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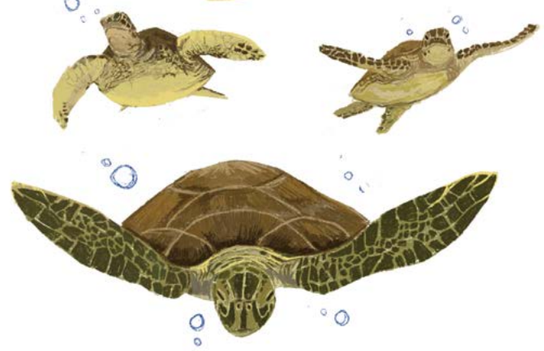

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editor's note

Cover art **Barkha Lohia**

This year's marine issue is here to make a splash.

Dive deep into the ecology and social culture of killer whales, and learn why this research matters for conservation. Next, climb aboard the research ship *Oscar Elton Sette* in the western Pacific Ocean and experience firsthand a day in the life of a bioacoustician tracking false killer whales (a species of oceanic dolphin). Then, head to the opposite end—the Eastern Tropical Pacific Ocean—where the governments of Costa Rica, Panama, Ecuador, and Colombia have committed to protecting 'swimways' that connect different marine protected areas, and which are used by countless migratory species (including the critically endangered scalloped hammerhead shark).

Take a break to sip on hot chocolate made using a secret 18th century recipe containing ambergris ('whale vomit')—a mysterious substance with a history spanning centuries, continents, and cultures. Thus refreshed, you can once again dive underwater to witness human-made reefs, which are creating new spaces where people and marine life mingle.

Next, puzzle over why the central desert of Baja California in northwestern Mexico features in a marine-themed issue. And don't be surprised when you learn that South Africa not only has penguins, but that their conservation is "everyone's business". Finally, you are invited to attend the Shockington Conservation Awards, where our notorious columnist celebrates the great achievements of conservation and the "hardworking people who labour so tirelessly" for the cause. Just remember to bring your sense of humour along.

—Devathi Parashuram

Killer whales: A not-so-black-and-white evolutionary exploration

Author **Kristina Kolařík** | *Illustrator* **Sayan Mukherjee**

Pppfff! I heard the breath at the same moment my eyes caught sight of the rounded black fin slicing through the water. *Pppfff! Pppfff!* Two more full breaths, each one causing my heart to skip a beat as my anticipation was finally met. I had heard hundreds of dolphin breaths before, but these were different. These belonged to 'J pod', an endangered population of Southern resident killer whales that live off the coast of Washington State, USA. A population that spends less time inland each year as local salmon stocks decline. Despite my frequent whale watching trips and luck at seeing the growing number of transient killer whales around my home, it had been seven years since I had last seen any residents, making this sighting special.

Residents? Transients? How can some killer whales be endangered while others are thriving? And why does this matter—a killer whale is a killer whale, right? Well, let us start at the beginning:

What's in a name?

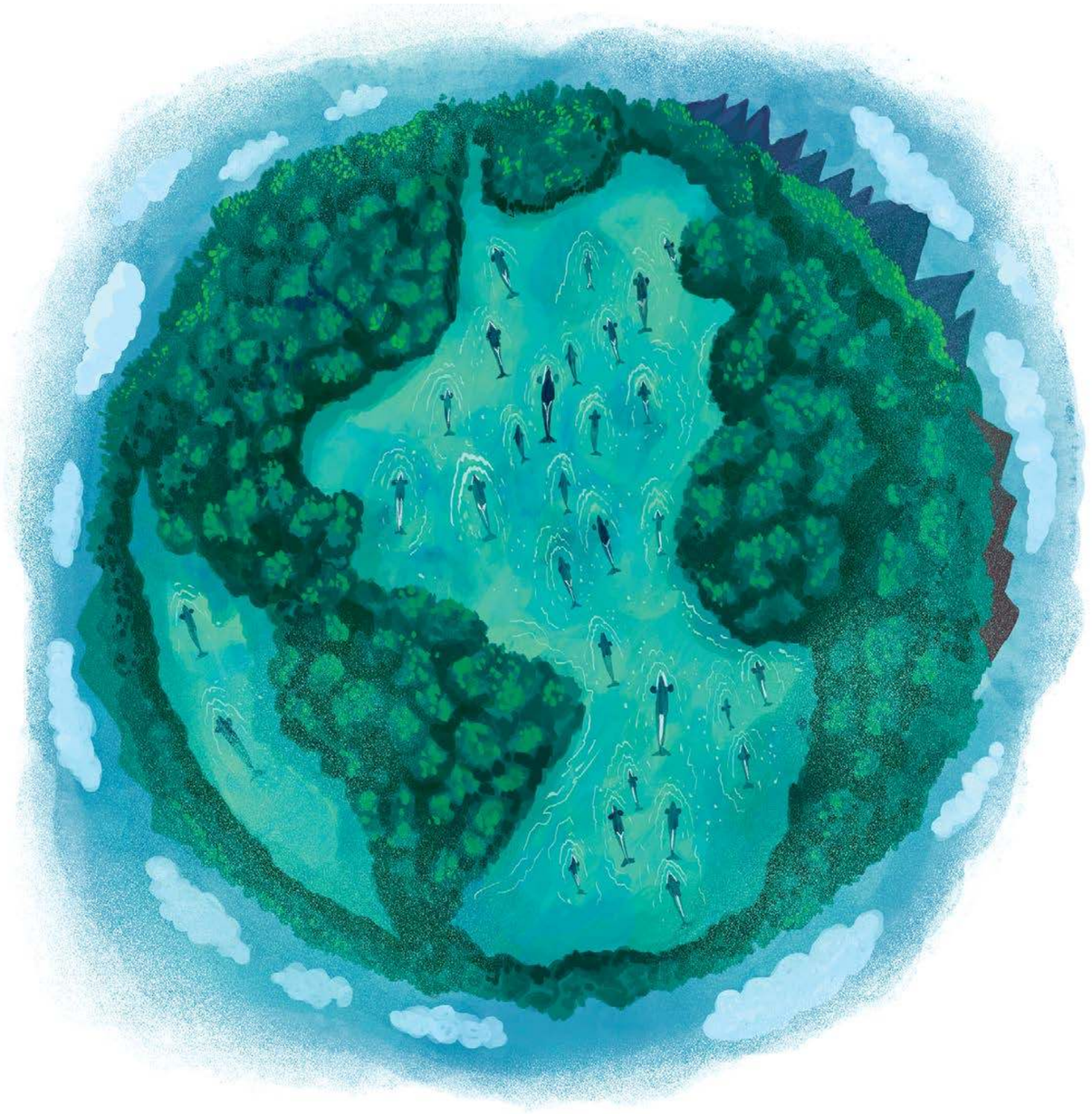
Killer whales are one of the most popular species of cetaceans, easily recognisable by their distinct black and white markings. Despite their name, they are actually the largest members of the dolphin family. Killer whales were first named by sailors who watched them hunt and prey on larger species. Even their scientific name, *Orcinus orca*, comes from the Roman god of the underworld, Orcus, reflecting their status as the ocean's top predator. Killer whales are found in every ocean of the world, and are considered to be the most widely distributed mammal, after humans.

Currently classified as a single species, there are ten recognised 'ecotypes' of killer whales. Most people are familiar with the common taxonomic ranks; remember kingdom, phylum, class, order, family, genus, and species? While not one of the major scientific classifications, an ecotype is defined as individuals or groups of individuals that share ecological adaptations. Differences in ecology are key to specialisation, which can lead to observable physical differences, reproductive isolation, and eventually separate species.

