Drought, Heat and the Shark Next Door

- Post Photo Essay Reprint: “If they die, we all die’: Drought fells Kenyan herds”
- Think Like a Reporter: Create a Photo Essay
- Post Reprint: “Fierce heat waves put habitats, biodiversity in jeopardy”
- Post Reprint: “The great white shark next door”
- Student Activity: What You May Not Know About the Man in the Gray Suit
Finding the Right Words and Photographs

When photographs and words come together to amplify and enhance the theme of a photo essay, readers receive memorable information and emotional impact. In this month’s Think Like a Reporter | Create a Photo Essay activity students are asked to consider what it means to be a photojournalist who produces a photo essay.

Teachers may wish to refer to the photographs that are used with Post articles to introduce students to the visual component of news, opinion and feature stories. For example, why did we choose Bryan Daniels’ photograph of a cub clinging to a charred branch as the dominant image to accompany “Fierce heat waves put habitats, biodiversity in jeopardy”?

“The great white shark next door” takes us to the California coastline almost 50 years since the 1974 publication of Peter Benchley’s *Jaws*. The Post’s Scott Wilson begins with a descriptive lede with “a fin about the height of a playing card,” slicing through the glassy-gray sea. The great white shark, nicknamed the “man in the gray suit” by surfers, are seen as juveniles and “cannibalistic elders,” the subject of scientific study, and residents of changing habitats. They were conserved — along with elephant seals, sea lions and other dietary favorites — by legislative action. They are tagged and tracked.

A lesson by Lisa Wu, marine biology educator, provides ways to look at the beneficial uses of the shark — in common products, the arts and cultural heritage. Students then look at the man in the gray suit as more than a predator. Their in-depth study involves research in the human health industry.

We begin with finding the right words and taking images to capture a theme and end in the Pacific Ocean with sharks. Still searching for words to give a complete picture of complex relationships.
The urgency of awe: Nature and the climate crisis

Kangaroos standing in a scorched forest, pigs and cows carted off to slaughter, penguins and polar bears watching their homes melt away. As countries negotiate in Glasgow, Scotland, on how to stave off climate disaster, photographers around the world are showcasing the effects of human-made climate change.

The Earth Project, a climate action advocacy organization, announced Saturday [Nov. 6] the winners and runners-up of a contest in which photographers were asked to submit images representing the toll that human behavior is having on the rest of the world’s living creatures. Their goal: to bring attention to the climate emergency.

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The industrial farming of animals like cows and pigs is a large contributor to climate change, and the United States has said plant-based diets especially in rich countries, would help mitigate its effects. The practice, long decried by animal welfare activists, takes a toll on livestock, which are transported long distances in squalid conditions before being slaughtered for food.

In South Africa, where poachers are killing off the rhinoceros population, protectors carry out “dehorning” — a traumatic procedure, but one that could protect the mammals from being killed. The horns, like fingernails, eventually grow back.

Extreme weather and an increase in fires linked to man-made climate change have also taken a toll on the wildlife population.

The World Wildlife Fund said the fire season in Australia between June 2019...
and February 2020 killed or displaced nearly 3 billion animals, including koalas, wallabies and kangaroos.

Other photographers chose to focus on the Arctic, where record-high temperatures are causing ice sheets to melt, destroying habitats and raising sea levels around the world.

Photos also showcased the natural yet surreal beauty of a planet at risk.

Photographer Edwin Giesbers photographed two penguins years ago while onboard a research ship in Antarctica, sailing into what he described as a “fairy-tale world.”

“It is precisely this photo — with the penguins small in the frame — that clearly conveys my feelings about Antarctica: an infinitely large and magical world where you as a human being feel small and insignificant. Nowadays, global warming is, unfortunately, a big threat to the penguin colonies,” he said.

Nick Garbutt captured a humpback whale in the coastal regions of British Columbia, where they migrate to feed on vast schools of herring. “Everywhere there is intricate interconnectivity and all driven by seasonal cycles threatened by climate change, he said.

Doug Gimesy photographed blue penguins living on a bay some four miles from the heart of Melbourne. On his website Gimesy wrote, “This is one of only a handful of penguin colonies that have established themselves next to a major city and the only penguin colony in the world that lives, feeds and forages in a bay,” making them especially vulnerable to human activity.

Tony Wu captured a humpback whale caring for her calf, which had just been attacked, presumably by a group of marine mammals. He saw the pair nine times over the course of 33 days, he said, documenting “the calf’s recovery and growth, as well as his mother’s change in mood and interactions with other whales.”

When this photo was taken, Wu said, the calf’s “wounds were healing well. He was energetic, active and so accustomed to seeing me that he often swam over to say hello. His mother had grown comfortable with my presence as well.”

“Humans and humpback whales are different in many ways,” Wu added. “This calf and his mother demonstrated many of the things we have in common — fear, love, hope, resilience, trust and perhaps even friendship.”

FROM TOP: A piglet and its mother. Industrial farming of animals is a big contributor to climate change. A humpback whale and its injured calf. A rhino in South Africa is dehorned to protect it from poaching.
In northern Kenya, a giraffe lies dead, its long limbs splayed. Camel skeletons bake in the sun, and people burn rotting animal carcasses to put a stop to the smell. Herder Yusuf Abdullahi saw 40 of his goats die of hunger — their white, withering bodies dot the warm dirt.

“If they die, we all die,” Abdullahi told the Associated Press.

The drought did this. As rivers dry up and vegetation wilts and perishes in northern Kenya, rangers and herders, along with their families, do what they can to keep more animals from dying. They fill plastic containers from boreholes. Conservancy rangers transport water in tankers.

The loss of a herd of sheep, or a caravan...
of camels, or a drove of cattle, can be ruinous for families. Some areas in northern Kenya haven’t seen rainfall in over a year. The United Nations has warned that 2.5 million people are already experiencing food insecurity in the country because of the drought.

