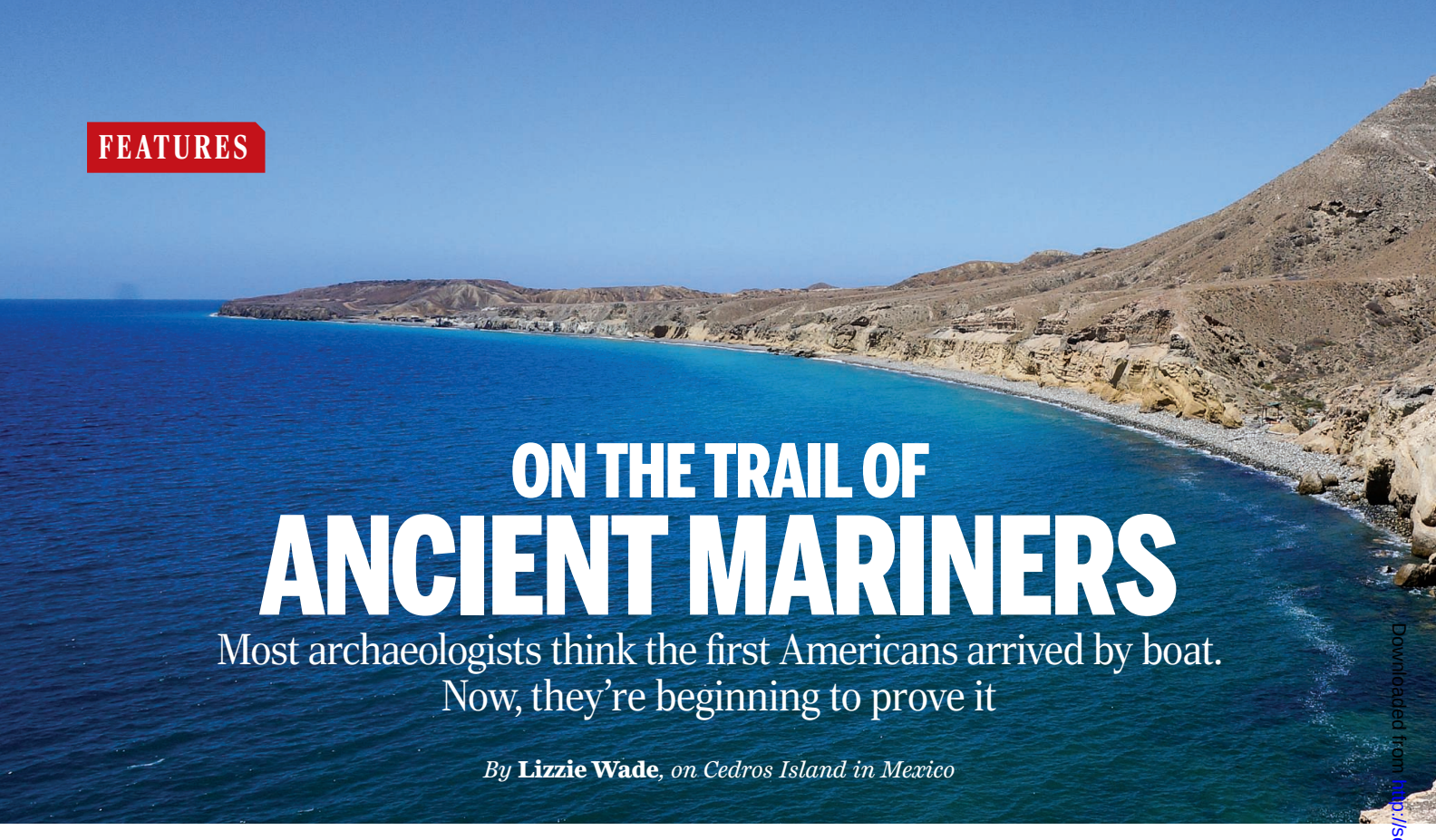

ON THE TRAIL OF ANCIENT MARINERS

Most archaeologists think the first Americans arrived by boat. Now, they're beginning to prove it

By **Lizzie Wade**, *on Cedros Island in Mexico*

Matthew Des Lauriers got the first inkling that he had stumbled on something special when he pulled over on a dirt road here, seeking a place for his team to use the bathroom. While waiting for everyone to return to the car, Des Lauriers, then a graduate student at the University of California, Riverside, meandered across the landscape, scanning for stone tools and shell fragments left by the people who had lived on the island in the past 1500 years.