As a single species all killer whales have relatively similar genetics and morphologies. However, upon closer inspection, different populations have their own prey preferences, language communication, and exhibit mating only with similar populations. Identifying these different ecotypes aids in the further classification of the species and helps our understanding of their ongoing evolution.

Studying evolution

Studying killer whales in the wild is extremely challenging due to their marine environment, so scientists are only just beginning to learn about the differences in killer whale populations and how they might have occurred. Understanding the role marine habitats play in relation to oceanic evolution is complex—unlike a terrestrial environment, there are fewer physical barriers and resources in the ocean. Additionally, genomic studies of killer whales have shown that there is a low genetic diversity between killer whale populations worldwide, perhaps due to a long history of overlapping habitats or slower mutation rates in cetaceans. Killer whale evolution is therefore best described by looking at historical geography, ecological differences, and their social culture.



Geography: In theory, killer whales can travel anywhere throughout the world's oceans. As apex predators, they are found in the largest densities in polar and temperate regions where marine productivity is highest, although it is not uncommon to find populations in the tropics. Perhaps the greater amount of landmass in the northern hemisphere has played a part over time in separating or reconnecting different northern populations, while in the southern hemisphere greater competition and niche divergence (the process in which animals use the environment in different ways to avoid competition) might have developed as there is a higher percentage of ocean coverage.

Ecology: Due to this lack of geographic separation, differences between killer whale populations are largely thought to arise from specialisation in different prey types. Killer whales have an extremely diverse diet and have been observed preying on more than 140 different species, including over 50 types of mammals. By specialising in distinct food requirements, it is thought that different populations can avoid competition, as well as limit the energy needed to travel, learn, and hunt a wide variety of different prey items.

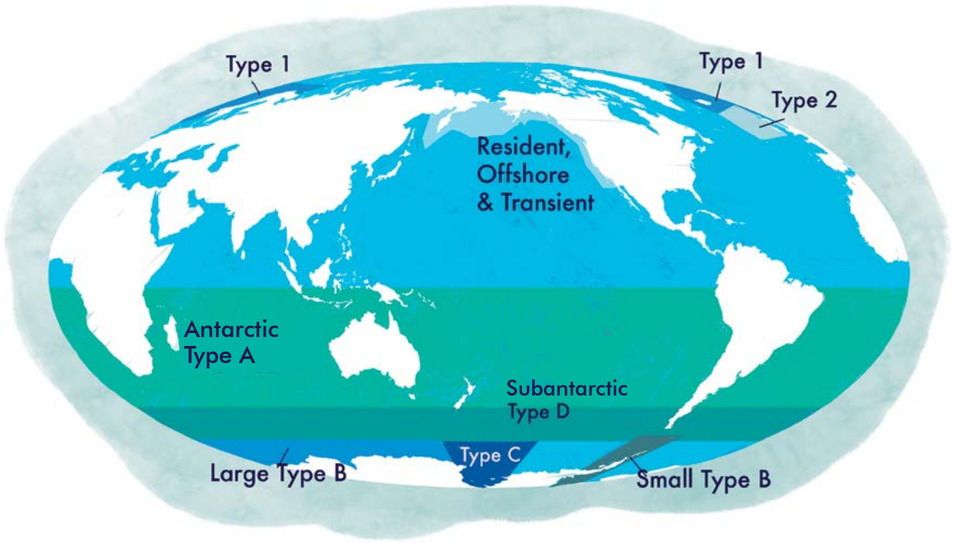
Culture: Killer whales form large family groups known as pods with highly complex social structures that centre around female members. In conjunction with prey specialisation, cultural transfer of such things as communication, hunting tactics, and pod size has contributed to the further divergence of varying populations. While mating is hard to observe in the wild, it is believed that different ecotypes are reproductively isolated. These social differences likely cause pre-copulation barriers as different cultural pods rarely physically mix, which over time may lead to reproductive isolation as populations continue to evolve farther apart.

Current classifications

Now we can start to see how and why different ecotypes have distinctive prey preferences, foraging behaviors, social cultures, geographic ranges, communication, physical characteristics, and to some degree, genetics. But what exactly makes each ecotype unique?

The Southern hemisphere has five ecotypes of killer whales: Antarctic type A, large type B, small type B, type C, and subantarctic type D.

Type A killer whales migrate between the tropics in the winter and Antarctica in the



Map created by Technology for wildlife: Illustration: Sayan Mukherjee

summer. They forage mostly on minke whales and elephant seals in ice-free, open water. Large type B, also called pack ice killer whales, have a dorsal cape and large eye patch. They can sometimes appear yellow due to local diatom algae buildup on their skin. These whales have a circumpolar range, feeding on ice seals in loose pack ice. They are known to wave-wash ice floes in groups to sweep their favorite prey, Weddell seals, into the water. Small type B killer whales also exhibit a yellow diatom film and a dorsal cape, but these whales have a narrower eye patch and a lighter grey color than large type B. They frequent the Gerlache Strait on the western side of the Antarctic peninsula, feeding on penguins. Type C killer whales live deep in the pack ice of eastern Antarctica in the Ross Sea where they forage for fish. These are physically the smallest of all killer whale ecotypes. Finally, type D subantarctic killer whales are very rarely seen, and have only recently been described. They have large, round heads with tiny eye patches. Sightings have been circumglobal in subantarctic waters, often around islands.

In the Northern hemisphere are the other five ecotypes of killer whales: Type 1, type 2, offshore, transient, and resident.

Type 1 Eastern North Atlantic killer whales are smaller, and often seen in Norway foraging for fish such as herring, mackerel, and sharks. Type 2 Eastern North Atlantic killer whales are larger with a slanted eye patch. Rarely observed, this ecotype ranges in the North Atlantic, hunting other cetaceans. Offshore killer whales have faint saddle patches and range between Alaska and Southern California along the outer continental shelf, making sightings infrequent. Living in large family groups, they feed mainly on sharks, whose rough skin wears their teeth to the gum line. Transient Bigg's killer whales are large with closed saddle patches, occurring in both offshore and coastal waters of the North Pacific. Favorite prey items include other mammals, such as seals, sea lions, otters, minke whales, and the calves of larger whale species. Resident killer whales exhibit open saddle patches with rounded dorsal fins. They forage for fish, oftentimes exclusively salmon, in coastal waters of the northeast Pacific. This is the most studied type of killer whale, with the Southern resident population being the most thoroughly researched group of marine mammals worldwide.

Why does this research matter for conservation?

Recent genetic studies strongly suggest that type A, B, C, and probably type D killer whales each be classified as their own species, with other ecotypes listed as subspecies until further research is conducted. Type 1 and 2 killer whales are closer to the beginning of the speciation process than the Antarctic populations, but already show extensive differences. Other studies have found that despite overlapping ranges, transient and resident killer whales share no recent common ancestor, also suggesting distinct species. Understanding what makes different populations of

killer whales unique can not only lead to a better understanding of their life histories, but also better conservation and management strategies.

The Southern resident population off the coast of Washington State is an excellent example of why this research is important for conservation. These whales are a large part of the culture and history in Washington, with over 500,000 people whale watching every year in their home range. However, the group has been steadily declining over the last several decades. Due to an abundant global population of killer whales and difficulty in determining separate species, the population was previously not eligible for protection under the Endangered Species Act of the United States or able to receive additional benefits.

