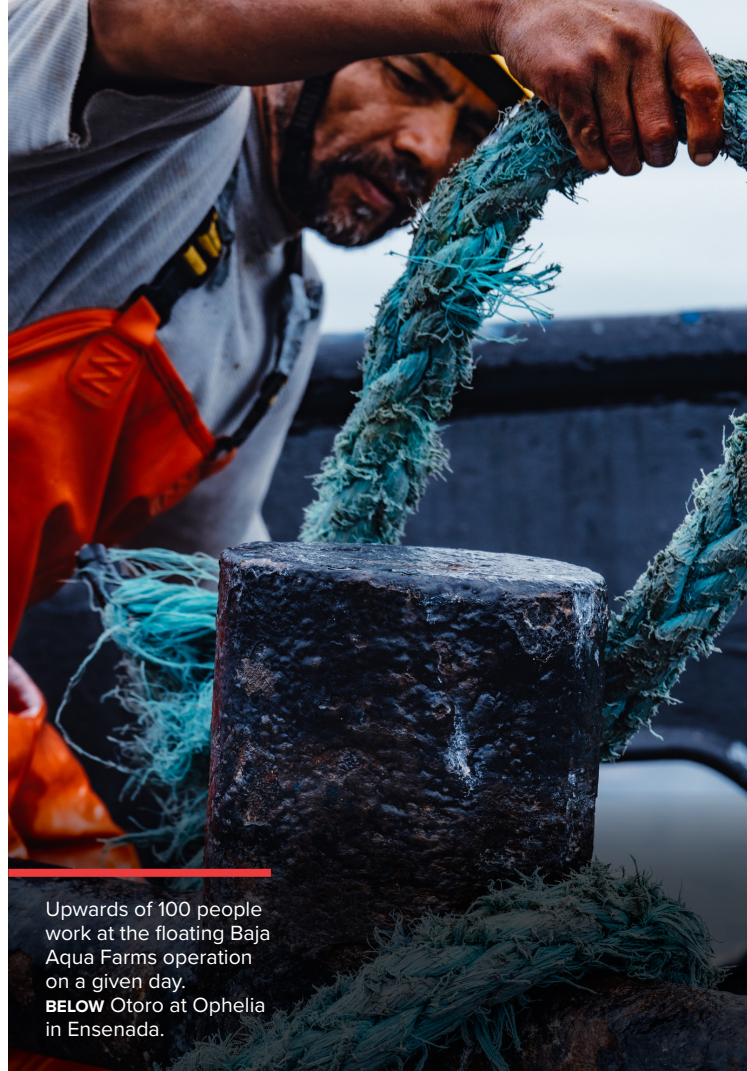
That tension—between wild and farmed—remains at the core of the modern bluefin story.

Gardner doesn’t buy it. “People have this perception that a farmed fish is bad, but they eat farmed everything else. Why not fish?” he says. “These operations can be good for bluefin tuna when they’re regulated and overseen.”

The otoro is simple and divine, a near-perfect meal. Fighting an urge to order more, I am reminded that we live in an age where to eat seafood is to make a series of quiet negotiations: between ocean and operation, local and global, sustainable and extravagant. And no species captures the contradictions and complexities of modern seafood like the Pacific bluefin. A single fish can sell for millions of dollars. This is the Wagyu of the sea: a delicious, fatty luxury that relies on an even more complex system than its bovine counterpart.

So, full of tuna and questions, the next morning, I board a speedboat for an up-close view of the ranch.

Getting to the farm means two hours of cold, rough porpoising from Ensenada. With me as chaperone is Tapia, plus a handful of other workers simply needing a ride to the ranch where they live and work for weeks at a time. I can hear Gardner’s voice in my mind: “They call it tuna ranching, and there are definitely people [at the ranch] you could associate with a kind of cowboy mentality,” he’d told me. “You have to be a little bit out there to do it.” No one speaks much during the loud trip in the dawn light.



Upwards of 100 people work at the floating Baja Aqua Farms operation on a given day.
BELOW Otoro at Ophelia in Ensenada.



The prevalence of gulls and sea lions hunting for scraps hint at the operation before the floating circles of the tuna pens come fully into view, each topped with chain-link fencing sticking many feet into the air for sea-lion defense—a hard-learned requirement, Tapia tells me as our boat slowly approaches the colossal main feeding barge, stained with rust and gull droppings. The place smells of fish flesh. We climb a ladder up the side of the vessel; hoist our bags up to the deck; and make our way over and around various tubes, ropes, riggings, and machinery to the main operations room.

