

## NORMAN LOCKS

*Michelle and Birds,*  
Big Creek Reserve, 2015  
Digital photograph,  
ink jet print, 45 x 21 in



COURTESY THE ARTIST

## JOSIE ISELIN Sea Otter, Kelp, and Our California Coast

How the diminished range  
of West Coast sea otters  
impacts coastal habitats

**Josie Iselin** is a fine art photographer and book author, passionate about the natural world around her. Iselin is intent on looking closely at the objects of our world and asking how we can learn both about and from them. Her newest book, *The Curious World of Seaweed*, takes a deep dive into the ocean universe of marine algae, creating a nexus where art and science converge. It will be published in August 2019 by Heyday Books. Iselin's design studio, Loving Blind Productions, is busy with ongoing projects: from art and science workshops and ocean advocacy to bold new scarf designs.

Larry and I walk the bluffs of MackKerricher State Park. The low morning light catches the spray off the huge rollers arriving from their trip across the great Pacific. Each set of fifteen-foot waves breaks one hundred yards out and pushes massive volumes of water in among the fragments of the continent, the chimneys and rock outcroppings that stand up along the rugged coastline. Last July I spent a foggy morning among the delicate red, sturdy brown, and translucent green seaweeds in and around the tide pools now covered by the white spume and rolling waves before us. I have to remind myself that the seaweed ecosystems need to be rejuvenated by the energy and dynamics of winter storm systems. A few hours of slowing down and taking note reveals the richness of this churning ocean all around us.

A group of glistening harbor seals, splotted white and black, slide from their basking rock into the adjacent pool, then pop their heads up to take stock of us. Larry points to some red-billed oystercatchers on the rock nearby and then, looking out to where the most violent waves retreat for an instant, we notice the patches of bull kelp, one to our left, one at center, and another to the right, clearly visible before the next wave breaks on top of them. Larry knows the contours of the coast under the white foam and notes that there is a deeper pocket right where that particular bed of bull kelp is overwintering. Knowing its architecture, we remark how the kelp's long, slender stipe and diminutive holdfast seem so delicate amid such forces. Larry reminds me that the smooth quality and shape of the *Nereocystis luetkeana* stipe makes it easy to glide and give with the surf. We both sigh that there are no otters among the bull kelp to point our binoculars at. We wish there were.

Larry is a commercial kelp harvester and spends the spring low tides out in these waters carefully harvesting the kelp and seaweeds. He is also a free diver and spear fisherman. He has lived near and loved these waters for three decades and knows them like a much-felt stone in one's pocket. He is a steward and educator. We look out to the rocks taking the full brunt of battering surf, where a few tattered *Posidonia palmiformis*, or sea palms, remain from the luscious miniature forests I photographed and revealed in months earlier. Larry calls the holdovers the "bad hair day" *P. palmiformis*. It fits. Pulling ourselves out of the reverie, we walk back along the dunes to be stopped

by whales spouting on the horizon. We peck down onto a small pocket beach to see a flock of ruddy turnstones, small hopping seabirds, swarming the masses of kelp that have washed up into the cove. The kelp flies and insects that devour the kelp are in turn magnificent nutrients for the dexterous birds, who disappear from view, camouflaged into the brown kelp. We are watching the carbon, nitrogen, and other nutrient cycling in action: from the ocean itself through the stupendous biomass of the kelp into the near-shore ecologies of shorebirds and even terrestrial plants along the coast. And farther along our walk home, Larry spots a flash of red in the surf. Again we stop and lift our binoculars to watch a sea lion thrashing an enormous three-foot-long salmon in the surf, coming up again and again to the air, where less resistance and gravity will help it pull apart the delicious meal, the gulls waiting for their leftovers.