Researchers then began looking into the evolutionary histories of killer whales for ways to differentiate groups from one another, and in 2005 the Southern residents were deemed a distinct population segment. This designation enabled them to be listed as endangered and paved the way for other killer whale populations to be evaluated. Further research has determined that anthropogenic threats such as a lack of food from dam development and overfishing, pollution, and increasing boat traffic are the major causes of the Southern residents' decline. This has led to supplemental boating laws, citizen science programs, watershed and salmon restoration projects, and a state-wide Orca Task Force made up of different government agencies that work together to find solutions specifically to protect this population. These conservation actions, while directed at saving the killer whales, impact more than just the Southern residents and help the entire regional ecosystem.

These efforts would not be possible without the research and knowledge of killer whale ecotypes and speciation, and are inspiring change for killer whale research worldwide. Hopefully, the global diversity of killer whales can be preserved, as we are only just beginning to learn exactly what makes them unique.

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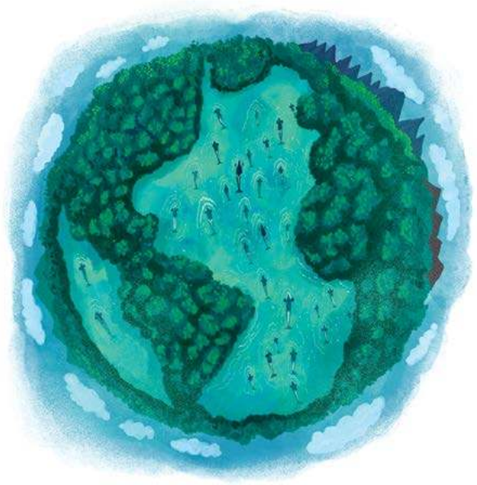

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Exploring sunken worlds

Author **Sofia Castelló y Tickell** | *Illustrator* **Aashti Miller**

I kick my fins below the surface of a sparkling sea, and blue haze transforms to reveal the contours of a shipwreck. Through my mask, I examine the colourful patches of sponge and coral that have colonised the ship's hull. A school of fish rounds the ship's prow in search of food or protection. On the ocean floor, this remnant of human life has a new part to play. Pausing a few metres above this human-made reef, I prepare my camera and my data collection sheets, printed on special waterproof paper. I signal to my dive buddy and we begin to record evidence of its conservation impacts.

Human-made reefs—hard, persistent structures submerged in the ocean by humans, including shipwrecks, oil rigs, fishing traps, piers, rock piles, and artistic sculptures—represent a unique blend of human and marine life. The mechanical sound of my breaths reminds me that before scuba diving was invented, it would have been unthinkable to find or monitor a shipwreck such as this one. Restless pioneers developed and refined the unwieldy tanks of compressed air that allow me to explore these sunken worlds and undertake research on them. The sea used to be a place where things were blindly sought or feared: fish, whales, monsters. It was a place where things were lost: ships, cargo, people. It was rarely a place where things could be observed or built.

Human-made reefs first emerged in coastal communities thousands of years ago, when people created stone fishing traps and sea walls and occasionally fell victim to accidental shipwrecks. In the last century, they have grown in popularity, along with our ability to access and transform the marine environment. Though some human-made reefs come to rest on the seabed by accident, they are increasingly submerged deliberately to fulfil a range of purposes, including the creation or improvement of fishing grounds, management of coastal erosion, extraction of oil and gas, tourism opportunities, art, and conservation.

These reefs have taken on a unique and controversial role in marine conservation. In a single article, they were described as "bastions for marine life" and "slapping the seas with the big almighty hand of humankind and damaging yet another part of the Earth." Many scientific questions remain unanswered. The creation of hard substrate in the ocean provides space for marine life to colonise, but it is unclear which organisms this will benefit most, or the extent to which human-made reefs produce new ecosystems rather than simply attracting components from elsewhere.

Human-made reefs are difficult to access and easy to forget once they have been created—particularly if they don't conform to ideals of success. Some structures create stunning visuals, which loom large in the public perception of human-made reefs. In others, vast clean-up efforts of tires or subway cars have been required after materials degraded in currents and salt water. However, the vast majority of human-made reefs are not monitored or assessed. This is limiting our ability to learn and inform future conservation practice in collaboration with other sectors, particularly as conservation pledges can play a role in the permitting processes that allow human-made reefs to be constructed. Conservationists are raising important questions about the responsibility inherent in creating and managing human-made reefs, but also about deciding whether to remove them (for example, in cases where toxic materials have been used).

One of the challenges in assessing the conservation potential of human-made reefs is that we have little idea of how many exist or where they are located. They are often created or found by groups of people who do not talk to each other—fishers, archaeologists, the oil and gas industry, tour operators, and conservationists—and the collection of this data is not a global priority. Nevertheless, UNESCO estimates that there are over three million shipwrecks in the ocean, and the Florida Fish and Wildlife Commission estimates that 70–100 projects are built every year, with 3,330 created since 1940. The Reef Ball Foundation claimed in 2007 that it had submerged over half a million of its patented concrete structures in 59 countries.

Human-made reefs (HMRs) present a fascinating confluence of human and marine life, meaning that we need to understand not only fish and corals, but also people and patterns in the creation and social uses of these reefs. My PhD research at the University of Oxford focused on integrating methods to find and assess their conservation impact to shape future policy, as my supervisors and I discussed in a paper published in BioScience. I trialled these methods around the island of Cozumel, Mexico, where I conducted a social and ecological assessment of HMRs found around the island. The process of assessing different structures and interviewing people from fishers to archaeologists, conservationists and tour operators, impressed upon me the extent and range of ways we are transforming the ocean—even in this one small patch.

The shipwreck I described at the beginning of the article was sunk intentionally almost 20 years ago, in an attempt to draw tourists away from beleaguered coral reefs and provide a new place for marine life to settle. On previous dives, I assessed submerged statues of marine conservationists Sylvia Earle, Ramyn Bravo, and Jacques Cousteau. I also visited a futuristic landscape dotted with concrete "alien eggs" (as described by a local diver, though they are more commonly known as Reef Balls), created in an attempt to restore coral and provide habitat for fish.

Each of these human-made reefs is creating a new space in which people and marine life mingle, prompting new ideas about how we will coexist in the future. The ocean is changing in myriad ways, and the effects of climate change, pollution, and overfishing are taking a toll. The place of human-made reefs in future marine ecosystems has yet to be determined. I believe we have the potential to shape it for good through accurate reporting, ongoing assessment of social and ecological impacts, and honest discussions about diverse views.

For now, it is time to take a breath and contemplate the many human-made reefs before us: figure out what works, what doesn't, and how we can take action to make room for people and nature in the collective future of our oceans.

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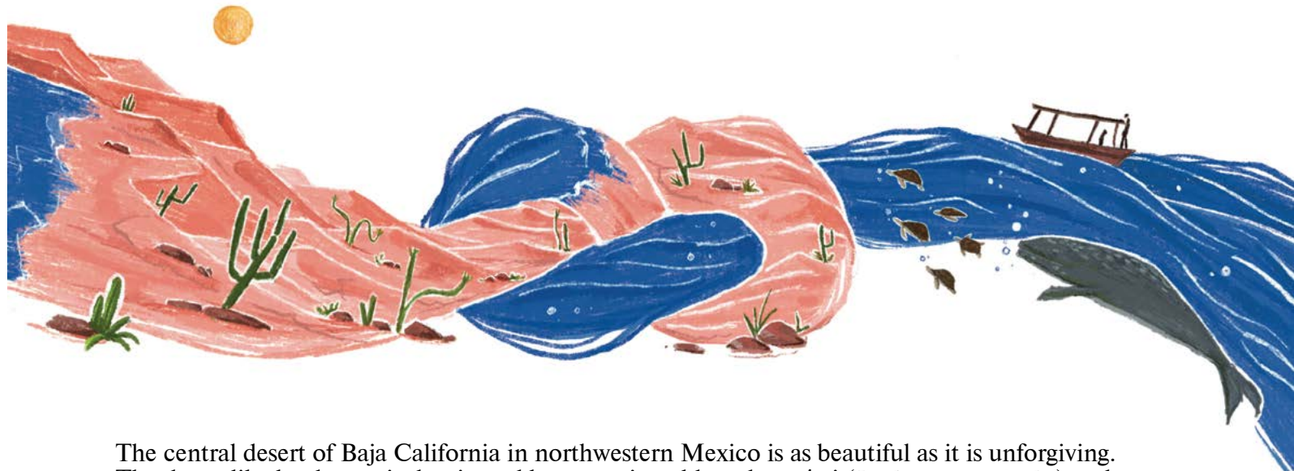
Navigating deserts and seas