Here in this room and out these windows, a large, invisible part of the contemporary tuna trade becomes visible. At the head of the operation, marine science experts point to giant screens displaying views from the dozens of underwater cameras that BAF uses to keep tabs on the fish in each pen. Specialists monitor when the fish have ceased eating and turn off the hose, so to speak. The screens show oxygen levels and temperature, checked three times a day at three different depths. BAF also routinely tracks phosphorus and pH levels below the pens, Tapia says. Behind us, with the help of AI, a specialist pauses a video to count each fish that came in from the most recent capture. Out on the water, small boats zig-zag from pen to pen.

Divers are consistently in the water with the fish, hand-cleaning and repairing nets (Tapia tells me BAF does not use the industrial net protectants that many operations do) and keeping a close eye on the product. On any given day, upwards of a hundred people—deckhands, divers, engineers, captains, maintenance crews—are out here working. The scale takes time to process, partly because I was not prepared for just how many small fish are required to fatten tens of thousands of large fish.

I suppose I had never seen literal tons of fish in person before—that is, until a sardine boat ties up alongside the floating warehouse on which we stand and begins pumping a few thousand pounds of burrito-sized fish into the big boat's refrigerated hold like loose ammunition.

The sardines are dead, but not frozen. This is a big selling point for BAF, Tapia tells me—that its tuna don't eat frozen

fish or any of a number of fish-feed slurries that other tuna ranches around the world at times have to rely on and then medicate around.

"We don't use antibiotics because we don't need to," Tapia says. "Because we're feeding them only fresh fish like they get in the wild, our tuna don't get sick."

The operation requires so many feeder fish because bluefin are not efficient weight-gainers. They have to keep swimming to force water through their gills and stay alive, so they are constantly burning calories. According to Gardner, this means it takes upwards of 25 pounds of small fish to produce one pound of bluefin. Not the most efficient farm animals.

"Compared to other species of fish aquaculture, bluefin are expensive to run," Gardner says. "It's like taking the Ferrari to the corner store to get milk, instead of your Volkswagen."

During our time at the ranch, Tapia explains that, due to timing, I can either swim with the tuna or see the tuna harvest up-close. Rather than watching hundreds of tuna be killed, I choose life. I want to pay my respects.

But, before departing back to Ensenada, our cold little speed boat stops by the harvest ship to pick up a hitchhiker, so I end up with a view of the marine slaughterhouse after all. On board, men in waterproof bibs move with a kind of practiced urgency. The harvest is still in progress, precise and bloody.

First, divers section a specific number of fish off from the rest within the chosen pen and stun them with electricity to make them safe to handle. Then comes an assembly line of efficient killing. In the humane ikejime fashion of dispatching fish, crew members drive steel spikes into the tuna's brains and a wire through their spinal cords to preserve the quality of the meat. The fish are bled and gutted. The gills and guts go to a fish meal plant. The blood spills quickly into the sea.





LEFT The main deck of the feeding boat offers an inside view of the modern food system. Here, specialists remotely monitor water quality and feed the tuna through tubes. Underwater cameras show a glimpse of life inside the cages. **INSET** Baja Aqua Farms relies on coastal sardine populations to keep its operation running. It takes about 25 pounds of small fish to convert to a single pound of bluefin.

BLUEFIN, IT SEEMS, REVEALS NOT JUST THE COMPLEXITY OF A SINGLE INDUSTRY, BUT A LARGER MORAL CALCULUS NOW EMBEDDED IN EVERY BITE OF SEAFOOD IN OUR MODERN FOOD SYSTEMS: THE SHIFT FROM HUNTING TO RANCHING, FROM WILD TO MANAGED.

Tapia tells me BAF only kills fish it's already sold, harvesting around 1,500 tuna per week.

As we motor away, I run some back-of-the-napkin math. According to the Bluefiná website, wholesale bluefin starts around \$20 to \$40 per pound and goes up from there.

Tapia won't disclose how many tuna BAF has at any given time, but he does say the pens can hold upwards of 1,500 tuna each. If each of the 30 pens contain, conservatively, 1,000 tuna, and each fish weighs—again conservatively—say, 80 pounds, that's a modest estimate of \$48 million in the water. Today's global tuna industry is worth \$40 billion. The ocean is rich.

And bluefin, it seems, reveal not just the complexity of a single industry, but a larger moral calculus now embedded in every bite of seafood in our modern food systems: the shift from hunting to ranching, from wild to managed. We've already done it with pigs, chickens, cows, and corn. Now, for better or worse, we are doing it with the sea.

Still, you can net a fish but not the current.

The ocean resists our domestication. It is too vast, too unwieldy. So we improvise—floating pens, AI tracking, revered fish in holding patterns, constant feeding, and massive amounts of labor to ensure that sushi bars and seafood restaurants stay stocked with the good stuff.