Kenya is meant to have two rainy seasons: “Long rains” from March to May, and “short rains” from October to December. Over the last year, little precipitation has fallen in northern Kenya. And the latest rainy season is also poor, making an already dire situation worse. Kenyan President Uhuru Kenyatta last month declared a drought-driven national disaster in 10 of the country’s 47 counties.

The landscape of drought and death paints a stark picture of the region’s future after world leaders just met in Glasgow, Scotland, to make climate commitments at the COP26 summit.

Africa is responsible for only 4 percent of the world’s carbon emissions, but its nations remain among those most vulnerable to climate change.
Think Like a Reporter | Create a Photo Essay

When working for a news organization, a photographer is a photojournalist. This distinction is found in the Code of Ethics that is followed. The National Press Photographers Association established its code to guide photographers in keeping the highest ethical standards in relationships with the subjects of their work and with those who may try to influence their work.

When the photojournalist is producing a photo essay, the emphasis is on the photographs. The images when placed in layout (size and dominance, order, and relation to other photographs) must tell a story. Captions will give context and fairly provide information for the reader of the images. The essay compliments the photographs, but in the photojournalist’s mind the words are secondary to the images. The reporter, or writer of the essay, regards the essay as more important. When photojournalist and writer work together, they communicate a powerful story.

For this activity, we are emphasizing the photographs in the photo essay.

What Are the Storytelling Elements in a Photo Essay?
Think of covering a student art exhibit. Images of the artwork convey only part of the story; add such photographs as the artists setting up the exhibit and the audience reactions to tell the whole story — creating the story of an event or artistic endeavor through several images. Online, photographs may be put in chronological or developmental order or grouped by types of involvement. The photographs, for example, from “What professional wrestling was like in the 1970s” begins with a dominant image using angle, lighting and line to set emotional impact. In the following images readers are taken ringside, backstage and in the ring.

The photographs may be categorized:
- Informational – the images are based on a scene or a situation
- Graphically appealing scenes — the use of line, alignment, shapes and number of objects (odd numbers are considered more appealing)
- Emotional scenes — faces, interactions and action clearly evoke emotion
- Intimate scenes — taken behind the scenes, a personal shared event
- All of the above combined in one picture

Be complete and provide context when photographing or recording subjects. Avoid stereotyping individuals and groups. Recognize and work to avoid presenting one’s own biases in the work.

Treat all subjects with respect and dignity. Give special consideration to vulnerable subjects and compassion to victims of crime or tragedy. Intrude on private moments of grief only when the public has an overriding and justifiable need to see.

Respect the integrity of the photographic moment.

— From the National Press Photographers Assoc. Code of Ethics
What Photographic Techniques Help to Create a Photo Essay Presentation?

Photographers should consider the type of focal length and camera angles. Whether using stills or a video, the photo essay should contain a variety of shots:

- Wide shots
- Medium shots
- Tight shots
- Detail shots
- Leading Line shots
- Panoramic shots
- Rule of thirds shots

Look for examples of photographic techniques online in these photo galleries.

- “The grueling struggle of being a California firefighter in the age of climate change”
- “Poetic depictions of Appalachia, a new home for this photographer and his family”
  https://www.washingtonpost.com/photography/2021/12/17/poetic-depictions-appalachia-new-home-this-photographer-his-family/
- “China’s Harbin Ice Festival offers chills and thrills”
  https://www.washingtonpost.com/lifestyle/kidspost/chinas-harbin-ice-festival-offers-chills-and-thrills/2022/01/05/963b617a-6d97-11ec-b9fc-b394d592a7a6_gallery.html?itid=sf_photography

There Are Two Types of Photo Essays: Thematic and Narrative

Thematic Photo Essay

A thematic photo essay is a series of images with a common theme. The theme could be anything — rain or weather or a color or an attitude. For example, a series of photographs of different types of ice creams or a series of photos taken on a summer day in a city form a theme. In a thematic photo essay, the images work together as a whole, revealing the broader essence of a story.

The Baconian essay may inspire this approach: Of socks, of mailboxes, of pets, of quarantine.

Narrative Photo Essay

A narrative photo essay has a linear storyline with a beginning, middle and end. Some images in the essay support the pacing of the story. A photo story gives you a sense of the subject’s experience. For example, a photo story may first show a patient being admitted in a hospital, then show the various stages of the patient’s recovery and finally show the patient being discharged from the hospital. Or the photo essay may show try-outs for a team, team practice, first game, and in the locker room after the game — either following one person or several.

The narrative photo essay may also be the chronological day in the life of a school, community or global village.

Read Online Examples of a Photo Essay

Compare and contrast the ways Post editors and designers presented these photo essays.

- “The Endless Call” by David Montgomery
- “A Year in Hong Kong” by May-Ying Lam
- “My GPS-Tracked Life on Parole” by James Baimbridge as told to Beatrix Lockwood
Read Print Examples of a Photo Essay

• “The urgency of awe: Nature and the climate crisis” by Ruby Mellen
  1. What is the theme that unifies images taken by different photographers?
  2. What photograph do you think most expresses the theme? Why?
  3. Which caption is most helpful to explain the relation of the image to the theme?
  4. Could the photographs and captions stand alone without the article to convey the main idea?

• “‘If they die, we all die’: Drought fells Kenyan herds”
  by Sammy Westfall and photographs by Brian Inganga
  1. What story does the dominant (largest) photograph tell?
  2. Before reading the captions, what aspects of the northern Kenyan drought are told?
  3. Which details in the captions best inform readers?
  4. Read the essay. Explain how the writer enhances understanding of the drought.
  5. What point of view is expressed in the last paragraph?

Photograph and Write Your Photo Essay

Brainstorm possible subjects and themes for your photo essay.
Are you involved in a club, athletic team or private lessons? Has your neighborhood changed in the last year?
Are there people in your school who do the behind-the-scenes work that no one notices? Is the season changing?

Decide whether your photo essay will be influenced most by the photographs telling the story with a short essay.
Or will the words of the essay have more prominence over the photographs.