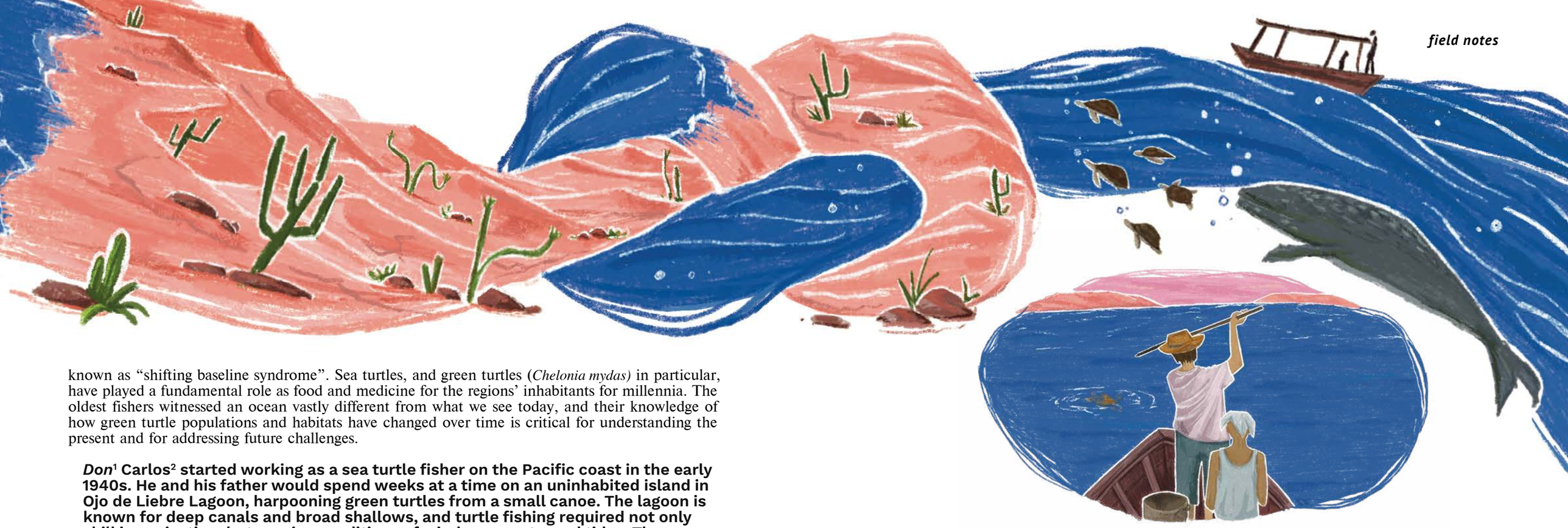
Author **Michelle María Early Capistrán** | *Illustrator* **Athulya Pillai**



The central desert of Baja California in northwestern Mexico is as beautiful as it is unforgiving. The dreamlike landscape is dominated by centuries-old cardon cácti (*Pachycereus pringlei*) and otherworldly boojum trees (*Fouquieria columnaris*), their common name in English aptly borrowed from Lewis Carroll's "Hunting of the Snark". Temperatures rise above 50°C in the scorching summers, and often plunge below 0° in winter, with a scarce 100–300mm annual rainfall. Nestled between the cold waters of the Pacific Ocean and the subtropical Gulf of California, the seas are rich and abundant: home to five species of sea turtles; diverse marine mammals, including grey whales (*Eschrichtius robustus*) that calve in the Pacific lagoons; and countless fishes and invertebrates.

Humans have inhabited this extreme landscape for at least 12,000 years. Cochimí people were nomadic foragers, fishers, and hunters who moved seasonally, traversing between water sources and resources on land and at sea. After European contact in the 18th century, the Cochimí population dropped 90 percent within two generations as a result of epidemics and famines caused by forced sedentarisation. In the following centuries a multi-ethnic society, sometimes known as *Californios*, was formed by the descendants of the Cochimí people, Spanish and Mexican settlers, and subsequent waves of immigration from various regions of Mexico, Europe, the United States, China, and Japan. They established small, dispersed communities and ranches throughout the peninsula. To this day, this isolated region has a population density of about two people per square kilometre, among the lowest in the world.

I've been fortunate to work in the central desert for the past ten years, learning from people who have not only survived, but thrived, in this harsh environment thanks largely to their detailed knowledge of the natural world. I've worked with master fishers on both coasts to try and reconstruct oceans in the past and how they have changed. Scientists may underestimate the magnitude of past biodiversity or abundance if research is limited to available ecological data—which in this region generally spans less than 30 years—a phenomenon



known as “shifting baseline syndrome”. Sea turtles, and green turtles (*Chelonia mydas)* in particular, have played a fundamental role as food and medicine for the regions’ inhabitants for millennia. The oldest fishers witnessed an ocean vastly different from what we see today, and their knowledge of how green turtle populations and habitats have changed over time is critical for understanding the present and for addressing future challenges.

Don[1] Carlos[2] started working as a sea turtle fisher on the Pacific coast in the early 1940s. He and his father would spend weeks at a time on an uninhabited island in Ojo de Liebre Lagoon, harpooning green turtles from a small canoe. The lagoon is known for deep canals and broad shallows, and turtle fishing required not only skill in navigation, but precise conditions of winds, currents, and tides. The smallest ripples in the surface water impeded visibility, so fishing was only possible during neap tides, with calm winds and still waters. Any turtles caught were filleted and salted, and their fat was boiled down into oil. Without any source of freshwater, they rigged a distiller from oil cans and copper pipes to distil seawater. Voyages would last until there was enough salted meat to make an overland journey to the nearest village, El Arco, worthwhile.

They would travel a day and a half by donkey or mule, packed with some 200 kilos of sea turtle jerky that could last for months without spoiling, and would be eaten in isolated ranches or mining towns. At El Arco, the meat was sold or traded for rations such as beans, rice, coffee, or wheat flour. In those days, several factors restricted sea turtle catches: demand was limited to a few towns or ranches, populated by a handful of people; fishing itself required detailed knowledge of the lagoon, extraordinary skill, and no small measure of danger; and *Don* Carlos and his father were the only fishers working in an area of at least 50 square nautical miles.

Don Ignacio arrived in the Midriff Islands of the Gulf of California in 1950. His family journeyed overland for two weeks by donkey, from one oasis or spring to the next, searching for promising fishing grounds. In his early days as a fisher, crews of two or three people would row for hours, or even days, to remote fishing camps, where they stayed until they either filled their canoes with turtles or ran out of food or water. The navigator’s skill was vitally important: the knowledge to read treacherous currents and shifts in the winds, to predict oncoming storms, and to guide the crew to safe (though uninhabited) harbours along the desert coast could mean the difference between life and death. Trips were short when fishing was good, and dangerously long when catches were scarce or when wind or storms kept them ashore. Detailed knowledge of the desert coast helped them stretch out supplies of water, sometimes supplemented from small springs or seasonal pools, and hunting skills could help stretch out food supplies. Fishers would make flour tortillas with sea turtle fat and sea water, and game such as mule deer (*Odocoileus hemionus*) and bighorn sheep (*Ovis canadensis*) provided meat that could be eaten at camp or salted.