This is winter on the Mendocino coast, where the richness of life is as exuberant as the power and energy of the waves crashing into the continent. Much of this richness depends on the kelp forest, and the kelp forest of this area, and in many places around the globe, is disappearing. The kelp forest is the primary producer of the nearshore ocean habitats—it is the bottom of the food chain—and it is an eco-engineer, generating three-dimensional habitat for fish and invertebrates to hide from prey and nurse their young, salmon to rest before heading out to sea, and larvae to find protection to grow to maturity. Its photosynthetic magic oxygenates surrounding waters for all those animal respirators, and the kelp provides drift and detritus that abalone, mussels, and other filter-feeders love. The murky waters associated with kelp-rich coastlines are nutrient-dense waters.

Before we turn to walk back, both Larry and I take another concerted look at the three distinct patches of bull kelp, knowing that, despite it being the overwintering kelp, this is a fraction of what it should be. We wonder aloud what the band of kelp might have looked like 10 years ago, 50 years ago, or 550 years ago. We know from the earliest aerial surveys of the Mendocino coast, done in 2008, that the coastal band of bull kelp along this area of coast used to be hundreds of times larger than these few patches we are seeing. And further back in time, we would have experienced even larger abundances of kelp. We both know that two crucial predators have disappeared from the complexity of life out beyond the waves—key factors in the

demise of the bull kelp forest on this section of coastline. The most recent predator to disappear is *Pyrosopodia helioanthoides*, or the sunflower sea star, the large, deep-water starfish whose populations were devastated by the sea star wasting disease that ravaged the entire West Coast from 2013 to 2016. The impressive, many-legged sunflower star seems to have vanished completely. But the sea otter, or *Enhydra lutris*, is the most charismatic predator missing from these Mendocino waters. From 1740 until roughly 1875, sea otter were hunted for their rich pelts to the point of ecological extinction along the entire West Coast by 1900. Both sunflower stars and sea otters are prodigious hunters of sea urchins, and without them, the urchin populations can and have exploded. Urchins eat kelp and for the last few years they have grazed through the kelp forests around Fort Bragg unchecked.

In the late 1970s and into the 1980s, when sushi was becoming popular around the globe, fishermen stepped into the role of top predator, or urchin management, in the form of a new fishery. Commercial divers collected red urchins from the local waters at prodigious rates. Steve Lackey, dive master at Sub-Surface Progression dive shop in Fort Bragg, has logged thousands of hours and many years under the waters of the bay at Van Damme State Park as a dive master. He recounts that at the height of the red urchin harvest, a diver could gather one thousand pounds of urchin in a day. He alerted me that in those days, red urchins, the larger urchin, which produce uni, or sea urchin roe familiar to sushi eaters, were much more common than the smaller purple urchins, which dominate the shorelines today. The red urchins grew to be enormous and ancient—up to two hundred years old. As the urchin numbers were reduced, the local kelp beds thrived and grew by 800 percent over the years, moving into the early 1990s. Urchins and kelp are at constant battle over domination of subtidal ecologies; when the urchin populations are kept in check, either by human economies or natural predators, the kelp forests grow lushly and densely, creating three-dimensional, dynamic habitat for all the attendant fish and invertebrates to hide and reproduce safely. When urchin populations are not kept in check, stability of the habitat is lost and the kelp forest can transform into an urchin barren—bare rock bristling with a carpet of purple and red urchins with no kelp in sight. This “regime shift,”

as it is called, from productive habitat to desolate rocky desert can be swift. The nature of this coevolutionary dance between urchins and kelp has been absorbing scientists and ecologists around the world for decades. The added stressors of warming oceans make the predator-prey dynamics more pertinent and the missing relationships concerning.