Prepare a storyboard of the types of photographs and photographic elements you will include. Do you want sunrise or sunset images? In what place are leading lines best captured? How will you handle some lighting challenges? How can you safely get a high angle shot?

After the planning, be ready to take photographs of the unexpected. Be respectful of your subjects.
Don’t manufacture scenes. Enjoy sharing your photo essay.

Are you still not quite ready to begin your photo essay? Review elements that make up a photo essay as you read these ten photo essays that capture 2021: “The Year of Endurance: Hope and uncertainty amid a pandemic that wouldn’t end.” [https://www.washingtonpost.com/magazine/interactive/2021/2021-photo-issue/](https://www.washingtonpost.com/magazine/interactive/2021/2021-photo-issue/)

SOURCE: Portions of this activity are from Outline for preparing a photo essay, Michel duCille, Great Digital Photography, as found in Visual Image, the January 12, 2012, Washington Post NIE curriculum guide.
Record heat waves have scorched the Pacific Northwest in recent weeks, prompting raging fires and devastating droughts across the region. The extreme weather has been blamed for the deaths of hundreds of people. But the toll among the region’s animals has been far greater, with the shifting climate threatening to permanently alter the area’s biodiversity.

Conservationists and scientists say the changes have been coming for years: Rising temperatures have coincided with drier conditions in parts of the Pacific Northwest, shaping the ways habitats interact with organisms. The full scope of the ramifications is still being studied, but it is expected to be extensive.

“It’s a big unknown,” said Jay Kehne, a conservationist and member of Conservation Northwest, an organization that aims to protect and conserve the region’s wildland and wildlife. “It’s really hard to grasp all the changes that can come...
from those really incremental changes.”

How does extreme heat affect animals?

Extreme heat, coupled with drier conditions, can significantly alter animals’ habitats. Dry winters can weaken plants and their leaves, diminishing potential food sources for wildlife. Mussels, barnacles and seaweed populations have faltered, impacting shoreside food chains. The shrubsteppe, a parched ecosystem located in eastern Washington, is an essential habitat for much of the state’s fauna. However, under the strain of development and climate change, an estimated 80 percent of the shrubsteppe has been lost, according to the Washington Department of Fish and Wildlife.

Climate change “is going to affect how different plants live and or survive from seedlings on up into their adulthood,” Kehne said. “That’s going to change some of the species that occur across the landscape.”

How are animals responding to extreme heat?

Animals have different tools to protect themselves from the effects of extreme heat. Some stay in the shade, while others lurk in creeks or lakes, according to Patrick Taylor, chief of interpretation and education at Death Valley National Park.

Adult birds tend to look for shady spots across a habitat, staying in the shadows until temperatures drop. Some birds also utilize a tactic called gular fluttering, vibrating their neck muscles while their mouths are open to regulate their internal temperatures, according to Nat Seavy, the director of migration science for National Audubon Society’s Migratory Bird Initiative.

However, there is only so much an animal can do. Wildfires have scorched large sections of the Pacific Northwest’s plains and forests, depriving wildlife of an essential barrier to extreme heat — and opening the door to mass casualty events.

The same outcome has been seen elsewhere in recent years.

“One of the places where this has really been studied has been in Australia, where there have been mass mortality events during heat waves,” Seavy said. “Birds have packed into very small areas of shade, and you find hundreds if not thousands of birds that have expired from the heat.”

Which species are most at risk?

The effects of climate change on wildlife have been especially noticeable among certain species, Kehne said. Fauna that once dominated the land — such as lynxes, pygmy rabbits, sage grouse — have dramatically declined. Lynxes and pygmy rabbits are already considered endangered species in Washington state, while the greater sage-grouse population has decreased 80 percent since 1965.

The seas are also under threat, according to Chris Harley, a University of British Columbia professor and marine biologist. Vast beds of shellfish were baked alive in British Columbia earlier this month, the consequence a fatal mix of extreme heat and low tides.

Stationary organisms like mussels, barnacles and seaweed are at the most risk, Harley said.

Researchers estimate more than a billion marine animals along the coast were killed by extreme temperatures in the Pacific Northwest after a heatwave in June. (Reuters)

However, extreme heat poses a threat even to animals that are more mobile because they may rely on organisms decimated by the extreme conditions.

“The mussels feed a lot of starfish. There’s migratory birds that rely on them,” Harley said. “All those species — mussels, barnacles, seaweeds — provide a lot of habitat for other things.”

How are experts responding?

As the effects of climate change become more and more evident, some experts are reevaluating their prior projections. One of Harley’s graduate students brought propane camp heaters down to the shore in the hopes of simulating a heat wave earlier in the month.

The actual heat wave that hit British Columbia was far hotter than the experiment.
“We’ve had to recalibrate our expectations and now we’re focused on what might happen in the very near future,” Harley said.

For Kehne, that means a closer examination of the effects of gradual climate change on habitats. More extreme climate events, like wildfires and lightning storms, tend to grab the headlines, Kehne said. But it’s the slight changes, those unseen by the naked eye, that threaten to disrupt the livelihoods of all sorts of wildlife across the Pacific Northwest.

“This is going to be a continual rise,” he said. “That’s really hard to get your head around and harder and harder for people to understand that it’s actually happening and try to take action to correct that.”

Experts have long looked toward extreme environments for guidance, hoping to draw meaningful lessons from habitats already facing extreme conditions, including the Mojave Desert in California and parts of Australia, Seavy said. With this information, experts hope to better predict the impacts of climate changes in other parts of the world.

What can we do?
The situation looks bleak, especially as wildfires continue to rip through the valleys and hills that cover much of the Pacific Northwest. However, there are actions people can take in the interim to help provide temporary reprieve for some species.

Extreme heat places nesting birds at significant risk, Seavy said, a consequence of their less mobile nature. Still, nesting boxes and bird-friendly garden landscapes can provide birds with safe alternatives to their natural habitats — which is especially crucial when those environments are under threat, Seavy said. Audubon has a database of native plants that attract and protect birds on its website.