Fishers primarily caught green turtles with a highly selective method: harpooning. This art, based on the careful observation of sea turtles’ behaviour and biology, required tremendous skill as the turtles were bought and transported live. Crews worked at night, with an oil lamp over the bow to illuminate the surface. The harpooner would signal the direction to the helmsman and throw the harpoon with just enough force to pierce the shell without breaking it or striking the lungs. Short, lightweight harpoons were used in summer months, when turtles are mobile and spend time near the surface. Long harpoons with weighted tips were used in winter months, when the turtles would lay dormant on the seafloor.

Green turtles were sent to market 800 kilometres away, near the U.S. border. The journey across the desert could take from two days to two weeks, depending on conditions. In the community, sea turtles were a staple food: a single turtle could easily feed 20 people, and its meat could be salted and preserved to last for weeks. Nothing was wasted: rendered fat was used for cooking and as medicine, and every part of the animal—including the shell, which could be boiled down to a gelatinous consistency—was used. The small human populations, difficulty of capture and transport, and limited market demand kept captures at a certain level. However, things would soon change.

[1]Don is an honorific used in Spanish, similar to “mister”, but with a higher degree of reverence. It is often used when referring to senior citizens.

[2] Names have been changed for confidentiality as established in the prior informed consent protocol.

From the 1960s onward, the growth in cities along the U.S.-Mexico border increased market demand for sea turtle meat. With the introduction of specialised set-nets, turtles could be captured easily and in far greater numbers. Off-board motors, with ever-increasing horsepower, allowed crews to move farther and faster, and reduced the risks of getting caught in winds or strong currents. The paved trans-peninsular highway, built in the early 1970s, reduced the journey to market centres from days to hours. This "perfect storm"of market demand, market access, and improved fishing technology led to massive captures that drove the population to near-extinction within two decades.

By working with fishers to estimate past green turtle populations and integrating them with ecological monitoring data, my colleagues and I have reconstructed over 70 years of green turtle population trends in the region. There is certainly good news: populations are growing after more than 40 years of conservation efforts (critical nesting beaches in southern Mexico have been protected since 1980, and all sea turtle captures in Mexico have been banned since 1990). However, populations have not reached historical baseline levels, and sea turtles face growing threats from climate change, which will be far more difficult to mitigate than direct human impacts. As fishing communities and sea turtles face the challenges of a fast-changing planet, the knowledge gained over generations will be critical for charting courses into the future.

Acknowledgements

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Saving Penguin Ryan
(and all of his siblings and friends)

Author **Shriya Lele** | *Illustrator* **Pari Satarkar**

Feeding response? Check!
Good vocal response? Check!

Then, watched by a dozen visitors with cameras at the ready, I carefully tube-feed AP047 and give him finely filleted pilchards. The ensuing ruckus from AP047 wakes AP048 with a start.
Now, AP048 has been a cause of worry: bloated tummy, poor feeding response, and barely a whimper when awake.
I tube-feed him diluted formula fortified with medicines and try to coax him into eating some fillets. He is not as happy with the food as his brother, who has since tried to eat more than his share from in between my fingers. AP048 gives me a that's-enough-for-now yawn and settles back against his little teddy bear.

Very well.

Thirty penguin chicks fed.
Eleven more to go.

The Chick Rearing Unit

I had been studying zebrafish brains in a lab. Wanting both a break and a challenge away from my natural laboratorial habitat, I made my way to Cape Town, South Africa, to volunteer at the Southern African Foundation for the Conservation of Coastal Birds (SANCCOB). I was an intern in the Chick Rearing Unit (CRU) for about six months and had the most fantastic time. Here, I worked with African penguin babies, played mom to hundreds of crowned cormorants, and played fish-catch with Pete, a particularly cheeky pelican.

Recently featured in a Netflix docuseries called 'Penguin Town', SANCCOB is a rehabilitation centre for coastal birds. They rescue and tend to a variety of birds, particularly the endangered African penguins, for their subsequent release back into the wild. Carers are forbidden from mollycoddling the birds so that they remain wary of humans and do not treat us as easy food providers. In fact, while hand-rearing the cormorant chicks, we would wear a gigantic black poncho and mask our faces as well. All this to ensure that the chicks didn't imprint on us, instead assuming they had an exceptionally large parent.

For the most part, I tended to African penguins who were brought in as eggs or chicks. The chicks would then be graded based on their weight, how well hydrated they were, and the appearance of their down feathers. Typically, eggs or chicks would be brought in by rangers, having been identified as either abandoned or

threatened. We would systematically enter the details in the system, maintaining records for each individual that was brought to us.

A typical morning shift in the CRU would begin at 5 AM with the penguin chicks chirping away in their crates, letting me know exactly how hungry they were. Taking care of endangered species is a delicate business where approximation doesn't cut it. The chicks first needed to be weighed and transferred into clean crates, no matter how hungry they were. The weighing helped calculate how much they needed to be fed based on their weight gain and other notes from the vet. I found two aspects of the early morning shuffle particularly endearing. One, getting a feeding response from the chicks by

teasing their beaks with my fingers, which would get them ready to glug down the fish I'd feed them. Two, I would always prep the crates with a little, soft toy for the penguins to nuzzle against, should they feel cold, sleepy, or just generally snuggly.

Morning shifts would usually end with my tag-team member coming in to take over for the evening shift. We would have a quick exchange of everything that had happened with the penguin chicks, including pointing out which chick had developed a cold, which ones would soon develop one, which chick was bloated, and whether any meds had to be changed—the works.

The many moods of a growing penguin chick

I soon established a good routine for feeding the birds, prepping their meals, administering their meds, and keeping the CRU spotless. With my training out of the way, I realised that I had been blessed with an insider view into the lives of penguin chicks. When penguin chicks hatch with a ninja-like flipper kick out of their eggshell, they are soggy little blobs with their eyes still shut to the world outside. This is the most vocal stage and they use their beaks as little tactile sensors to get familiar with their surroundings. Once they dry and fluff out, we move them out of the incubators and into little pots, where they remain with a soft toy friend that provides the warmth and physical contact that a penguin parent would have in the wild.

Vocal and energetic feeding responses are a marker of good health. Poor responses get flagged so that we know which young ones need extra care and looking after. Since they aren't being reared in the wild—an environment where they would gain robust immunity through food regurgitated by their parents—we have to be extremely careful to maintain a high standard of hygiene at the Unit.

As they get older, penguin chicks recognise that their human carers are not conspecifics and start to treat us with a rather haughty countenance. They are no longer keen on food, nor very vocal. However, this behaviour, which is in stark contrast to their younger days, is considered normal. Once a little older still, they regain their vocal nature. Some are exceptionally loud and curious, and invariably get housed in a crate with a penguin who would rather not be bothered at all.

During my six months at SANCCOB, there were two occasions when the CRU (and I) suffered from empty nest syndrome when all our chicks had grown up and been moved to the Nursery. The Nursery is where I worked with several other birds, a lot of whom could very well fly. It took a lot of coaxing to suppress my survival instincts and not bolt when faced with a sharp beak flying at me.

