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IN DEPTH

Sempra Energy bets big on LNG

Liquefied natural gas project part of goal to make company global energy leader

BY ROB NIKOLEWSKI

HACKBERRY, La.
For miles, you drive past the reeds and marshes of the Louisiana Gulf Coast on a February morning under a cloudy, bruised-colored sky. Then, after going over a ridge, it appears. The first thing you see are three storage tanks 200 feet tall and within moments the entire project rolls out like a carpet — a giant rectangle of piping, concrete and metal 2 miles long and a half-mile wide, hugging the Calcasieu River. It's the \$10 billion Cameron LNG facility, nearly five

\$10
BILLION

The cost of the Sempra LNG facility in Louisiana.

years in the making. It's not only a mammoth project but a significant part of San Diego-based Sempra Energy's ambitions to become, in the words often repeated by the company's leadership team, the premier energy infrastructure company in North America.

The development of LNG — short for "liquefied natural gas" — is a result of dramatic changes in the fortunes of energy producers in the United States that practically nobody predicted.

Just a few years ago, the nation was importing natural gas.

But today, so much is being produced in places such as Texas and Pennsylvania that the U.S. is rapidly becoming one of the world's top exporters of the stuff by liquefying the gas, putting it on cargo ships and sending it to customers in countries hungry to use gas to heat their homes, generate elec-

SEE LNG • A8

SPORTS



GENE LITTLER
1930-2019

S.D. NATIVE WON 1961 U.S. OPEN

Pro golfer and San Diego native Gene Littler died Friday in San Diego. He was 88. Littler won 29 times on the PGA Tour, his first win coming as an amateur when he captured his hometown San Diego Open in 1954. Called "Gene the Machine," because of his flawless swing, he was also a World Golf Hall of Famer. **D1**

Giant kelp making recovery but it faces renewed threats

FIGHTING TO SAVE STATE'S OTHER FOREST

BY DEBORAH SULLIVAN BRENNAN

Off the coast of La Jolla, kelp beds shifted in the surf, their mossy gold fronds twisting down to thick stalks in an underwater grove.

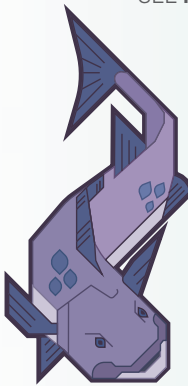
This is California's other forest, an aquatic counterpart to the state's redwood groves. Like the old growth stands, giant kelp stretches from lush canopies to luminous understories, brimming with life. And like those ancient groves, they face an uncertain future in a changing world.

On a sunny Saturday last month, Ed Parnell, a researcher with Scripps Institution of Oceanography, dove down to take stock of their condition. His conclusion: for the moment, they're better than expected, and better than other parts of the state.

"It looked a little beat up from the storms, but not as bad as I thought it would be," said Parnell, who studies kelp ecosystems. "Not as bad as it was a few years ago."

In Northern California, armies of sea urchins have clear-cut most of the kelp forest, forming "urchin barrens"

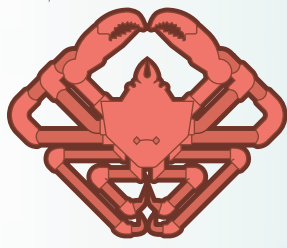
SEE KELP • A20



Fish such as **kelp bass**, **sheephead** and **clingfish** regulate populations of smaller organisms that feed directly off the kelp. Without these predators the smaller creatures would destroy the kelp forests.



Sheephead



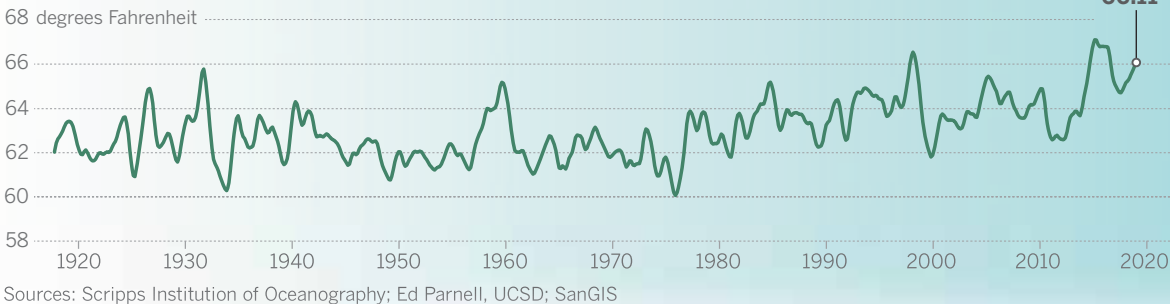
Kelp crabs and snails feed on the kelp blades.