Shocks in seafood production also threaten to harm shellfish growers and Indigenous communities in the United States and Canada. As those communities assess the long-term impact of climate change on their local shoreside environments, it may open up new possibilities for sustainability and conservation.

The implications of climate change are far-reaching and will only continue to threaten at-risk populations, Kehne said. Climate-related migration will likely increase, as will mass mortality events. Just last year, half of Washington’s pygmy rabbit population was killed during wildfires. Now, only about 90 remain, Kehne said.

Still, experts remain hopeful that the worst impacts can be averted. Climate change is becoming more evident to both researchers and the general public. As the problems become clearer, perhaps so will the solutions, Harley said.

“I think it is important not to lose hope,” Harley said. “It’s really bad. But if we can understand it, that helps us plan. And hopefully, we can all make small steps to make these things less likely in the future.”

Alyssa Gehman encountered this mussel bed during the heatwave in late June in Vancouver.
The great white shark next door
Anxiety grows along West Coast as predators expand their range

BY SCOTT WILSON

• Originally Published July 24, 2021

SANTA BARBARA, Calif. — The glassy-gray sea ripples with the movement beneath. Then, a fin, about the height of a playing card, breaks the surface, slicing through the water from just beyond the surf line, a glimpse of a tail tip visible a few feet behind.

The dark shape just feet beneath the murky water resolves itself quickly from the bow of a boat. On the iPhone screen where Patrick Rex, a California State University at Long Beach graduate student, has been tracking it by drone, the young great white appears like a cartoon cutout, a wide span of pectoral fins, a broad head and narrowing nose, a large, swishing tail.

It is within feet of a teenage lifeguard on a paddle board, unaware of what’s below.

“You guys looking for sharks?” the surf-camp volunteer calls out, steering his stand-up board toward Rex’s Boston Whaler. He is looking for them too, an early-warning patrol meant to alert the dozens of kids on the beach about 20 yards away.

“There was a six-footer just inside your board and the beach,” said Chris Lowe, the veteran scientist who runs the Shark Lab at California State University at Long Beach. “It’s about six yards off your port bow now.”

A slow turn, and the lifeguard calmly heads toward shore: Another great white shark has come too close to the rollicking campers nearby. He delivers the warning more than a dozen times a day. “Thanks,” he calls coolly over his shoulder.

California, blessed and cursed by the extremes of its place at the continent’s edge and the shore of the world’s largest ocean, is learning with trepidation to live in harmony with “the man in the gray suit.” It is a nickname that surfers have applied to great white sharks over the years, animals in their element, going about their business day.

If wildfires, earthquakes, mudslides and drought were not concerning enough, the geographic range of young great whites has expanded north along the California coast by hundreds of miles, bringing the quintessential summer-blockbuster predators within feet of surfers and swimmers from the Mexican border to beaches just south of San Francisco.

These are juvenile great whites, most just a couple of years old and seven to eight feet long. Unlike their large and often cannibalistic elders who more commonly live miles offshore, and often attack people by accident, the young ones have shown no interest in adding humans to their
developing diets.

But their numbers are growing.

At a thriving nursery for great whites just a few miles east of this weekend refuge of a city on the border of Central and Southern California, two days with Lowe and his team revealed more than 15 great whites, some cruising no more than four feet from the beach. Many had been tagged previously by Lowe, who the year before tagged 35 great whites along the same mile-long stretch. There were, he said, undoubtedly more today.

But the great white phenomenon here is novel mostly because of the far larger geographic coastal range where juveniles are now learning to hunt before heading offshore to the cold-water island groups that have hosted the big ones for centuries.

The wider distribution of great white nurseries is the result of successful decades-old conservation efforts and a warming coastal Pacific Ocean, which scientists say has opened a near-tropical water highway for the temperature-sensitive juveniles to comfortably ride much farther north than ever before.

The trend prompted the state legislature to act three years ago, approving a $3.75 million great white monitoring program. The money is a response to the new questions being raised by the animals and to the additional public safety risks more sharks might pose.

Late last month, a swimmer was bitten just south of San Francisco by a juvenile great white, the farthest north Lowe said he had ever heard of such an attack happening.

A few days later, off the island of Catalina in Southern California, a shark bumped a Boy Scout's kayak and bit into his hand. Those bump-and-run encounters, scientists say, may be more of a "nothing to see here, move it along now" signal from sharks rather than an intentional attack. But the last shark-bite fatality in the state was last year. According to state Department of Fish and Wildlife statistics, there have been 197 shark attacks and other types of encounters off the coast since the 1950s, including 14 fatal ones. Those numbers have grown each decade since the 1960s, peaking in the 2010s with 55 attacks.

"White sharks right now are beneficiaries of climate change," Lowe said. "But there are many questions about what is happening and why it is happening in these places. And as the teenage population of the white shark continues to grow, what and where are they going to eat?"

**Apex predators, apex scientists**

The mysteries surrounding California’s great white population have grown along with the geographic scope of its nurseries.

But sharks are elusive, as a few days with Lowe's team revealed, and hard to count. Shark scientists working in labs from San Diego to Monterey Bay debate if the shark population is growing or if the "distribution" of its juvenile habitats is just giving the impression of a booming shark renaissance.

Put simply, scientists want to know: Are more white sharks in these waters? Or are these white sharks just in more places along the coast because of the warming waters associated with climate change?

The tentative answer, according to Lowe and several recent papers on the California white shark population, is yes and yes. Both phenomena are probably true.

The seminal event that prompted these new questions began in 2014. The Pacific Ocean off the U.S. West Coast has not been the same since, including the behavior of its rich variety of large mammals, diverse shark populations, and an array of other sea life.

An eastern Pacific heat wave, nicknamed the blob, shuffled the warm and cold currents that run along the California coast. The following year a periodic, if rare, weather event known as “El Niño,” when warm currents surge north from the southern Pacific, reached California and exacerbated the effects of the lingering warm-water blob.