Conservation is everyone's business

There I was, a young grasshopper, absolutely clueless about animals and birds. Yet, I was welcomed by this remarkable and driven community of conservationists, marine biologists, and numerous local and international volunteers, all doing their part to save an endangered species. I worked with 18-year-olds who were volunteering as part of their gap year activities, as well as a couple of 70-year-olds who just wanted to do their bit for conservation. I saw how Cape Town tackled the loss of its once abundant population of penguins as a society. It wasn't only the rangers and conservationists who were doing their part ceaselessly. The local community also immediately alerted the concerned authorities, if they saw an injured or abandoned bird in their vicinity.

Even at the height of the pandemic, SANCCOB was readily supported with a seemingly endless supply of newspapers, towels and medicines. Although I wasn't in Cape Town then, seeing and hearing about it warmed my heart. At the end of my stay, I was armed with a lot more empathy towards nature and its caretakers, and had SANCCOB confirm what we all need to realise—conservation is everyone's business!

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“The older it grows, the more it seems to become agreeable”

Author **Madhuri Ramesh** | *Illustrator* **Shrobontika Dasgupta**

For a substance that is often dubbed as ‘whale vomit’, ambergris has an unexpectedly interesting history that spans different cultures and continents.

Historical records from the 9th century onwards indicate that the Arabs valued it for its medicinal properties and they knew it was always found along the seashore. The famous physician Ibn Sina wrote that a fountain in the middle of the ocean spouted *ambar*, while another physician, Yuhanna ibn Sarabi, insisted it was a marine mushroom that periodically got washed ashore. In later times, the Arabs believed that when whales consumed this substance, it scorched their innards and made them throw up. Perhaps its lumpy greyish white appearance reminded them of the embers of a fire and stoked this explanation. Despite its dubious origin, the Arabs believed that when ambergris was given to people in medicinal doses, it strengthened the body, heightened the senses, and acted as an aphrodisiac (of course).

Moreover, they probably introduced it into the Indian mainland in the 8–9th century, where it was known as *sugandhi dravya* (an aromatic product) or *matsyika* (a product from a fish). In addition, we know from a precise account by an Arab merchant, Sulaiman of Basra, that ambergris was found along the island shores of the Bay of Bengal during the south-west monsoon and that the Nicobaris bartered it with outsiders, in exchange for iron.

In the European world, ambergris was known to the Greeks and Romans through their trade links with the Arabs and Indians. However, they believed it was the resin of a tree. It is likely that during the Crusades (11–13th century), the use of ambergris became known to a larger number of European countries, such as Spain, Italy, England, and France. In fact, the word ambergris itself comes from French—*ambre gris* means grey amber. The colour differentiated it from real amber, which is a yellow fossilised plant resin (*ambre jaune*).

The Arabs sold ambergris to the Chinese too—records from the 13th century indicate that the Chinese valued its medicinal properties, although they had a different explanation for how it was formed. They believed that the Sea of the Arabs contained many dragons and when these monsters slept with their mouths open (like guileless children), their spittle formed hard lumps in the sea water and got washed ashore as ambergris.

The European appetite for trade had increased considerably by this time and naval expeditions were sent to different corners of the world. For instance, the explorer Marco Polo's travelogue mentions that many ships called at the islands of Socotra, Zanzibar, and Madagascar to obtain ambergris. He also notes that the Nicobaris harpooned the whales, dragged them ashore, and disembowelled them to extract ambergris and spermaceti oil. By the 14th century, ambergris was well-known to Europeans as *gemma marina*, the treasure of the sea. However, most Europeans unimaginatively believed it to be a type of bitumen that oozed up from the sea floor. The Chinese Ming emperors also sent out naval expeditions in the 15th century. Explorers such as Fei Hsin wrote that Sumatra was a major collection and trading post for ambergris, and its rulers sent back some to the Ming emperors as tribute.

Another novel theory about ambergris emerged in the 16th century: a Portuguese pastor and traveller Duarte Barbosa (brother-in-law of the navigator Ferdinand Magellan) reported that his informants in the Maldives had told him that ambergris was the marinated guano of large birds that roosted on cliffs along the seashore. The Maldivians classified ambergris into three types: the brown, worthless *minabar* which had been eaten and vomited by whales, the grey *puambar* that had been weathered by exposure to sea water and the white *ponabar* which was the freshest and the most valuable. The Mughal record *Ain-i-Akbari* written by Abu'l Fazl in the same era, also describes various theories including that it might be the dung of the sea cow. Like the Maldivians, Fazl noted that the cream-coloured variety, *ashhab*, was the most prized and it was used to make a perfume, *ambar-i-ashhb*. He mentioned three more grades of ambergris in decreasing order of value: the pale greenish *ambar*, the yellow *khash khashi*, and a black variety that was considered to be dross.

Also in the 16th century, a Portuguese physician who lived in Goa, Garcia da Orta, reported finding ambergris along the south Indian coast and observed that it contained the 'beaks of birds.' By then, the Portuguese were selling ambergris to the Chinese and complaining that in European markets, the ambergris was adulterated with benzoin, beeswax, aloe shavings, musk, and civet scent. In 1574, while translating Garcia da Orta's work on Indian pharmacopeia, a botanist from Belgium, Carolus Clusius, identified ambergris as a type of whale excrement and surmised that the beaks reported by da Orta must have been those of cuttlefish.

A century later, the Spaniards were obtaining ambergris by trading with the Araucanian people in western South America and English whaling ships occasionally reported finding it in the intestines of whales hunted near Greenland. Wealthy English households of the 17th century consumed ice creams flavoured with nutmeg, orange-flower water, and ambergris. At the other end of the world, the French physician Francois Bernier, who spent over a decade traveling around India, wrote that India sourced ambergris from Maldives and Mozambique. Despite widespread trade and consumption, speculations about its origin continued.

In 1667, the Royal Society of London sent out a survey, comprising 38 questions, to different parts of the East Indies, to gather more information on ambergris. As before, its nature exercised—and eluded—many great minds of the day, such as Nicolas Lemery (who described acid-alkali reactions), Robert Boyle (who formulated Boyle's law), and Robert Hooke (who articulated the cell theory). In fact, Lemery and some others believed ambergris was made of honeycombs. However, this theory was methodically disproved by a Dutch physician, Englebert Kaempfer, who was posted in Japan during the same period. Further, he reported that the Japanese considered it to be whale dung, which was congruent with the accounts of European whalers.

Finally, in 1783, a German physician, Dr. Franz Schwediawer, interviewed "two captains of ships, men of good sense and veracity" and carefully examined many pieces of ambergris. In addition, he marshalled all the available facts and wrote a report that was read out to the Royal Society by his friend, the famous botanist and explorer Sir Joseph Banks. His report persuasively argued that ambergris was the hardened dung of sperm whales (thus confirming the Japanese accounts) and that the embedded material was indigestible matter, such as cuttlefish beaks.

Even after its coarse origins were explained, ambergris continued to be popular in elite circles. For instance, it was consumed by the Medici court and features in the recipes compiled by Princess Anna Maria Luisa in the 18th century. In fact, to compete with the splendour of the Spanish court, her father the Grand Duke Cosimo III de Medici ordered his physician, Francesco Redi, to create a special secret recipe for hot chocolate: it was jasmine-flavoured and required expensive spices such as cinnamon, vanilla, and "2 scruples of ambergris".