As he explored, his feet crunched over shells of large Pismo clams—bivalves that he hadn't seen before on the mountainous island, 100 kilometers off the Pacific coast of Baja California. The stone tools littering the ground didn't fit, either. Unlike the finely made arrow points and razor-sharp obsidian that Des Lauriers had previously found on the island, these jagged flakes had been crudely knocked off of chunky beach cobbles.

"I had no idea what it meant," says Des Lauriers, now a professor at California State University (Cal State) in Northridge. Curiosity piqued, he returned for a test excavation and sent some shell and charcoal for radiocarbon dating. When Des Lauriers's adviser called with the results, he said, "You should probably sit down." The material dated from nearly 11,000 to more than 12,000 years ago—only a couple thousand years after the first people reached the Americas.

That discovery, in 2004, proved to be no anomaly; since then, Des Lauriers has discovered 14 other early sites and excavated two, pushing back the settlement of Cedros Island to nearly 13,000 years ago. The density of early coastal sites here "is unprecedented in North America," says archaeologist Loren Davis of Oregon State University in Corvallis, who joined the project in 2009.

The Cedros Island sites add to a small but growing list that supports a once-heretical view of the peopling of the Americas. Whereas archaeologists once thought that the earliest arrivals wandered into the continent through a gap in the ice age glaciers covering Canada, most researchers today think the first inhabitants came by sea. In this view, maritime explorers voyaged by boat out of Beringia—the ancient land now partially submerged under the waters of the Bering Strait—about 16,000 years ago and quickly moved down the Pacific coast, reaching Chile by at least 14,500 years ago.

Findings such as those on Cedros Island bolster that picture by showing that people were living along the coast practically as early as anyone was in the Americas. But these sites don't yet prove the coastal hypothesis. Some archaeologists argue that the first Americans might have entered via the continental interior and turned to a maritime way of life only after they arrived. "If they came down an interior ice-free corridor, they could have turned right, saw the beaches of California, and said, 'To hell with this,'" says archaeologist David Meltzer of Southern Methodist University in Dallas, Texas.

The evidence that might settle the question has been mostly out of reach. As the glaciers melted starting about 16,500 years ago, global sea level rose by about 120 meters, drowning many coasts and any settlements they held. "We are decades into the search for coastal dispersers, and we're still waiting for solid evidence or proof," says Gary Haynes, an archaeologist at the University of Nevada in Reno, who thinks the first Americans likely took an inland route.

The hunt for that evidence is now in high gear. A dedicated cadre of archaeologists is searching for maritime sites dating to between 14,000 and 16,000 years ago, before the ice-free corridor became fully passable. They're looking at the gateway to the Americas, along stretches of the Alaskan and Canadian coasts that were spared the post–ice age flooding. They are even looking underwater. And on Cedros Island, Des Lauriers is helping fill in the picture of how early coastal people lived and what tools they made, details that link them to maritime cultures around the Pacific Rim and imply that they were not landlubbers who later turned seaward. "All eyes are on the coast," Meltzer says.

ON A SUNNY JUNE DAY, Des Lauriers crouches in a gully here, bracing himself against the wind blowing off the ocean. He leans over to examine what could be a clue to how people lived here 12,000 years ago: a delicate crescent of shell glinting in the sun. A few centi-

Matthew Des Lauriers (above) transforms a beach cobble into a type of stone tool used by people who lived on Cedros Island nearly 13,000 years ago. These people lived near freshwater springs but relied on the sea, dining on fish, sea mammals, and seabirds.

PHOTOS: LIZZIE WADE

meters away, a sharply curved shell point lies broken in two pieces. Des Lauriers knows he's looking at the remains of an ancient fishhook. He has already found four others on the island. One of those, at about 11,500 years old, is the oldest fishhook discovered in the Americas, as reported this summer in *American Antiquity*.

Des Lauriers wasn't planning to collect artifacts on this trip, but the shell fishhook is too precious to leave to the elements. His team scrambles for anything they can use to package the delicate artifact. Someone produces a roll of toilet paper, and Des Lauriers scoops up the fragments with his trowel and eases them onto the improvised padding. Each fragment is wrapped snuggly and slipped into a plastic bag.

