For years, sharks have been hunted for their valuable fins, but now most of these vital ocean predators have vanished from the deep.

By Erik Vance|Wednesday, May 29, 2013

October used to be a good month for sharks in La Paz. When the waters cooled, hammerhead sharks arrived in this part of the Mexican state of Baja California in droves. In the late ’70s, marine biologists discovered massive swirling schools of hammerheads around a nearby undersea mountain called El Bajo — so many that they could simply hold their breath, dive down a few dozen feet, pick one at random, and affix an electronic tag on it with a stick.

At the time, perhaps because of their odd-shaped head, the iconic sharks were feared as maneaters. The seamount eventually became a magnet for scientists and photographers alike. The images of hundreds of schooling hammerheads, with their instantly recognizable oblong heads, became an emblem of the ocean’s bounty and one of the greatest wonders of the natural world.

In October 2011, when I arrived in La Paz, the colder water was still attracting recreational divers, fishermen and a new generation of shark scientists. Taylor Chapple, one of the shark world’s rising stars, wandered into the historic town square looking every bit the surfer gringo: shorts, button-down shirt and an ornamental stone fish hanging from his neck. Between his long, blondish hair and broad shoulders, he could have been just another tourist looking for waves.

But Chapple had come to northwest Mexico hoping to prove a longstanding scientific theory: that hammerheads and perhaps other sharks navigate through a powerful magnetic sense. To prove the reality of the ancient sense, he had conceived a truly novel experiment.

He would catch a shark, attach a magnetic transmitter to its head and release it to the wild. Then, as the shark trolled the waters, Chapple would alter the magnetic current by remote control. If the animal sensed magnetism, Chapple’s device would direct the shark like a remote-controlled toy car.

There was just one problem — no sharks. “We spent two months on the water and didn’t have any luck whatsoever,” he told me over coffee. “Which was really disappointing. We tried every fishing method we could. We tried days, we tried nights, we floated for 12, 24 hours. There’s not much more you can do.”
Hammerhead sharks were once plentiful in the waters of Baja California. That’s no longer the case.

Back in the 1980s, hammerheads were hundreds strong in the Sea of Cortez, a gulf between the Baja peninsula and the mainland. Every year they gathered around seamounts and rotated in a slow-motion courting dance, circling during the day and dispersing at night for weeks.

Today, the dancing has stopped. If they are lucky, tour operators might see a few adolescent sharks in a season. Across the planet, as here, sharks are being scooped out of the water for their valuable fins as fast as gill nets and long-liners can haul them. Although accurate numbers are stubbornly hard to find, in many areas shark populations have dropped 90 percent or more, with hammerheads hit especially hard.

Attracted by the area’s long and detailed history, Chapple and two other young scientists have come to the waters off La Paz, hoping to help revive the shark populations that once thrived. Zigzagging around the Pacific planting tracking devices with sensing ability unheard of even a decade ago, they aim to answer some of the many questions surrounding the elusive shark: How many are left? Where do they migrate? And can we create ocean preserves to save them?

But the biggest question seems to be: By the time we get our answers, will there be any sharks left?

Dr. Hammerhead

The first scientist to study sharks in the Sea of Cortez was Peter Klimley, the legendary University of California, Davis marine biologist often called “Dr. Hammerhead.” Klimley first came to the area seeking sharks in 1978, when he was 31 years old. The quintessential rugged explorer, he was burly with a barrel chest covered in blond fur, and a thick mustache straight out of an episode of Magnum, P.I.

Unlike many shark biologists, Klimley was a behaviorist — a student of a student of the great Konrad Lorenz, the Austrian scientist who famously imprinted goose chicks to think he was their mother and pioneered the field of animal behavior.
Since childhood, Klimley had been fascinated with sharks, which he sensed were more complex than their reputations as cold maneaters of the deep. He was inspired by Dian Fossey, who dissipated the myth of the brutish gorilla in the 1970s by observing tender, complex social behavior while living among them.

Klimley longed to see something unfiltered and genuine in his subjects in much the same way. The previous year, as a student at the Scripps Institution of Oceanography, he spent a season watching sharks churned into a frenzy by bloody fish scraps thrown from a floating platform near San Diego.

But he quickly got bored. Thrashing about in a hysterical tangle did not seem like the sharks’ natural behavior. He wanted to see how they lived after they gracefully disappeared into the dark.

So he left for Mexico following a vague report of hammerheads gathering in the Sea of Cortez. With his mentor, Don Nelson, Klimley spent a year searching for the shark schools without finding them. Then, one day in 1979, while diving near Cerralvo Island off the coast of La Paz, it happened. The team spotted a cluster of hammerheads that scattered when the scientists approached.