Today we know that ambergris is a waxy secretion produced by a sperm whale's intestines, when they are chafed for a long time by chitinous cuttlefish beaks and, therefore, it is not dung in the strict sense of the word. In other words, this highly prized substance is found only in whales with serious indigestion. Ambergris gets released into seawater when the whale manages to excrete the waxy lump in its bowels or when the whale dies and decomposes. Fresh ambergris is black and odoriferous, but it becomes more aromatic with oxidation and weathering. Or as Dr. Schwediawer put it, "The older it grows, the more it seems to become agreeable"

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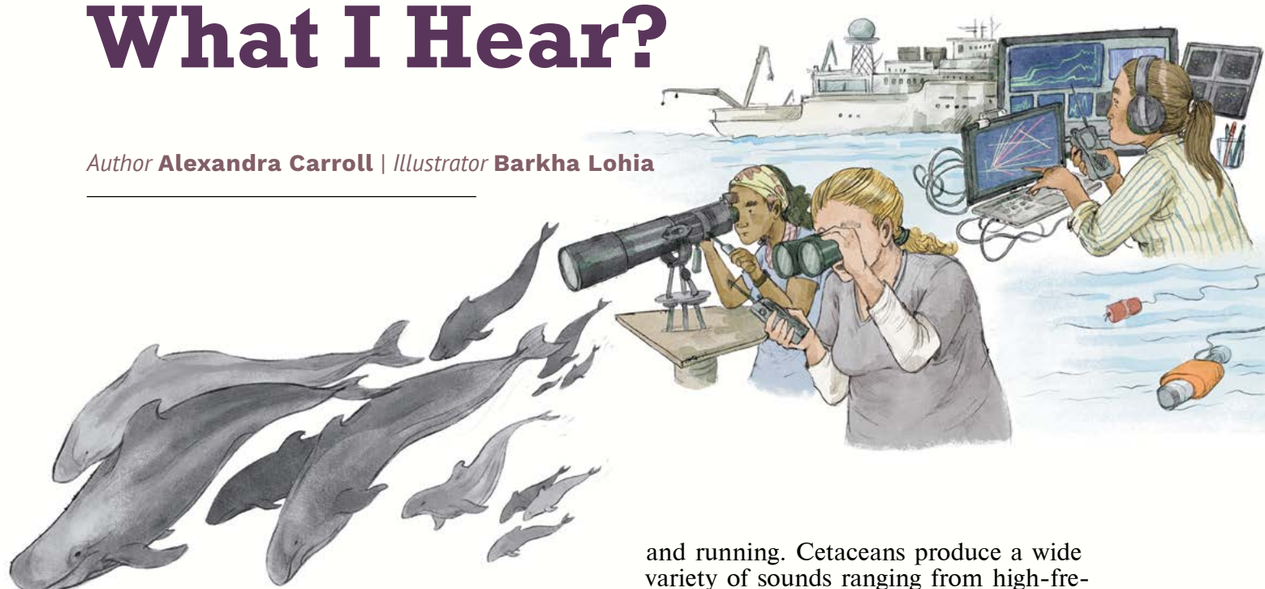
Do You Sea What I Hear?

Author **Alexandra Carroll** | *Illustrator* **Barkha Lohia**



It was another stunning morning in the Mariana Archipelago. At 5:20 AM, the moon was setting as the sun's rays began to shimmer on the horizon. With no land in sight, it felt like waking up on an entirely different planet, complete with wispy violet clouds and piercing azure waters so clear it felt like you could see all the way to the bottom of the Mariana Trench. Our first job of the day was to deploy a 330-m long cabled hydrophone array (complete with a series of underwater microphones) off the back of the *Oscar Elton Sette*—our National Oceanic Atmospheric Administration (NOAA) research ship—where it would be towed until sunset. This array allowed us to eavesdrop and even determine the position of life hidden below the water's surface. For this survey, we were in pursuit of marine mammals, specifically cetaceans (whales and dolphins). Little did we know just how busy our serene morning would become as we walked back inside to begin monitoring.

Although it was already 27°C (81°F) outside, the acoustics lab was a brisk 18°C (65°F), forcing us to bundle up as we got our computer systems up and running. Cetaceans produce a wide variety of sounds ranging from high-frequency clicks, whistles, and pulsed calls to low-frequency moans, groans, and tones that can travel over many nautical miles. We use specialised computer software called PAMGuard to visualise those sounds in various ways. For example, some of our monitors displayed spectrograms, scrolling plots of sound representing frequency or pitch (Y-axis) over time (X-axis). Others showed plots of more detailed acoustic measurements as well as the direction from which we received incoming sounds. PAMGuard also contains classification algorithms trained to recognise vocalisations of specific cetacean species which aids us in our interpretation of what we hear and see. The results appear as colour-coded symbols on yet another display. This particular morning, our monitors were blowing up with a mixture of orange and red classifications, indicating a large number of false killer whales (*Pseudorca crassidens*) in the vicinity, and we needed to localise them all.

False killer whales—a species of oceanic dolphin—are social animals who enjoy being in

small subgroups that spread out over a large area. Combine this behaviour with their reputation of being incredibly cryptic and stealthy, and accurate abundance estimates can become rather difficult for scientists. We immediately called up to the bridge to request that the ship maintain speed and direction while we frantically localised and logged each new subgroup that appeared on our monitors. Our adrenaline was pumping as subgroup after subgroup passed us by. We were surrounded! Yet despite the cacophony of whistles, clicks, and burst pulses lighting up our monitors, our team of visual observers searching from the flying deck (highest platform on the ship) had seen nothing! Moments like these are an important reminder that no one method of surveying is superior to another in marine conservation research. Marine animals can be seen and not heard, or heard and remain unseen. That's why NOAA has specific protocols in place to ensure the collaboration between multiple methodologies.

We let out a huge sigh of relief as the ship drove past the last subgroup of false killer whales, but we weren't done yet. It was time to alert the visual team to the presence of this large family of cetaceans, turn our ship around, and combine forces to get an even better estimate of the number of individuals present. Grabbing the radio, we informed the visual team it was time to initiate the false killer whale protocol. Their response: 'Bring it on!' We then immediately hailed the bridge and requested a 180° turn. That's right, we were officially in charge of steering our 1,827-tonne ship. As the *Sette* made the turn, we monitored the incoming localisations from the very chatty subgroups. Given the linear shape of the towed array, our system was incapable of differentiating between left and right of the ship during our first pass; our localisations gave us bearings and distances from both sides of the *Sette*. Therefore, the visual team would have double the locations to investigate. However, vocalisations that continue as the ship turns will move across our monitor in such a way that we can determine their exact location. Thankfully, that's exactly what happened. We could now direct the *Sette* towards each subgroup and tell the visual team exactly where to look.

The situation quickly became stressful; we called out position after position over the radio for the visual team to search to no avail. The false killer whales seemed determined to remain hidden below the surface despite our best efforts. Almost 20 minutes of searching passed with no visual confirmation. Time was running out before our cruise leader would determine our combined effort ineffective and send us back onto the survey track line. As an acoustician in this situation, emotions run high. The experience is as frustrating as it is humbling to realise that despite all the technology and talented team members at your disposal, we will always be at the mercy of the animals we wish to protect; you can't train wild animals to make an appearance. As each subgroup came closer to our ship with each passing minute, we repeatedly begged them to surface! Our pleading desperation must have successfully radiated through the hull of the ship, and not a moment too soon as boisterous cheers rang out over the radio along with the declaration of visual confirmation at last!