The primary consequence was that for the first time subtropical water from northern currents from Mexico made its way around Point Conception along this county’s northern coast. The outcropping — effectively the geographic gateway to Central California — had historically served as the barrier between warm southern currents and far chillier northern waters.

Suddenly, no more barrier.

Species of shellfish, anemone, commercial fish and sharks commonly native to deep Southern California and Baja were showing up in Monterey Bay — and even
areas north of San Francisco. Food supplies — for migrating whales, elephant seals and sea lions, for young great whites — shifted routes and drew the large animals with them, sometimes toward shore and sometimes farther out to sea.

Salvador Jorgensen, a marine ecologist and researcher at the University of California at Santa Cruz, said juvenile great whites were hardly seen off the Central and Northern California coasts before 2014. Now they are nearly as common as the group that hangs out in the warm waters here east of Santa Barbara off a sandy beach where, on most days, you can see the Point Conception headlands in the western distance.

“If you just look there in Monterey Bay, you would say, wow, this population is just massively increasing,” Jorgensen said. “But when we took a step back and looked at what the drivers are, why these sharks are up here, we realize that there’s just been this massive shift in the northern boundary of warm water along California.”

Jorgensen, who often works closely with Barbara A. Block, the eminent Stanford University shark scientist, said that “it seems like sharks that were previously south of Point Conception are now making it up around that corner, which has always been a big barrier thermally, and up into this region.”

The warmer water, though, is only one part of what is pulling great whites into places they have never been seen before.

The turbidity, or clarity, of the ocean; the salinity; and the amount of chlorophyll in the water, which can indicate how rich in food a region is, are other factors that dictate a great white’s broader movements. The research is time-consuming and remote, and the data sometimes conflicting, often bringing more questions than answers.

In one measure of how quickly habitats are emerging and changing, the experts have sought help from the amateurs to understand the new great white behavior off California.

In the paper published this year in Scientific Reports, Jorgensen wrote that “the emergence of juvenile white sharks in Monterey Bay was unexpected, sudden and outpaced established scientific monitoring programs.”

What Jorgensen acknowledged was that because “shark scientists go where they know the sharks are,” it was eyewitness reports from long-time surfers, divers and fishermen that first tipped him and others off that new juvenile white shark nurseries were emerging around the northern edges of the bay.

Other clues, such as an increase in bites on otters — which are not traditional great white food, being light on fat and long on thick fur — added to the evidence that the bay was full of novice juveniles testing what is edible and what is to be avoided. (Lowe jokes that otters are like “vegan brownies” for sharks — they resemble, in murky water, fatty seals, but one bite and sharks are grossed out.)

“We used a lot of citizen science data to capture this transition,” Jorgensen said. “But I think the bigger danger we’re talking about here is climate change. We’re having a complete shift in the patterns of where these animals go, and they’re showing up in new places that people aren’t used to. These things are all shifting, and it makes prediction much harder.”

Conservation success with an edge

The great great-white revival is a conservation triumph, albeit one with an occasionally frightening edge to it.

Although there were few solid population numbers at the time, the great white population off California was severely challenged before voters passed a 1990 ballot measure outlawing the use of gill and other indiscriminating nets set adrift in the coastal waters off Central and Southern California.

The ban took effect in 1994, when then-Gov. Pete Wilson (R) also signed into law a prohibition on hunting, catching and killing great whites off the California coast. Lowe and other shark scientists trace the white shark resurgence to those measures.

The data were scarce because traditionally commercial fishermen, working the highly productive waters of the Santa Barbara Channel and other productive fisheries, would simply list in their catch logs “shark” if they hauled one in as “by-catch” in their nets.

Not until 1975 did fishermen begin specifying if the caught shark was a great white, a bit of bureaucratic detail Lowe attributes entirely to the publication the previous year of Peter Benchley’s smash novel, “Jaws.”

The California conservation measures also protected elephant seals, sea lions and other
favorites of the great white’s diet. It was, suddenly, a good time to be a great white.

“There is a lot of food,” said Echelle Burns, a sustainable fisheries researcher at the University of California at Santa Barbara, who studied under Lowe in Long Beach. “But we still don’t really know why these juveniles are picking the spots they do or why they change them sometimes year to year.”

Great whites, for better or worse, were suddenly pop stars. The population grew over decades, and under some pressure from the public, given the ubiquitous YouTube drone footage and GoPro highlight reels of sharks coming within feet of swimmers, the state decided it had a stake in protecting the public from its conservation successes. The $3.75 million that the state approved three years ago to establish a great white monitoring system is managed by Lowe’s lab.

The program is not an early-warning system. But Lowe shares the tracking data with lifeguards along the coast and helps design protocols for when a beach should be shut down. It is tricky, subjective work with a sometimes profound economic impact on communities when beaches are closed in regions seen as havens for great whites.

During the great white population recovery, the adults ranged widely, from the “cafe” in the center of the Pacific, through California’s offshore island chains, such as the northern Channel Islands off Santa Barbara and the Farallon Islands off San Francisco. The young stayed in the warm waters of Mexico and Southern California around San Diego, and sometimes off the busy beaches south of Los Angeles and in the Santa Monica Bay.

Great whites do not make happy families. Adults and juveniles remain segregated, a leave-me-alone relationship developed over millions of evolutionary years to avoid cannibalism. Adult great whites, especially males, will eat their young.

No great white shark birth, in fact, has ever been witnessed. One theory is that females give birth to pups — five, six, seven at a time — in deep, cold water such as in the trenches of the Santa Barbara Channel, among the richest marine habitats on the West Coast.

Once born, the young head instinctively toward the warm near-shore waters and the females head out to colder currents, an evolutionary security measure developed since prehistoric times. Scientists say adult and juvenile great whites behave for years as if they were two different species. In a paper published recently in *Frontiers*, Burns and several members of Lowe’s team wrote that juvenile great whites have developed numerous “shallow, nearshore habitats across southern California,” with a strong preference for sandy beaches such as this one along Padaro and Santa Claus lanes east of Santa Barbara.