“We came to the surface, and Don Nelson and I were lamenting how we weren’t able to get close to them,” Klimley says. “And then one of the guys in the boat needs to go to the bathroom, so he jumps in and swims about 20 meters away, and says, ‘They’re here!’ ”

In fact, the sound of scuba bubbles had been driving them away. So the researchers took off their tanks and tried with just a mask and snorkel. Klimley paused for just a moment. Since big sharks were considered vicious, scientists mostly observed them from inside a cage. But to see unfiltered behavior, it was worth the risk.

What he saw changed his life.

“It was like Grand Central Station in New York City at rush hour. There were tunas, there were huge schools of skipjack as far as you could swim,” he says. “And then you swam past the seamount, and in one place suddenly there they were — all these sharks, hundreds of them. And the challenge was how do you tell how many are there?”
What was more, the sharks seemed oblivious to his presence, placidly swimming in wide loops. That season, Klimley estimated there were more than 500 sharks at the underwater mountain’s northern slope, clustering over an area roughly the size of a soccer field. “The current would carry you over the seamount, and then it would fall off into the deep and right at the edge, as far as I could see underwater, there were these schools.”

He spent the next decade and a half returning to the seamount, El Bajo, trying to understand what such huge aggregations of hammerheads were doing and how they navigated during their daily foraging routes. He eschewed scuba tanks and shark cages, simply tagging these supposedly ferocious animals with a spear and using a snorkel in up to 100 feet of water.

He began with plastic streamers, attached by spear to their backs; he used the streamers, which were color-coded, to count the animals visually, without losing track. A few years later, he used a technique called biotelemetry — sophisticated trackers emitting acoustic pulses that he followed from above in a small skiff or through underwater listening stations that tracked the animals for days at a time.

Telemetry requires two components: a tag fixed to the shark and a listening station to receive the signal. Klimley became a pioneer in both, setting up stations for detecting ultrasonic acoustic tags that emitted signals at frequencies far beyond what the human ear could sense.

By 1982, Klimley had unraveled the first mystery of El Bajo’s hammerheads. The circling sharks turned out to be female, with the largest, most mature ones near the middle or the bottom, fiercely maintaining position. He watched as males swimming at the periphery entered this swirling mass to mate as close to the center as possible, thus ensuring the fittest males found the fittest females.

This was perhaps the most complex social arrangement ever attributed to animals considered (erroneously) so small-brained. But even more interesting was what they did at night. Klimley found the seamount was like a bike hub, with sharks following various spokes up to 10 miles out to find food. Then they returned along the same path back to the hub for another day of circling.

How did they find their way back to El Bajo every morning? After puzzling it over and practically wallpapering his house with seafloor topography and magnetic field maps, in 1993 Klimley hypothesized that somehow their oblong-shaped heads can sense tiny changes in the magnetic lines created by volcanic lava flows.

The theory was controversial, but Klimley was convinced: Sharks had to be following these trajectories to navigate the seas. It was the first time anyone had ever suggested that any animal could use local magnetic field patterns to traverse the ocean floor.
On the Trail

It was a hot La Paz February morning a few months after my first meeting with Chapple. The Baja sun was glaring, and the ground was bone dry except where I slopped through the mud with James Ketchum, also a disciple of Klimley’s, at his lab.

Now in his 40s, Ketchum grew up in Mexico City and came late to shark science after a career as a dive master in La Paz. He is tall and broad with a long, dark ponytail, dark eyes and a soft midsection he chalks up to a new baby and a recent knee injury. His deep voice is thoughtful, punctuated by random snickers, as if to his own private jokes.

Wandering tidal wetlands outside of town, we searched for a transmitter the size of a Magic Marker that Ketchum had attached to a whale shark a couple of weeks before. The torpedo-shaped device, connected by a cord to a barb buried deep in the shark’s skin, transmitted signals to passing satellites whenever it was near the ocean surface.

Ketchum was getting a signal now. Somehow he managed to stay on top of the cool, sticky mud while I sank to my knees with almost every step.

Peter Klimley took these tracking devices (left) with him on a shark tagging expedition in 2010. Such technology has advanced rapidly in recent years, allowing marine biologists to better understand and predict sharks’ behavior. A new variation on these tools could allow Taylor Chapple to test whether sharks navigate based on magnetic fields. In 2009 Peter Klimley (right) tags hammerhead sharks at Malpelo Island off the coast of Colombia.

“Whale sharks are hard to tag. Especially here, because in the shallow water they rub against the ground and against each other, and lose the tags,” Ketchum grumbled as we slogged along.

Gone are the days when scientists could just stumble upon a huge school of sharks. Those trained by Nelson and Klimley still use short-range acoustic tags to track local movement, relying on classic listening stations to bring in the data. But now they also deploy satellite tags that can track animals across the ocean over the course of months or even years. At a cost of $1,700, the satellite tag we sought — and never found — was valuable, indeed.
Given the cost of the research and the dwindling number of sharks, scientists like Ketchum tend to collaborate widely and work in teams. The ocean is rife with such collaborations: The projects, including MigraMar and Tagging of Pacific Predators, stretch up and down the West Coast from California to Ecuador, allowing everybody to track each other’s animals and share the results.