Kelps are brown algae that can grow as much as a foot a day at the height of summer, when days of sunshine are long and ocean waters are cold and full of nutrients. Bull kelp, or *N. lutekeana*, is the dominant kelp offshore from the Golden Gate north to Vancouver Island and up into Alaska. Or at least it used to be. A small holdfast keeps it tethered to the ocean floor and a single ropelike stipe rises toward a gas-filled bladder lifting a profusion of blades toward the surface. At maturity, the tubular end of the kelp floats along the ocean surface with as many as sixty blades reaching across the ocean's surface, collecting as much of the summer sun's photons as possible, stoking the chemical pathways that transform carbon dioxide and water into sugars (or biomass) and oxygen. By late summer its blades are heavy with dark-brown patches of spores called sori. These spore patches fall away, delivering millions of spores to the rocky ocean floor in the vicinity of the parent kelp. *N. lutekeana*—it is the only species in its genus—is an annual and the storms and violent waves of winter will rip up many of the kelps and deliver them onto the beach or into deep canyons of the ocean. Some bull kelp overwinter in the rough waters, but on my January visit, the coves and beaches of MacKerricher State Park are jammed with enormous bull kelp pushed up into the high tide wrack line.

*N. lutekeana* was named by Karl Heinrich Mertens, the naturalist on board the corvette *Semirarin*, after the captain of that Russian exploratory expedition, Freiderich von Lütke. In an account of the *Semirarin*'s arrival in Sitka Sound (then called Norfolk Sound), Alaska, in 1827, Mertens describes with delight the bull kelp all around and comments that the Russians called this seaweed “sea otter cabbage” because the otter made “particular choice of this seaweed as its favourite refuge and residence; delighting to rock and sleep on the long cylindrical bladders, which, like enormous sea-serpents, float on the surface of the water, and individually sweep between the little islands, rendering the channels impassable for boats.” The bull kelp and the sea otter are physically and tropically intertwined;

they evolved together and are interdependent. But the bull kelp forests of Sonoma and Mendocino have not had resident sea otters for over 180 years. People have seen sea otters around the Monterey Peninsula or they have seen river otters, a land-based cousin to the sea otter, cavorting at the shore, and think that sea otters exist all along the California coastline. But this just isn't so.

Prior to 1740, when the second Bering expedition set out from eastern Russia to explore the Aleutian chain of islands and find America, it is estimated that around 300,000 sea otters populated the entire range skirting the North Pacific Ocean, from the very northern tip of Japan, along the Aleutian Islands, down the coast of Alaska and British Columbia, and continuing south through Washington, Oregon, and California to Baja California in Mexico. This is not a large number of marine mammals in total, but sea otters are individually impactful—each otter contributes significantly to the ecosystem that it inhabits. Sea otters are voracious top predators, eating up to a quarter of their body weight every day. Their favorite prey are sea urchins, clams, abalones, crabs, and other mollusks, as well as sea cucumbers. They are associated with the kelp beds they live within, keeping the urchin grazer in control so the kelp beds and the richness of life they support can thrive. They are a quintessential “keystone species,” affecting food webs beyond themselves. Like other top predators, otters provide resilience to the nearshore ocean systems they live within.

Otter fur is the most abundant and thick of all fur-bearing mammals. Sea otters do not have blubber, so it is the thickness of their fur that traps air next to their skin to keep them warm in the cold Pacific Ocean. In 1742 the Russians tasted the riches a sea otter pelt would fetch on the Chinese market and the race was on to hunt or barter for as many pelts as they could get. The hunting of sea otter was indiscriminate—males, females, and pups were killed. The Russian hunting parties moved across the Aleutians down the coast of Alaska and present-day British Columbia and into California, where they set up base at Fort Ross on the Sonoma coast. By 1840, the fur-mammal populations of otter, seal and fox were wiped out; the Russians left and soon after sold Alaska to the Americans.

Farther south, the Spanish controlled the otter fur trade from their base in Monterey and only became interested when they discovered the pelts could be traded

in China for the quicksilver (mercury) they needed for their South American mining endeavors. After the last expedition of Captain James Cook, which began in 1776, Bostonians and the British learned that sea otter pelts could fetch a high price in Canton, China, and American and British trading vessels rushed around Cape Horn into the Pacific Northwest to take part in the sea otter fur trade, and continue the hunting and slaughter.