Twenty years ago, most archaeologists believed the first Americans were not fishermen, but rather big-game hunters who had followed mammoths and bison through the ice-free corridor in Canada. The distinctive Clovis spear points found at sites in the lower 48 states starting about 13,500 years ago were thought to be their signature. But bit by bit, the Clovis-first picture has crumbled.

The biggest blow came in 1997, when archaeologists confirmed that an inland site at Monte Verde in Chile was at least 14,500 years old—1000 years before Clovis tools appeared. Since then, several more pre-Clovis sites have come to light (*Science*, 25 March 2011, p. 1512), and the most recent date from Monte Verde stretches back to 18,500 years ago, although not all researchers accept it. Genetic evidence from precontact South American skeletons now suggests that the earliest Americans expanded out of Beringia about 16,000 years ago (*Science Advances*, 1 April 2016).

Not only were the Clovis people not the first to arrive, but many researchers also doubt the first Americans could have made it by land. Glaciers likely covered the land route through western Canada until after 16,000 years ago, according to recent research that dated minerals in the corridor's oldest sand dunes. Another study showed that bison from Alaska and the continental United States didn't mingle in the corridor until about 13,000 years ago, implying that the passage took at least 2000 years to fully open and transform into a grassland welcoming to megafauna and their human hunters.

That makes the coastal route the first Americans' most likely—or perhaps only—path. It would have been inviting, says Knut Fladmark, a professor emeritus of archaeology at Simon Fraser University in Burnaby, Canada, one of the first to propose a coastal migration into the Americas back in 1979. "The land-sea interface is one of the richest habitats anywhere in the world," he says. Early Americans apparently knew how to take full advantage of its abundant resources. At Monte Verde, once 90 kilometers from the coast, archaeologist Tom Dillehay of Vanderbilt University in Nashville found nine species of edible and medicinal seaweed dated to about 14,000 years ago.

On Cedros Island, artifacts suggest that people found diverse ways to make a living from the sea. That isn't a given because 13,000 years ago, the island was connected to the mainland, hanging off the Baja peninsula like a hitchhiker's outstretched thumb (see map, p. 545); early sites cluster around freshwater springs that would have been several kilometers inland back then. But Des Lauriers's work reveals that the Cedros Islanders ate shellfish, sea lions, elephant seals, seabirds, and fish from all sorts of ocean environments, including deep-water trenches accessible only by boat.

In addition to making fishhooks, the island's inhabitants fashioned beach cobbles into crude scrapers and hammers—"disposable razors," as Des Lauriers, a stone tool expert, calls them. Such tools are best for scraping and cutting plant fibers, suggesting that the islanders were processing agave into fishing lines and nets. Researchers have found a similar suite of tools at other early sites along the Pacific coast, hinting that fishing technologies were widespread even though the organic nets, lines, and boats likely decayed long ago.

Certain tool types found here suggest even more distant connections. Des Lauriers often finds stemmed points, a style of spear point found from Japan to Peru (*Science*, 7 April, p. 13) and perhaps used on the island to hunt sea mammals and native pygmy deer. The shell fishhooks even resemble the world's oldest known fishhooks, which were crafted from the shells of sea snails on Okinawa in Japan about 23,000 years ago.

Although the evidence of a widespread, sophisticated maritime way of life along the ancient Pacific coast—what Meltzer calls "Hansel and Gretel leaving a trail of artifacts"—is provocative, it can't prove the coastal migration theory, he says. The oldest sites on Cedros Island are younger than the first Clovis spear points used to bring down big game on the mainland.

But older coastal sites are beginning to turn up. This year Dillehay announced the discovery of a nearly 15,000-year-old site at Huaca Prieta, about 600 kilometers north of Lima. Its earliest residents lived in an estuary 30 kilometers from the Pacific shoreline but still ate mostly shark, seabirds, marine fish, and sea lions (*Science Advances*, 24 May), and their artifacts resemble those at other coastal sites. "I was stunned how similar [the tools of Huaca Prieta] were to [those of] Cedros Island," Davis says.

Still, pinning down the coastal migration theory will take a string of well-dated sites beginning before 15,000 years ago in southwestern Alaska or British Columbia in Canada and extending through time down the coast. To find them, archaeologists will have to take the plunge.