Ketchum has just launched his own collaboration, called Pelagios Kakunjá, based in La Paz. His partner, Mauricio Hoyos, is another Mexican shark scientist trained by Klimley. As kinetic and small-bodied as Ketchum is laconic and tall, Hoyos gestures erratically, his eyes growing wide when he talks about sharks.

“When we are with these animals, we are changed into little kids,” he says. The partners both cut their teeth tracking sharks: Hoyos set up the first listening stations near Guadalupe Island, 150 miles off Baja, for tracking great whites. Ketchum wired the Galapagos to study hammerheads, Galapagos, silky and whale sharks.

Chapple rose through the ranks at just the same time. From 2005 through 2010, he worked with Klimley to estimate the entire population of the great white shark in central California by amassing photos of fins and counting the individuals. Once they had a sense of how many sharks were in the densest communities and combined that with previous data on the sharks’ movements, they modeled an estimate for the population as a whole.

The total for central California: A shockingly paltry 219 animals, not counting the very young. Another study estimated about 130 additional sharks in Mexico for less than 400 great whites in all of Mexico and California, a figure suggesting the oceans could be crumbling from above.

**A Shark Sandwich**

Now the trio has converged on La Paz to reverse the trend. With new equipment and innovative research techniques, this tech-savvy group just might be able to plumb the shark’s secrets deeply enough to bring them back from the brink.
Already their findings are making waves. For instance, scientists long thought that most sharks were limited to whatever area they were most commonly found. But as trackers got smaller and battery life went from days to weeks and then months or years, it became apparent that sharks crossed huge distances, even oceans.

White sharks, considered coastal, were found wandering near Hawaii and congregating in a spot in the middle of the Pacific now nicknamed the “shark café.” Hammerheads turned out to have a complicated migration from one food source to another, with lives spent visiting islands and seamounts thousands of miles apart.

To uncover more of the details, Chapple has developed a totally new kind of tracker — one based on Klimley’s theory, now widely accepted but still technically unproven, that hammerheads follow magnetic changes along the ocean floor.

People like Michael Walker at the University of Auckland have proposed methods of sensing magnetic fields. And Carl Meyer at the University of Hawaii showed in 2005 that six sandbar sharks and one scalloped hammerhead could be conditioned to enter a feeding area when an artificial magnetic field was turned on.

But Chapple wants to prove magnetic navigation beyond a doubt. With the Max Planck Institute for Ornithology in Germany and a company called Desert Star Systems in California, he plans to attach four small disks containing Helmholtz coils to a shark’s head, two above and two beneath, like buns on a shark sandwich. Helmholtz coils change the magnetic field of whatever is between them.

Once attached, Chapple will be able to alter the field between the buns, thus changing what the shark is sensing. If the sharks indeed have some way of following magnetic lines, when he engages the coils, the sharks will change directions.

By October 2011, Chapple was ready to deploy his new Helmhotz coil tags — a delicate process involving catching a shark and gently but quickly attaching the disks while the shark is held in the water alongside the boat. The perfect place to do this was El Bajo, where shark movements have been well documented for decades.

But in what should be the busiest time of the year, not one hammerhead could be found. Alongside some of the area’s best shark fishermen, Chapple trolled up and down the coast, baiting the hooks night and day, sometimes for days on end. Each time something struck, his heart leapt, but not once did his team pull up a hammerhead. Hoyos and Ketchum see the same thing — there are simply no hammerheads left to catch.
Valuable Fins

So where did the sharks go? To Asia — in the worst possible way. In China, shark fin soup is as important for weddings as diamond rings and champagne in the United States. Once a sign of wealth, shark fins are now ubiquitous at any important event; the Japanese put them into sushi, cookies and even food for cats.

As Asia grows wealthier, so does its fin demand. From 1985 through 1998, imports to Hong Kong surged, and the worldwide trade leapt more than 214 percent. During that time, the La Paz area became a hub for soup-bound shark fishing, especially hammerheads, which fishermen say have especially large fins.

At prices in the hundreds of dollars per pound in Hong Kong markets, shark fins are among the world’s most expensive ingredients. One study estimates global trade at about half a billion dollars and 73 million sharks per year — a shocking haul. Shark fins are even illegally smuggled as part of organized crime.

“Anyone who has spent time on the ocean over the last 20 or 30 years will tell you that they used to see lots of sharks and that they don’t anymore,” says Boris Worm, a marine conservation biologist and leading expert in shark populations at Dalhousie University in Canada.