In 1911, when the decimation of marine mammals was clear, an act of Congress—the North Pacific Fur Seal Convention—made it illegal to kill sea otters as well as fur seals. But there were none to be found in any case. The last sea otter on the California coast was seen in 1917. In 1925 a wildlife refuge was established in the Aleutian Islands. A survey was done to see what wildlife was in the refuge. Not a single sea otter was found.

But remnant populations remained in remote harbors of the Aleutian Islands and Prince William Sound of Alaska, places where typically harsh weather and stormy seas made human intrusion a rarity. The sea otter was not extinct! In the late 1960s and 1970s, to diminish the possibility of an extinction event in these isolated populations, wildlife biologists translocated and reintroduced sea otters into a number of sites in southeastern Alaska, on the west coast of Vancouver Island in British Columbia, along the Olympic Peninsula in Washington State, and along the Oregon Coast. These were crude affairs. Not much was known about the otter and many died in the process. The otters in Oregon dispersed and disappeared, but the reintroduced populations in British Columbia, Alaska, and Washington have thrived. As otter populations in Alaska and British Columbia grow, the subsequent expansion of the kelp beds and their associated biodiversity have been greeted with relief and enthusiasm, but only by some. There are many people, in particular fishermen and foragers, who view the otter with distrust—as a destroyer of the natural bounty. Sea otters had been gone a long time, allowing populations of invertebrate prey, from sea cucumbers to abalones to clams, to build up and be considered the natural order of things. The sea otter fell out of the ecological story in many places. Slowly, especially among First Nations fishermen, it is being remembered that nearshore habitats evolved with both sea otters and indigenous peoples over many millennia.

The sea otters of present-day California have their own story. In 1938 the newly built Highway 1 opened up the remote coast of Big Sur to travelers and a raft of ninety otters was discovered in a secluded cove near Bixby Creek about fifteen miles south of Carmel. Edna Fisher was a pioneering zoologist teaching at San Francisco State College and within a month of the rediscovery, she was on the Big Sur coast with her binoculars, making observations of the sea otters. Fisher took her students down to camp in the field and help with observations, a revolutionary way to teach biology. Fisher wrote a groundbreaking paper about the sea otter's use of tools and published numerous papers and articles about the Bixby Creek otters. She was an advocate for their protection throughout her life. All of her descriptions and her native drawings of the sea otter mothers and their pups pair the sea otters with the bull kelp, *Nereocystis*. This is their home. She describes in detail how the otters depend on the bull kelp for camouflage and for protection and for play, wrapping themselves or their pups in the “long tubular kelp” so as not to float away.

This small, remote population was granted state protection and eventually expanded up around the Monterey Peninsula and southward along the Central Coast. The giant kelp (*Macrocystis pyrifera*) forests of the calmer Monterey Bay were traditionally surrounded by large patches of bull kelp in the rougher water and, in tandem with the otters, maintained their robust vitality. Today, despite now having the protection of the federal Marine Mammal Protection Act, this sea otter population of about three thousand otters has plateaued. It seems to have hit its limit. At the north end, there is a healthy group of otters living in Elkhorn Slough, halfway up the bite of Monterey Bay, and to the south, an increase in the number of otters in Morro Bay. But the range has not expanded either direction. There are no otters above Santa Cruz, California, nor south of Point Conception along the coast. There is one other small population of sea otters around the island of Saint Nicolas in the Channel Islands, the remnant population of a translocation effort in the 1980s.

Today, Alaska's and British Columbia's otter populations are growing rapidly but the California otter population is holding steady. The contrast of coastal geography is a key factor. While Alaska's coastline is a vast network of interconnected bays, islands, inlets, and waterways, all

replete with cold-water food sources that otters need to expand their territory, California's coast is, relatively, a straight line. Standing on the cliffs at MacKerricher State Park in Mendocino County, I can see the rugged coast stretching for miles both to the north and to the south. Similarly, the range of possibilities for the otters on the California Central Coast is not a web but a thin line, with only two ends. And those ends are where kelp forests are thinning and where shark territory starts. As young male otters range from the core populations and pioneer new territory, their mortality by shark bite increases sharply.