Researchers tracking ancient coastal dwellers found 13,200-year-old human footprints on Calvert Island in British Columbia (top) and the Americas' oldest fishhook (bottom) on Cedros Island.

LOREN DAVIS TRIES TO STAY STEADY as he makes his way into a laboratory aboard the research vessel *Pacific Storm*. The archaeologist was desperately seasick in his cabin for 2 days in late May as the 25-meter-long ship fought rough seas more than 35 kilometers off the Oregon coast. With Davis laid low, his team members scanned the ocean floor with sound waves.

They are seeking the now-flooded landscape ancient maritime explorers would have followed on their journey south, when today's coastlines were dozens of kilometers inland. Some coastal travelers did eventually turn landward, as shown by early inland sites such as Oregon's Paisley Caves, which yielded a 14,200-year-old human coprolite (*Science*, 9 May 2008, p. 786). But the earliest chapters of any coastal migration are almost certainly underwater.

Sixteen thousand years later, it's tempting to envision such a migration as a race from beach to beach. But as people expanded into the uninhabited Americas, they had no destination in mind. They stopped, settled in, ventured beyond what they knew, and backtracked into what they did. So the first step for archaeologists is to figure out where, exactly, those early mariners would have chosen to stick around.

The decision likely came down to one resource: freshwater. "Water is the lifeblood of everything," Davis says. So he has been painstakingly mapping the probable courses of ancient rivers across the now-drowned coastline, hoping that those channels are still detectable, despite now being filled with sediment and covered by deep ocean.

As team members pulled up early results to show Davis during May's cruise, a black line representing the present-day sea floor squiggled horizontally across the screen. Then it diverged into two lines, a gap like a smile opening across the image: An ancient river channel lay below the modern sea floor, right where Davis's model had predicted. "If I hadn't been so sick—and if there had been alcohol on the ship—that would have been a champagne moment," he says. "We can [now] begin to visualize where the hot spots [of human occupation] are probably going to be."

This summer, Davis's colleague Amy Gusick, an archaeologist at Cal State in San Bernardino, used one of his maps to take the first sample from another probable hot spot: a drowned river off the coast of California's Channel Islands. Terrestrial sites on the islands have already yielded 13,000-year-old human bones as well as characteristically coastal stone tools (*Science*, 4 March 2011, p. 1181). But since then, the rising sea has inundated 65% of the islands' ancient area. Gusick and her colleagues are confident that submerged sites, possibly even older than the ones on land, exist off today's coast.

In June, she used a 5-meter sampling tube to pierce what Davis's map told her was the ancient riverbank. The muck she collected will reveal whether ancient soil, perhaps including plant remains, pollen, animal bones, or human artifacts, can still be recovered from deep underwater. Eventually, Gusick hopes to understand the drowned landscape well enough to pick out anomalies on the sonar map—possible shell middens or houses—and target them for coring that might bring up artifacts and the organic material needed to date them. A date of 15,000 years or older would show that before the ice-free corridor fully opened, adept mariners had explored the Channel Islands, which were never connected to the mainland and could be reached only by boat.

"This is the biggest scientific effort to move us down the road to answering this question" of how and when people settled the Americas, says Todd Braje, an archaeologist at San Diego State University in California, one of the leaders of the coring project. "Those submerged landscapes are really the last frontier for American archaeology," says Jon Erlandson, an anthropologist at the University of Oregon in Eugene who has excavated on the Channel Islands for decades and also is part of the project.

All the same, to make a definitive case for the coastal route, researchers must find pre-Clovis coastal sites in the doorway to the Americas itself: on the shores of southwestern Alaska or British Columbia. Luckily, archaeologists working there may not even have to go underwater to do it.

ABOUT 13,200 YEARS AGO, someone strolled through the intertidal zone just above the

PHOTOS: (TOP TO BOTTOM) JOANNE MCSPORRAN; MATTHEW DES LAURIERS

beach on Calvert Island, off the coast of British Columbia, leaving footprints in the area's wet, dense clay. When high tide rolled in, sand and gravel filled the impressions, leaving a raised outline. Layers of sediment built up over the millennia, preserving the barely eroded footprints under half a meter of earth.

Daryl Fedje, an archaeologist at the University of Victoria (UVic) and the Hakai Institute on Quadra Island in Canada, spotted that outline while excavating on the beach in 2014. Since then, he and his UVic and Hakai colleague Duncan McLaren have documented 29 of those footprints beneath Calvert's beaches. A piece of wood embedded in a footprint's fill provided the radiocarbon date. "It raises the hairs on the back of your neck," says McLaren, who in April presented the footprints at the annual meeting of the Society for American Archaeology in Vancouver, Canada.