Holdfast

Warming water temperature

Kelp relies on cold water to churn up nutrients it needs for growth. This 100-year record high surface water temperature at Scripps Pier shows a warming trend that started in the late 1970s, and could damage kelp forests in San Diego.



Illustrations by MICHELLE GUERRERO; graphics by MICHELLE GILCHRIST and CRISTINA BYVIK U-T



San Diego's kelp forest

Based on aerial surveys conducted by Scripps personnel since the early 1960s, these are the areas where kelp may grow along our coast.

Seabirds eat crabs and snails found among the kelp blades.

Garibaldi dine on algae and small organisms that feed off of kelp.

California's underwater rainforests

Kelp serves as a "keystone species" allowing an entire ecosystem to flourish. Explore the different layers of the kelp forest and the life it sustains.

Canopy

The uppermost layer of a kelp forest is home to Garibaldi, snails, crustaceans, anchovies and juvenile fish. Seals and seabirds floating at the surface dive through the canopy for a meal. Predators help keep smaller animals that munch the kelp, such as nudibranchs, in check.

Understory

Light filtering through the kelp forest controls which species grow in the understory. Smaller kelp such as oarweed and feather boa grow amid giant kelp blades, which house predatory fish such as kelp bass, rockfish, giant kelpfish, pipefish and others.

Forest floor

The base of the kelp is anchored to a rock or boulder by small "roots," called holdfasts. They shelter young anemones, isopods, sea stars, sea fans, sea urchins, kelp crabs and sea hares that prowl the ocean bottom.

Sea urchins dwell on the forest floor and devour the holdfasts. Overgrowths of urchins have decimated kelp forests in Northern California.

MIGRANTS DETERRED BY ASYLUM POLICIES TURN BACK

Thousands waiting across border give up on attempt to gain U.S. entry

BY JOSE A. DEL REAL, CAITLIN DICKERSON & MIRIAM JORDAN

Pushed beyond their limits by prolonged waits in dangerous and squalid conditions in parts of Northern Mexico, thousands of caravan members who had been waiting to seek asylum in the United States appear to have given up, Mexican officials said, dealing President Donald Trump an apparent win after an eventful week for his immigration agenda.

About 6,000 asylum seekers who had traveled en masse, many of them in defiance of Trump's demands that they turn around, arrived in Northern Mexico in late November as part of a caravan that originated in Honduras. Since then, more than 1,000 have accepted an offer to be returned home by the Mexican government, the officials said. Another 1,000 have decided to stay in Mexico, accepting work permits that were offered to them last fall, at the height of international consternation over how to deal with the growing presence of migrant caravans.

Trump on Friday declared a national emergency after he failed to secure funding from Congress for a border wall that he said would block migrants from entering the United States. But the data from Mexican officials suggested that

SEE MIGRANTS • A15



AFF/GETTY IMAGES

President Donald Trump speaks during a meeting to discuss fighting human trafficking on the southern border on Feb. 1 in Washington.

BORDER WALL IMPACT ON HUMAN TRAFFICKING DEBATED

Trump says it's needed to stem flow, but experts say there's a lot more to issue

BY KRISTINA DAVIS

In President Donald Trump's repeated calls for a border wall, he has recently turned his focus to the horrors of human trafficking along the southern border to illustrate the need for such a barrier.

"Even one woman or one child trafficked is too many," Trump said in a Feb. 1 speech at the White House. "But there are thousands and thousands and thousands..."

While a presidential platform is often appreciated on social issues, some trafficking victim advocates say the focus is misplaced and ignores the broader picture of trafficking in the United States.

"Claims that a wall will stop vast amounts of human trafficking are not only inaccurate and misleading," Bradley Myles, CEO of Polaris, a nonprofit that runs the National Human Trafficking Hotline, said in a statement, "they also harm our efforts to educate the public on the true nature of this crime."

So what is the relationship between human trafficking and the border? And who are the people being trafficked in the United States,

SEE TRAFFICKING • A10

TRAVEL

IMPERILED PARADISE

Bali clings to its pristine aura even as it struggles with identity-altering transition. **E10**



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KELP

FROM A1 on the denuded sea floor. Giant kelp off San Diego has fared a bit better, and are recovering from damage wrought by strong storms and abnormally warm water in recent years, Parnell said.