On our California coast, sea otters have not expanded their territory up toward the San Francisco Bay. They do not dive for urchins or crabs or abalones in the bull kelp forests off the coasts of Marin or Sonoma or Mendocino. There are no otters to work their apex-predatorial magic on the kelp habitats around Trinidad, or along the Humboldt or Del Norte coasts or up into Oregon at Port Orford. No otters are found moving north up the western seaboard until halfway up the coast of Washington State, along the Olympic Peninsula; three miles out from Ruby Beach, there is a large raft of over a thousand sea otters at Destruction Island and a small number in the Strait of Juan de Fuca. Archeological remains of First Nation shell middens in Oregon reveal genetic information on sea otters dating from 600 to 10,000 years before the present. Sea otters were part of the mix, as proportionately plentiful as seals of all types, according to Shawn Larson from the Seattle Aquarium. She has been investigating sea otter genetics since the fur trade caused the sequential extirpations that reduced the otter population by 99 percent.

As coastal restoration issues arise up and down the West Coast and conservation of marine resources is discussed, it is interesting to note where the otter comes into the conversation and where it does not. In Oregon, the Elakha Alliance (*elakha* means “sea otter” in Chinook), led by Robert Bailey, is investigating how to include the otter in the statewide nearshore conservation game plan. Bailey has organized a daylong otter symposium and has Native tribes as active and spiritual partners. But Oregon does not have abalone divers; natural catastrophes in 1964 wiped out the abalones of that coast, eliminating any possibility of a recreational abalone fishery. But the Mendocino coast, where the kelp forest crisis is so acute, is where abalone

diving and the red urchin fishery have been economic drivers for a long time and sea otters are not part of the restoration conversation. Otter and abalone divers compete for the same delicacy. Cynthia Catton, the former California Department of Fish and Wildlife biologist spearheading a kelp recovery program around Fort Bragg that includes a broad group of stakeholders, points out that the current ecology on the Mendocino coast could not support otters. The urchins are now too impoverished. Having eaten all the kelp, the urchins are resorting to chewing into the coralline algae, leaving their insides full of nibbled crust. These urchins have nothing inside—no guts or gonads—and could not support the hypercharged metabolism of a sea otter. So the local efforts are once again mimicking the missing top predators and divers are collecting purple urchins around a few remnant patches of bull kelp, hoping to allow their spore banks to remain viable.

But while it is still a tricky subject on the docks, the sea otter has come back into the kelp forest narrative in schools and among conservation-minded groups, whether the Pacific Beach Coalition in Pacifica or at the Noyo Center for Marine Science in Fort Bragg. The importance of kelp and otters has become recognized and the full trophic cascade—or food dynamic—whereby otters eat urchins, which eat kelp, has become a common point of conversation. And while otters are not part of a near-term solution, it is acknowledged by all that top predators across habitats offer resilience in stressed times.

The historic range of the sea otter might be indicated by a gray ribbon running along the edge of the North Pacific Ocean, tracing the arc of the Aleutians and western Alaska into southeastern Alaska and down piecemeal through British Columbia. Slowly this gray ribbon is turning yellow as otter numbers rebound from both native and translocated populations. But the yellow ribbon stops halfway down the Washington coast. As we continue south, the ribbon remains gray until there is a small yellow section along the central coast of California, from just north of Monterey to Pismo Beach, north of Santa Barbara, but then it returns to gray. The middens and the fur trade records reveal otters were historically abundant in the Channel Islands and down into Baja.