It is data on the ocean’s turbidity, salinity, chlorophyll, food supply and even DNA content that Lowe and his team were here to collect late last month. The beach here is mostly free of rocks, unusual for the area, and slopes so gradually into the channel that a boat can bob in 10 feet of water as far as 40 yards offshore.

Shuffle out into the light surf this time of year and, just ahead, clouds of sand rise as sting rays, many the size of old vinyl records, emerge from the sand. They are delicacies to a young great white and bountiful within a basketball-court length of the shore here.

“There are many questions about why
hers,“ Burns said. “But these sharks are not trying to eat people — that’s the major thing.”

A ‘hot spot’ on shore and off

Lowe, a marine biology professor who grew up on Martha’s Vineyard and is a man in demand, calls active great white nurseries “hot spots.”

This fits the description of Santa Barbara County’s south coast in more ways than one. The one-mile stretch of beach where the shark nursery thrives is among the most expensive real estate in one of the most expensive neighborhoods in one of the most expensive cities in the state. These are literally movie-star homes — the majority along Padaro Lane in the eight-figure range — that look south over carefully cut lawns onto a green sea full of great whites. Ashton Kutcher and Mila Kunis, Ellen DeGeneres and Portia de Rossi, George Lucas, and Kevin Costner have all owned or been associated with property in the beachside neighborhood.

Over 15 minutes one recent afternoon, one boat with Lowe’s team tracked a roughly 10-foot great white swimming languidly in slow circles about 10 yards off the beach, at times dipping into water as shallow as four feet. In the near distance, a couple tended a hedge that separated a lawn from the sand and the shark a few yards beyond.

Just a few hundred yards to the east is the beach at Santa Claus Lane, where the summer surf camps gather each year. These are gentle beaches and surf, all sand, small swell and sparse rock, ideal classrooms for aspiring surfers and predatory sharks alike.

“I use Padaro as a community learning to adapt,” said Lowe, tall and lean with a narrow face that shows some of the telltale signs of a career spent in the sun. “These sharks really look at these people as flotsam, just floating trash.”

Over two days, amid low ocean visibility, Lowe’s team encountered at least 17 great whites, ranging in size from about five feet to more than 10 feet. The spotting is done by drone, by underwater acoustic monitors, and by good old-fashioned fin-spotting when the sea is calm enough.

To begin on an early gray day, Yamilla Samara Chacon, a graduate student responsible mainly for collecting white shark tissue, blood and other biopsy specimens, pulled on a full wet suit, strapped on a weight belt and prepared for a plunge about 30 yards offshore.

Her task: to stake monitoring devices to the sea floor in water visibility in the two- to three-feet range. The team had spotted its first white shark of the day minutes earlier, a seven-footer that had been previously tagged and was not far away.

“This isn’t her favorite part of the day,” Lowe said, deadpan, as Samara Chacon grimaced at the opaque ocean surface.

Then she plunged in, planted the devices, and emerged. These devices are temporary. Others are not.

With help from the state funding, Lowe now has more than 100 tracking receivers in place from the Mexican border to Morro Bay, a notorious spot for adult sharks in Central California. They ping when a tagged shark passes, allowing Lowe’s team to track specific juveniles on their journeys up and down the coast.

They are itinerant, trend-driven, with one summer’s “hot spot” turning into the following summer’s shark-free zone. Padaro, about a 10-minute drive from the former royals Harry and Meghan’s place, has endured. Lowe’s radio crackles.

A smaller Boston Whaler farther offshore is using an underwater robot, extraordinarily similar in appearance to a cruise missile, to make a three-dimensional map of the Padaro area. The robot traverses the mile-long stretch at a sluggish three knots, rising and falling to take measurements.

“Oh, my God, a shark just hit the robot and breached,” the voice of Emily Spurgeon, a graduate student overseeing the robot mission on this day, sounded over the radio. “It was turning and then out of nowhere the shark hit it.”

“That has never happened before,” Lowe said to anyone listening.

The robot is a $250,000 piece of equipment.

“Does it still work?” Lowe asked.

An elephant seal pup peers through a gate at the Marine Mammal Center in Sausalito, Calif., on April 2, 2019. A surge of warm water has affected the Pacific, creating challenges for native species and ushering new warmer-water species into the ecosystem.

Bay, a notorious spot for adult sharks in

“Yeah, just some paint chipped where you can see a tooth mark,” Spurgeon answered.

Lowe said that similar robots, some far more expensive, get hit by sharks all the time when deployed in waters home to adult sharks off Mexico at the Guadalupe Island. A lot of that is made for TV, though, with a TV budget to replace the damaged equipment.

“They think it’s great,” Lowe said, straight-
Barbara Channel to the islands, a protected will make the 22-mile swim across the Santa real heft on them.”

and 3-year-olds, and some are getting some day ended.

bottom. It would happen again before the

the moment, the Queequeg of Carpinteria.

spear cocked in his right arm. He was, at

of the Phyllis Ann with a Hawaiian sling

identify the DNA they hold, was on the bow

emerging sun and slightly clearing sea.

ings quickening as visibility cleared with the

great white spotted of the day, with sight -

to its database entry. This was the seventh

Shark Lab tag.

trying most of Lowe’s team, was pursuing

“June gloom,” the Phyllis Ann, the boat car -

tried to break through the region’s traditional

“June gloom,” the Phyllis Ann, the boat car -

mouth of a shark on the robot. As the sun

as the orange rudder swings right, then a

shadow, a dark shape, and in a blink the

mouth of a shark on the robot. As the sun

tried to break through the region’s traditional

“June gloom,” the Phyllis Ann, the boat car -

But the team wanted a tissue sample to add

to its database entry. This was the seventh

great white spotted of the day, with sight -

ings quickening as visibility cleared with the

emerging sun and slightly clearing sea.