Such an intimate view of early coastal Americans is possible on Calvert Island because of a geological quirk. The melting ice sheets flooded coastlines elsewhere. But when the coasts of British Columbia and southwestern Alaska were suddenly freed from the weight of the nearby glaciers, parts of the underlying crust began to rebound, lifting some islands high enough to largely escape the flood.

To maximize their chances of finding ancient sites, McLaren, Fedje, and their UVic colleague Quentin Mackie have spent decades mapping the local sea level changes along the coast of British Columbia. On Calvert Island, where the footprints were discovered, sea level rose only 2 meters. Around nearby Quadra Island, local sea level actually fell, stranding ancient shorelines in forests high above modern beaches. There, "potentially the entire history of occupation is on dry land," Mackie says.

The painstaking work required to identify and search those ancient coastlines is paying off with a march of increasingly older dates from the British Columbia coast. The remains of an ancient bear hunt—spear points lying in a cluster of bear bones—in Gaadu Din cave on the Haida Gwaii archipelago date to 12,700 years ago. The Calvert footprints stretch back 13,200 years. And a cluster of stone tools next to a hearth on Triquet Island is 14,000 years old—the region's oldest artifact so far, according to radiocarbon dates from the hearth's charcoal. Although reports about the footprints and the Triquet tools have yet to be peer reviewed, several archaeologists say they are impressed by the British Columbia team's approach. "They're looking in exactly the right place," Erlandson says.

Despite the proliferating evidence for the coastal route, not everyone is ready to discount the ice-free corridor entirely. The region has barely been studied and is ripe for "interesting surprises," says John Ives, an archaeologist at the University of Alberta in Edmonton, Canada. For example, the corridor may not have been a welcoming grassland until 14,000 years ago, but Haynes says it is naïve to assume that people couldn't have ventured into the corridor as soon as the ice was gone. Before grass took root, "the inland corridor route would have been full of freshwater sources, seasonally migrating or resident waterfowl by the millions, and large and small mammals exploring new ranges," he says. "Eastern Beringia's inland foragers of 14,000 years ago were descendants of expert pioneers and could have traveled far south on foot."

And so the hunt continues. Before breakfast one morning on Cedros Island, Des Lauriers spreads out satellite images of the island's southern edge. Most of the land appears as brown pixels, as one would expect from a desert island. But here and there, clusters of blue pixels appear—signs of moisture in the ground. Find the springs, Des Lauriers knows, and he'll find the people.

Davis and the rest of the team pile into the back of a pickup truck, and Des Lauriers follows a dirt path to a spring he hasn't visited before. The patch of green lies at the bottom of a steep-sided arroyo, which is otherwise bone dry. Algae cover the surface of a meter-deep pool. The dark soil is rich with organic matter, unusual for arid Cedros Island and possibly indicating an ancient settlement. Stone tools characteristic of the earliest islanders dot the surface. "There's a lot of stuff here, Matt," Davis calls to Des Lauriers. "It's punching all the boxes."

Interspersed with the recognizably early tools are things neither of them has seen on the island before: large, striated scallop shells belonging to a species known as *mano de león* (lion's paw). Today those scallops live in lagoons east of here, on the coast of the Baja peninsula. Des Lauriers says he suspects that similar lagoons connected Cedros Island to the mainland before 13,000 years ago. Were people here early enough to visit such lagoons? Could those shells be hinting at a phase of settlement even older than the one signaled by the Pismo clams 13 years ago?

To find out, Des Lauriers will have to wait until the team excavates and takes samples for radiocarbon dating. He records the site's GPS coordinates and then, just as people have done here for millennia, sets off up the arroyo in search of the next source of freshwater. ■

The coastal connection

Most archaeologists now think people arrived in the Americas by boat before 14,000 years ago and hopped down the Pacific coast. A growing list of ancient coastal sites like these supports the idea.

Lost lands

Before the ice age glaciers melted, Cedros Island was connected to the Baja peninsula. Archaeologists suspect many early sites up and down the Pacific coast were lost beneath the seas.

GRAPHIC: G. GRULLÓN/SCIENCE

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