Because of the enormous impact of the sea otter on its environment, because the kelp forest responds rapidly

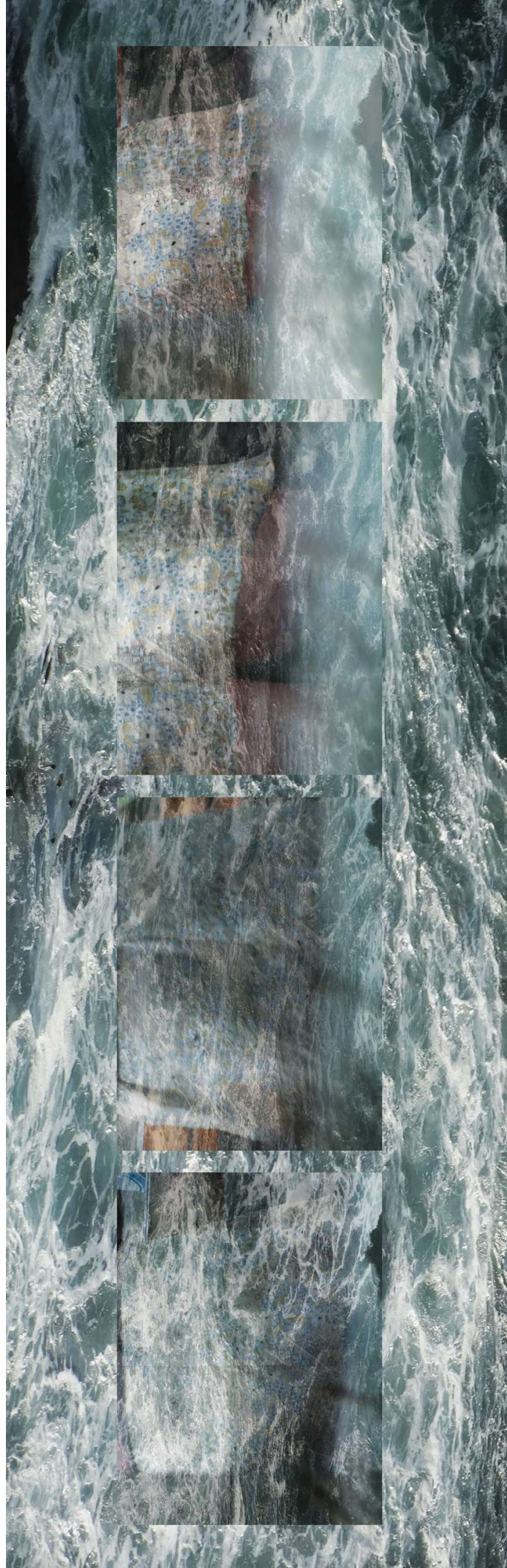
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*Figure and Waves,  
Big Creek Reserve, 2017*  
Digital photograph, ink jet print, 20 X 62 in

on the kelp forest, such as warming oceans and major storm events, will take a toll. Nowhere is this more apparent than the bull kelp forests off the Mendocino coast.

Larry and I can't help wonder, if sea otters were again resident here off MacKerricher State Park as they were when all of the bull kelp and *P. palmiformis* and harbor seals and sea lions and Chinook salmon evolved, would they be out in this weather? Would they be in that patch of *N. lutekeana*, their nurturing nursery, even on stormy days? We just don't know. Would they stay in more sheltered coves and come out to the rocky coast to feed on calmer days? Larry and I both wish with all our hearts that seeing sea otters were part of the worldly bounty of this day.

to other presence, with rising herring and rockfish populations following soon after, this ribbon is also an indicator of where kelp forest resilience has been strongest. The positive stories about nearshore habitat restoration in the presence of sea otters stop, however, where the ribbon turns back to gray. Sara Hamilton has been studying the bull kelp in Oregon and reminds us that bull kelp is not nearly as well understood as its much more famous cousin down south, giant kelp, or *Macrocystis pyrifera*. There is much that we don't know about the bull kelp, and the rough waters off the rocky coast of Northern California and Oregon don't make it easy to discover its secrets. But we can be relatively sure that without sea otters or sunflower sea stars, other stressors



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