Zach Merson, a graduate student who

had been collecting ocean samples to

identify the DNA they hold, was on the bow

of the Phyllis Ann with a Hawaiian sling

spear cocked in his right arm. He was, at

the moment, the Queequeg of Carpinteria.

Rex’s drone was overhead, and as the

boat approached the large shape in the

water, there was a thump as Merson hit the

shark with the spear, tipped with a fitting

to gather tissue. No luck. The tissue sample

had been collecting ocean samples to

identify the DNA they hold, was on the bow

of the Phyllis Ann with a Hawaiian sling

spear cocked in his right arm. He was, at

the moment, the Queequeg of Carpinteria.

national park teeming with wildlife. Of the

great whites Lowe has tagged here, at least 20

are out at the islands now as teens or adults.

The thriving protected sea lion and seal

population is one draw.

On the westernmost San Miguel Island,

Lowe said, there are an estimated 200,000

sea lions alone, a steady food source that

has made more of these sharks “residents”

of the area rather than the traditional

migrants many are, trekking south to the

Guadalupe Island, west to the so-called

white shark cafe halfway between Baja and Hawaii, north to the Farallons off San Francisco.

“I mean, why migrate out to the middle

of the Pacific if you don’t have to?” Lowe

said. “But what is true is that as the density

of the population increases here, so will

the behavior.”

The laundry list

It was the Shark Lab’s second day of field

work off Padaro. Spurgeon had finished

robot-chasing duty, which despite the shark

strike of the previous day, is generally pretty
tedious work.

The lab boats were gathered near one

of its buoy sensors, which the day before

tracked 10 great whites in 10 minutes, all

within 500 yards of the marker. On her

iPhone, Spurgeon has an alert app that

signals when a shark swims near this buoy,

which sits about a mile offshore.

“Anything?” a colleague called to her.

“Let me check,” Spurgeon responded.

“Sometimes I turn off the notifications

because there are so many.”

Lowe set out this day with a goal of

bringing a great white aboard his boat

after surrounding it with nets, gradually

tightening the space around it, then hauling

the shark up. More tests can be performed

in this riskier way, more samples taken

before the shark is turned loose.

But the wind had freshened by

midmorning and, frankly, the sharks were a

bit larger than Lowe had in mind.

“We’ve got Number 3587,” a voice

over Lowe’s radio announced, referring to

a tagged great white another boat was

tracking.


“No, it’s about six to seven feet,” came the

reply. “And it seems to be tagged.”

Another boat had been following a five-

foot great white swimming leisurely along

the shoreline. Lowe came over to survey the

shark.

“Way too big,” he said. “We’re really

looking for babies.”

Lowe wants at least two new sharks tagged

before the day’s end. So he switches to jab

tagging, using a spear to attach a tracking

tag near the dorsal of a young shark.

He was on the bow, looping his arms over

the spear across his shoulders. The sea was

green, the formless dark blobs more visible

than in the flat gray light of the previous day.

On one knee, drone buzzing directly

overhead, Lowe hit the great white with the

tag, snapping the tip and losing the tag in the

process. He replaced it and, within minutes,

snapped a second.

There are no more to spare and, disappointed,

Lowe draws his hand across

his throat to signal the end of the mission.

“We’ve done a lot of research on migration,”

Lowe said. “But what we still don’t know is

why this beach on this summer. And why

some other beach next summer? The laundry

list of our questions grows.”

Scott Wilson is a senior national
correspondent for The Washington Post,
covering California and the West. He has
previously served as The Post’s national
editor, chief White House correspondent,
deputy assistant managing editor for foreign
news, and as a correspondent in Latin
America and in the Middle East.
The man in the gray suit — the nickname surfers have given the great white shark — is a rather nonchalant reference to the amazing animal that unfortunately is misrepresented and demonized in pop culture.

My first up close and personal encounter with sharks was as a volunteer diver at the National Aquarium in Baltimore. Every two weeks working with a buddy, I would prepare food and enter 335,000 gallons of water, check the health of the inhabitants, feed the fish, clean the exhibit, then surface to interact with the public. This exhibit focused on coral reef fish of the tropics and included several species of smaller, less aggressive sharks such as bonnet heads and nurse sharks. While the colorful reef fish darted in and out of crevices, the sharks drew my attention by the sleek undulations that moved them along the surface or the bottom. The nurse sharks that fed along the bottom never slowed their movements as they moved along. The food placed on the bottom would simply disappear as they passed over it. Once I wasn’t feeding them fast enough, and one shark slowly moved up my leg toward my hand with the feeding bucket. There was no biting involved, just a strong vacuum-like suction pulling at my wetsuit. Another exhibit, showcased larger sharks that tended to be more aggressive during feeding so they were fed with long poles from platforms standing above the water.

The interaction with the public often included families and school groups and most of the questions were concerning the sharks and their relatives the rays and skates that were also in the exhibit. As an educator, I couldn’t help but be grateful for the fascination and wonder sharks inspired. I began making a list of topics from biology, culture, history, ecology, climate change, engineering, physics, evolution, commerce, human health, to name a few, that could be started with discussions on sharks. There is more to admire about these misunderstood predators than there is to fear.

Lisa Wu, former oceanography lab director at Thomas Jefferson High School for Science and Technology, wrote “What You May Not Know About the Man in the Gray Suit.” In her more than 30 years of teaching, she worked with many STEM students on their projects in, on and under the sea including the Potomac River and Chesapeake and Delaware bays. Unable to give up the pipette for the pen, she continues her commitment monitoring water quality aboard the floating lab, Sea Dog, for the Potomac Riverkeeper Network and serves on the executive board of the Women’s Aquatic Network.
The goal of this lesson is to foster discussions about student perceptions, experience, and knowledge about sharks and to introduce them to new areas of research and innovation that demonstrate the importance and connection sharks have to our lives and life on this planet.

From Movies to Make-up
Let’s dive into the past and see what your students know about sharks, their past and current connections to humans. Begin by asking the class what they know about sharks: For centuries sharks have influenced culture and commerce. What do you know about the following connections to sharks? Encourage them to consider all sources such as books, movies, aquariums, beach trips and family stories.