With another El Niño in the works, and ocean temperatures on the rise, however, they could face renewed threats.

“The California Current definitely has changed, and it’s going to continue to change with global warming,” Parnell said. “What that will mean is that we’ll probably lose our kelp forest, and it will change from a forest, to patches that appear and disappear.”

San Diego kelp started dying back around 2014, when “The Blob,” a mass of stagnant warm water, squatted off the Pacific Coast. Kelp relies on upwelling of nutrients from cold water to sustain their stratospheric growth rate, so they withered in the sluggish bath.

The Blob rolled into an El Niño weather pattern in 2015 and 2016, bringing more warm water, along with pounding storms that ripped kelp strands from their holdfasts on the seafloor.

“During strong El Niños, it’s a double whammy for kelp,” Parnell said. “You have warm water with low nutrients, so the kelp can’t grow. Then you get strong waves that come and wash it out.”

Kelp evolved with those cycles, and has adapted to rugged coastal conditions by maintaining extraordinary productivity, growing up to two feet per day to a maximum length of about 175 feet. A single kelp can live eight to 10 years, but most are torn from their riggings within a year, Parnell said, and quickly replaced by new growth.

“It came back fast,” he said of the kelp’s recovery off La Jolla. “It makes its living by growing fast.”

On the sunny afternoon, giant kelp floated in greenish-brown masses on the water’s surface, so thick that they tangle around a swimmer. Unlike its terrestrial counterparts in California forests, giant kelp isn’t a plant. Scientifically called *Macrocystis pyrifera*, it’s a protist, part of the algae kingdom, and the very largest among its clan.

Viewed from underneath, the blades form a gilded canopy on the water’s surface. Gazing down, the stems descend through layers of shimmering blue to the holdfast, which anchors the organism to the sea floor.

The water was a bracing 62 degrees Fahrenheit at the surface, and in the mid-50s on the ocean floor, so Parnell donned a dry suit to insulate himself from the chilly water. Only a few creatures stirred

at the surface; a surf perch flitted through the kelp, while an orange *Norrisia norrisii* snail and a large barnacle clung to the blades.

The bottom, however, was full of big fish and other organisms. The divers saw kelp bass, sheephead and a four-foot giant seabass, listed as critically endangered on the International Union for Conservation of Nature’s Red List of threatened species. Seeing a big one off San Diego is a good sign, Parnell said. One of his diving companions, his former colleague Cleridy Lennert-Cody, spotted a seven-gill shark, as well.

Giant kelp is a “keystone species” that forms the basis for an entire ecosystem, creating one of the most diverse marine habitats. Steve Schroeter, a research ecologist at UC Santa Barbara, who works in San Diego County, has tallied that diversity while monitoring the kelp bed off of San Dieguito Lagoon.

“Our crew counts about 350 species of invertebrates that live in the kelp forest: starfish, sea urchins, snails, cup corals,” Schroeter said. “The kelp forest supports a whole host of fish. So starting the food chain from plants to invertebrates to fish, that’s the kelp forest.”

Sea stars, anemones, crabs, and jellyfish dwell in kelp forests, and sea birds swoop in to feed on small crustaceans, according to the National Oceanic and Atmospheric Administration. Commercial species including bass and rockfish use kelp for cover, and rockfish larvae take shelter in the upper water column. Fish, in turn, are food for seals, sea lions and others mammals. Sea urchins devour the kelp. And sea otters eat urchins, while lounging and playing in kelp beds.

“It’s a characteristic community,” Parnell said. “Diving in the kelp forest is like taking a walk through a terrestrial rainforest. Ten feet below the surface, it’s like you’re flying in the canopy. When you’re on the bottom, you’re shaded by this wonderful forest, and you feel protected. You feel like you’re pretty much inside, rather than outside the house.”

The divers returned to the surface with lustrous abalone shells, as well as sea urchins, snails and cowries. They found some unwanted things, too, including weedy clumps of sargassum, an invasive seaweed that competes with kelp.

Despite that intruder, Parnell was pleased by what he saw. Last month’s winter storms didn’t wreak as much damage as he expected, and regrowth is replacing kelp lost to the warm water die-offs.

“The kelp forest is looking a lot better than it was a few years ago, I’ll tell you that much,” he said, peeling off his drysuit.