Wide swaths of the Caribbean and the Mediterranean are now nearly shark-free. At St. Paul’s Rocks, about 600 miles off the coast of Brazil, Charles Darwin described teeming masses of reef sharks during a stopover on his famous voyage. By 2011, scientists declared the Galapagos reef shark locally extinct.

That’s where research comes in. Chapple, Ketchum and Hoyos believe that if the movements of sharks can be understood well enough, governments like Mexico can design and enforce marine protected areas (MPAs) for crucial aggregating and feeding to take place.

“I started out just being interested in science,” says Chapple, who grew up in the Midwest near the shores of Lake Erie. “I wanted to go out and watch fish swim around. But we’ve gotten past the point where we can be naturalists. Now our only hope is to seriously protect them.”

Ocean scientists debate over the efficacy of MPAs when it comes to migratory species, like hammerheads, with a range too large to ever protect in full. A narrower, more achievable goal would be mapping out their annual ranges to identify key breeding areas, like El Bajo once was, and conserving those.

“If you want to protect a species, you identify an area where they congregate — the hot spots,” says Mike Carr, a biologist at UC Santa Cruz and an MPA expert. “You don’t have to protect the whole [ocean], just those particular locations where we know they aggregate to spawn.”

That’s exactly what Klimley’s heirs hope to do, and the Mexican government has given signs that it is eager to protect its dwindling ocean life. Last year it enraged local fishing communities with a sudden effort to enforce a decades-old law protecting sharks in Baja during the summer, theoretically a prime breeding time.
It’s the first serious move in years by Mexico to protect hammerheads. And just this March, the Convention on International Trade in Endangered Species (CITES) voted to ban undocumented sales of several hammerhead species, threatening to sanction countries that don’t comply.

Shark fin soup, a luxurious food, has lost some popularity in recent years due to its controversial nature, but Hong Kong remains the shark fin capital of the world.

**Turning the Tide**

On a perfect April morning, I join Ketchum and Hoyos on a fishing skiff heading to the tiny community of Cabo Pulmo, near the southern tip of Baja. Cabo Pulmo is among the world’s most successful MPAs, created in the mid-’90s by locals alarmed at the disappearance of sea life.

To turn the tide, they created a tiny preserve from 27 square miles of rugged coastline, enforced by the fishermen who switched to tourism for income. It was a long, at times bitter, process imposing a fishing ban on fishermen who had trolled these waters for generations.

Certainly the fact that the Mexican University of Baja California Sur and the National Institute of Ecology in Mexico City were involved helped the process, but observers say in the end it worked because the rules were created and enforced by the locals themselves.

Today, with over five times more fish biomass than when it was first established, Cabo Pulmo is an oasis in an underwater desert, with massive schools of fish and vibrant coral reefs that some say comprise the most robust MPA in the world. Even some sharks have returned. There are no hammerheads, but a few weeks prior, Hoyos saw schools of black-tipped reef sharks, thought until recently to be extinct from the region.

If MPAs are to save sharks, they will look a lot like Cabo Pulmo.

As part of their collaborative effort, Pelagios Kakunjá, the two scientists are setting up listening stations around the preserve to track sharks — the first stations ever installed along this particular stretch of the Mexican coast. Already they have discovered a tiger shark that wandered 300 miles from an island offshore just to snack at Cabo Pulmo before heading back out. Then the boat captain spots a cluster of black-tips and lemons, and the two scientists really perk up.

“Un limón, un limón!” Hoyos blurts. “This is my first lemon shark!” And with that, Hoyos is in the water like a missile, trying to get a glimpse of one of the sharks. Ketchum waits on the boat at first and eventually
gets in. I jump in, too. Even though I am alongside professional shark trackers and know the animals don’t want to hurt me, my heart is thumping up my throat as a ghostlike black-tip glides past. Then, like a phantom, it’s gone.

Every shark researcher has a different story, but all agree it’s these moments that drive them. For Chapple, it happened when he was 13 years old and stumbled upon a feeding nurse shark. For Ketchum, it was the first time he saw a school of hammerheads near El Bajo.

And for Hoyos, it was meeting face-to-face with a great white named Mystery. Each can tell you small details from that experience — the color of the water, the type of wetsuit they wore.

These are the only sharks we’ll see this trip. Yet the thrill of the chase and a deep love of sharks spur them on. Chapple, now working at the Hopkins Marine Station of Stanford University, has been waiting two years to hear news of returning hammerheads in Baja for his Helmholtz coil experiment. He has yet to get the word.

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Shark populations are plummeting, and since these predatory fish mature slowly and reproduce infrequently, their dwindling numbers aren’t likely to rebound quickly, if at all. After a decade of collecting and compiling data, Canadian marine ecologist Boris Worm expresses concern for these keystone species: “I feel that sharks are the most endangered marine wildlife we have right now.” This map pinpoints how far shark populations around the globe have fallen. It also highlights sanctuaries established to protect the sharks that remain. —Breanna Draxler