To encourage discussion and to answer the question, teachers might list the following. Not sure of the connection? Do speed research to see who can first make the connection of the object to sharks. Or assign objects to small groups to do research.

- Fossil teeth
- Musical instruments (rattles)
- Food — fish/chips, shark fin soup
- Movies/literature/art
- Food graters for wasabi
- Sand paper
- Cosmetics (oil)
- Shark oil barometers
- Sword handles
- Leather

If time or resources allow, I sometimes divide students into smaller groups with artifacts mentioned above to start the conversation and have them figure out the connection, then discuss it as a class. Artifacts or pictures could include a shark tooth, picture of a Samurai sword, a fish and chips carton from a fast food restaurant, piece of sand paper, leather, lipstick, barometer and a mermaids purse (shark egg case) found on the beach.

From Shark Repellents to Human Health
Let’s sink our teeth into some current topics to see if the man in the gray suit is more than the perfect predator. Since sharks have been apex predators for millions of years, their success and survival holds secrets that the human health industry is working to unlock.

Divide the students into small groups. Use the following three areas as springboards for them to further investigate topics in shark research and modern health. Teachers are provided information to help direct student research. Each area below can be subdivided depending on the size of the class. Have students report on their findings to the class.

- **Wound Healing** Sharks have been observed to heal quickly, resist infections and recover from serious injuries. Since the 1990s, scientists have been interested in shark antibodies when they discovered that the size and stability of the antibodies were different from our own. The antigen-antibody reaction is a fundamental response in the immune system to protect us from infections, disease and complex toxins. The shark antibody’s distinct structure and stability makes it an important tool for the researcher. These antibodies are able to reach more deeply into tissues, and may lead to a new class of therapeutic drugs to treat Alzheimer’s disease which occurs when proteins clump together to form plaques which move around the brain killing neurons. These antibodies could potentially detoxify the harmful plaque forming compounds and stop the disease in its early stages as well as other age-related illnesses.

  In other research, a synthetic of a steroid produced by dogfish sharks called squalamine has been shown to prevent harmful protein buildup that occurs in neurodegenerative diseases such as Parkinson’s in addition to its anti-viral and anti-cancer properties.

  Shark cartilage has been shown to have anti-inflammatory properties and has been FDA approved as one of the compounds in a graft device to heal serious burns.

- **Cancer** In many serious human diseases, the instability of our DNA is the issue. This genome instability, which results from accumulated DNA damage, is well known to predispose humans to numerous cancers and age-related diseases. Research decoding the great white’s genome uncovered that their DNA has evolved in ways ours hasn’t. Their DNA can repair itself and is much more tolerant to damage. Some shark immunity genes may have evolved to have cancer-resistant properties. The first map of great white sharks’ DNA revealed mutations in multiple genes each with important roles in genetic stability. Research continues in the hope that these findings may be used to prevent disease as well as uncover new medical treatments.
Hospital Infections

Shark skin has been used for centuries. It is composed of special teeth-like placoid scales. The scales overlap and point to the tail to reduce drag in the water enabling the shark to be a fast and efficient swimmer. Brushing the shark from the tail to the head the scales create a sand-paper feel. In addition to more efficient swimming, the rough texture prevents microorganisms from attaching and forms an effective armor for protection. It is this property of deterring microorganisms from attaching to its surface that has the interest of the medical community. To minimize the need for antibiotics and prevent contamination of surfaces, instruments, medical devices and hospital-acquired infections, researchers are investigating the surface pattern texture inspired by shark skin to create a solution.

Note: In addition to the health topics, sharks play a role in biodiversity of our seas as well as climate change.

Resources

Sharks4Kids
https://www.sharks4kids.com/
Curriculum, games and activities will allow teachers to integrate shark education into their science programs on an introductory, intermediate or advanced level. An international group with materials developed by shark experts, they have virtual field trips as well as an invitation to a shark expedition off Mexico!

Dream of being a shark scientist?
https://www.youtube.com/watch?v=QO7HFChPU0
Minorities in Shark Sciences is an organization dedicated to empowering women of color to pursue careers in shark sciences. Watch this panel discussion with the founders of MISS that’s full of great advice.

The International Shark Attack File
https://www.floridamuseum.ufl.edu/shark-attacks/about/
A compilation of all known shark attacks that is administered by the Florida Museum of Natural History and the American Elasmobranch Society, a professional organization comprised of international workers studying sharks, skates and rays. Great for designing research questions using their data.

National Oceanic and Atmospheric Administration
https://www.fisheries.noaa.gov/feature-story/12-shark-facts-may-surprise-you
My all-time favorite go-to for great marine conservation information. Here is another discussion starter as well as links to Shark Week!

The effects of climate change on sharks

The Shark Conservation Act
https://www.fisheries.noaa.gov/national/laws-and-policies/shark-conservation-act

Smithsonian Institution’s Ocean Portal
https://ocean.si.edu/ocean-life/sharks-rays/sharks
In honor of Shark Week, the Smithsonian’s Ocean Portal team decided to show how sharks have sunk their teeth into almost every aspect of our lives.

“Sharks and Humans: A Love-Hate Story”
https://ocean.si.edu/ocean-life/sharks-rays/sharks-and-humans-love-hate-story
A story originally published in Smithsonian Magazine explores the historic connection to sharks

Smithsonian Learning Lab
https://learninglab.si.edu/collections/movement-of-life-initiative-discover-what-makes-sharks-move/74MV9mDjnp7PvG9k
A great free resource but requires an account.

NPR | Sharks Will No Longer ‘Attack.’ They Will Only ‘Bite’
https://www.npr.org/2021/07/21/1018755085/2-australian-states-say-their-sharks-will-no-longer-attack-they-will-only-bite
Why does language make it harder to protect species?

How overfishing and shark finning could increase the pace of climate change

Shark DNA could help cure cancer and age-related illnesses in humans

How shark skin can help human medicine