That’s not to say that San Diego’s kelp forests are out



ANDREW ROE PHOTOS

Scripps Institution of Oceanography researcher Ed Parnell inspects the kelp forest off the San Diego coast during a dive last month to check on the current conditions of the local kelp.



A *Norrisia norrisii* snail sitting on a kelp leaf is shown during a dive last month to check on conditions after recent storms.

of the woods. While their condition is good, their coverage isn’t as extensive as it was before.

“There’s kelp missing in many areas that it used to be,” Parnell said. “In the areas that it’s now present, it looks very healthy and it’s growing rapidly. Fundamentally, they’re missing from some of the other areas where they typically grow. They basically haven’t recovered from the last El Niño in some areas.”

They have been spared the destruction of urchin barrens, however. That’s partly because urchins died off during the warm water episodes, as well. Although there is some urchin overgrazing on San Diego kelp beds, particularly near Point Loma, it’s not on the scale seen in Northern California, Parnell said.

“You had two different warm water events, and the kelp virtually died off,” he

Anatomy of giant kelp

Giant bladder kelp: *Macrocystis pyrifera* can grow two feet per day to a maximum length of 175 feet. It lives eight to 10 years and is perfectly adapted for life in cold, moving water.

Blade: Photosynthesis occurs on both sides of the blade to synthesize food. The serrated edges move essential nutrients.

Stipe: The strong flexible network of branches that connect the blades resemble plant stems, but do not transport nutrients.

Gas bladder: *Pneumatocysts* are small air-filled sacs that connect the blade and the stipe. These keep the blades afloat near the water’s surface to absorb sunlight.

Source: U-T research

MICHELLE GUERRERO U-T

said. “Sea stars and urchins (also) died off.”

It’s lucky for Southern California kelp forests that their most voracious predators declined under the same conditions as the seaweed beds. But the long-term prospects for kelp in a warming world are troubling, researchers say.

Australian kelp forests off Tasmania have all but disappeared, declining by 95 percent as the water of that region has warmed faster than the global average, researchers report. Although the continent’s coral reef decline has been widely publicized, its kelp loss could be just as calamitous. San Diego’s situation is not that dire, but it may be in coming decades.

“The Tasmanian kelp story is probably the southern California kelp story over the next century,” Parnell said.

An ocean temperature time series taken from Scripps Pier over the past century shows an unsettling pattern. While ocean temperatures rise and fall in annual cycles, the average temperature began rising in the late 1970s, creeping up by several degrees. Last year, San Diego saw some of the warmest water temperatures on record, spiking to a record 78.6 degrees in August. It’s unclear, Parnell said, if that’s simply a new record, or a new normal for the region.

Paul Dayton, a professor emeritus of oceanography at

Scripps, began diving in San Diego kelp beds as a graduate student in the 1960s, and continued that research after joining the faculty in 1970.

“My first dives were one of wonder at this habitat as I floated around looking at the different structures in the kelp forest, and all the different animals,” he said.

At that time, he said, kelp forests were still recovering from strong El Niños in the 1950s. They bounced back from those blows, but Dayton isn’t confident we can count on that in the future.

“Right now, it looks bad to me, because the ocean warming is continuing. Even though we have a break in the El Niños, the macro kelp will be in trouble if the nutrients in the water diminish with global warming,” he said. “Right now, there’s a lot of kelp out there, so I can’t say we’re in the middle of a disaster, but it doesn’t look good for the next 10 years.”

If they decline, or disappear, he said, they’ll take a host of ecological communities with them. Kelp provides food and shelter for marine animals not only while it’s growing offshore, but also after it washes away. On the beach, decomposing kelp provides food for small animals such as sand worms, arthropods and other invertebrates, which are prey for seabirds, Dayton said.

You might not care much about sand worms, he acknowledged, “but everyone loves the birds.”

Kelp paddies can also detach and float out to sea, where they provide food and shelter for rockfish larvae.

“It’s sort of a condominium of young animal people out there in the kelp paddies,” he said. “The paddies are really important to these populations for rockfish that we’re trying to recover.”

The massive algae also sink to the bottom of the sea, creating a submarine smorgasbord for deep sea creatures, he said. And they can drop into San Diego’s offshore canyons, where juvenile kelp bass and hake dine and hide in the disintegrating seaweed, Dayton said.

“If we were to lose *Macrocystis*, which it looks like it’s likely, it’s not only the divers that lose the structure and the beauty of our kelp forests, it’s the whole ecosystem,” Dayton warned.

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