Our false killer whale protocol was a success. We logged each subgroup we heard, noting those confirmed by the visual team, while also listing who had remained silent but surfaced for our visual team to see. Thanks to the efforts of our visual team, we had acquired visually verified recordings of false killer whales which, for an acoustician, is synonymous to obtaining the Holy Grail! Such recordings leave no doubt that a particular vocalisation is associated with a particular species and can subsequently be used to develop automated classification algorithms. Development of these kinds of algorithms is unquestionably the future of acoustic monitoring as the amount of data acousticians collect continues to grow exponentially. I'm talking petabytes... that's millions of gigabytes! There is so much data that we simply do not have the resources to manually analyse

it through human action alone. Excitingly enough, our very own lead acoustician had recently developed such a classifier for false killer whales earlier in the year, using visually verified recordings taken around the Hawaiian Islands. By incorporating these additional recordings from a different part of the world into her algorithm, she will help eliminate any site-specific biases that may exist within it by accounting for possible differences in dialects, ultimately increasing its accuracy in classifying this species globally. Fact: An automated classifier is only as good as the data on which it has trained.

Later that night I lay reflecting on the rewarding chaos that was our morning. It had been an incredible day of progress and I felt so proud to be a part of the team. The data we collected will help answer many uncertainties about cetaceans in this data deficient region of the world (e.g., estimations of their occurrence and abundance and information on their population structure). The data will also be utilised by the U.S. Navy in their modelling efforts to assess and mitigate the potential impacts of their activities on these amazing creatures. While I continued to reflect on the day, I checked that the alarm on my watch was set for 2 AM. A few weeks ago, our team had deployed a passive acoustic recording device called a DASBR (Drifting Acoustic Spar Buoy Recorder[1]) to drift with the ocean currents, hoping to record the vocals of cetacean species that tend to avoid passing ships. I was going to be part of the team to search the moonlit waters for its reflective buoy component on the surface of the sea so we could bring it home. Just another day in the life of a marine bioacoustician.

Want to hear more about the adventures aboard the 2021 Mariana Archipelago Cetacean Survey (MACS)? Check out the online story map for the entire 59-day ship survey at https://arcg.is/1KaPaW!

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Barkha Lohia *loves working on picture books, editorials and sometimes dabble in tattoo art. Apart from these, she can often be found loitering around jungle spaces of Delhi. Clicking, collecting and sketching away.*

[1] https://www.fisheries.noaa.gov/science-blog/adrift-sea

Protecting the swimways of endangered species in the Eastern Tropical Pacific Ocean

Authors **Mariano Castro & César Peñaherrera** | *Illustrator* **Bhavya Magdziarz**

Yolanda had her 15 minutes of fame in 2021. She was the first tiger shark to record a journey from Galápagos Marine Reserve in Ecuador to Cocos Island National Park in Costa Rica. The shark was tagged on an expedition led by Dr. Alex Hearn from the organisation MigraMar, with support from the non-profit organisation OCEARCH, the Galapagos National Park Directorate, and scientists from the Charles Darwin Foundation. Yolanda travelled at least 700 kilometres from the point where she was tagged in 2014 to where she was registered in 2021, providing valuable information to researchers studying the migratory movements of marine species between biodiversity hotspots in the Eastern Tropical Pacific Ocean (ETPO).

The ETPO is a vast region that extends from the Gulf of California in northwest Mexico all the way to the Piura region in Peru. The confluence and influence of various marine currents makes the ETPO a highly dynamic environment, allowing the existence of contiguous warm (tropical) and cold (temper-

ate) ecosystems. As such, the ETPO hosts one of the most functionally diverse ecosystems found in the world. In recognition of the uniqueness of this area, the governments of Costa Rica, Panama, Colombia, and Ecuador signed a joint declaration in 2004 that created the Eastern Tropical Pacific Marine Corridor (CMAR for its acronym in Spanish), which acknowledges the ecological connectivity between marine protected areas (MPAs) and promotes the sustainable use and conservation of biodiversity.

When the CMAR was created there was no information on how exactly ecological connectivity occurred in the region. To gain a better understanding of this, scientists have been collecting data for over a decade by tagging marine species with acoustic and satellite technologies. The resulting location data have revealed that, just like Yolanda, several other marine species use well-defined migratory routes to move across the ETPO. The decade-long project has allowed researchers to understand migratory species' susceptibility to threats when moving beyond the protective boundaries of MPAs. For example, the critically endangered scalloped hammerhead shark constantly migrates between Galápagos and Cocos, and while doing so, faces extensive pressure in unregulated fishing areas that lie between both MPAs. Information on this and other species have given managers valuable insights for marine spatial planning and improvements in protection for other threatened and protected species, such as leatherback sea turtles, green sea turtles, and thresher sharks.

A critical result of this decade-long research has been the identification of 'swimways'—areas used by migratory species to move between feeding, resting and breeding grounds. The aim is to protect these routes and safeguard the integrity of interconnected open water and reef ecosystems between the different MPAs in the ETPO. MigraMar has identified two swimways in the region: the Cocos-Galápagos swimway, which connects Cocos Island National Park in Costa Rica and the Galápagos Marine Reserve in Ecuador; and the Coiba-Malpelo swimway, connecting Coiba National Park in Panama and Malpelo Flora and Fauna Sanctuary in Colombia.

These findings motivated scientists and conservationists to advocate for more effective protection of highly migratory species by increasing the size of existing MPAs and promoting cooperation between countries. While the CMAR is not a legally binding instrument for the protection of open water ecosystems, the creation of swimways would allow Yolanda, and other marine species, to safely migrate between these iconic MPAs.

There are, however, challenges associated with the swimways initiative. Nature knows no borders, and thus protecting these ecosystems requires a paradigm shift from a local, single-species focus to a more holistic, regional management approach. These highly mobile species' migratory routes are not only vast, but also in many cases remote, which makes international collaboration critical for effective management, control, and surveillance of marine resources in jurisdictional waters and the high seas. Moreover, it is also important to understand how implementing MPAs can be beneficial for the productive sector. A clear example of this is the Galápagos Marine

Reserve, which hosts tourism and artisanal fishing activities within its borders and also benefits—via the spillover effect—the industrial fishing fleet that occurs right outside its limits.

2021 was a positive year in the political arena for the consolidation of the swimways initiative. During the recent UN Climate Change Conference (COP 26) in Glasgow—almost two decades after the CMAR was created—the governments of Costa Rica, Panama, Ecuador, and Colombia announced their commitment to further conserve and promote sustainable development of this marine corridor. The four countries agreed to increase the size and improve the management of the MPAs in the CMAR, as part of their commitment to protect 30 percent of the world's land and ocean by 2030. Panama took the lead in June 2021 by adding 50,519 km² to the Cordillera de Coiba Marine Protected Area. A few months later, Costa Rica expanded its oceanic MPAs to 54,844 km² (Cocos Island National Park) and 106,285 km²,(Seamounts Marine Management Area), for a combined protected area of 161,129 km². At the beginning of 2022, Ecuador announced the creation of 'Hermandad', a new 60,000-km² marine reserve in Galápagos. *Hermandad*, which means sisterhood/brotherhood in Spanish, symbolises the connection of these waters with Ecuador's neighbouring country, Costa Rica, and the importance of protecting the ecological connectivity between Cocos Island and Galápagos. More recently, Colombia expanded the Malpelo and Yurupari MPAs to 47,300 km² and 117,600 km², respectively, and also created a new 27,400-km² MPA called Colimas and Lomas. Through the combined actions of these four countries, there has been a fourfold increase in the protection of oceanic waters of the CMAR region.

The expansion of these marine protected areas not only offers hope to restore the populations of endangered marine species, but also to strengthen ties between countries connected by the ocean. The expansion of these areas also offers a unique opportunity to secure the identified swimways, and help Yolanda and other migratory species to safely travel across the region.

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THE SHOCKINGTON CONSERVATION AWARDS

Author *Kartel Shockington* | Illustrator *Amit Kaikini*

Friends!

We are thrilled to announce an exciting new initiative that will give us a chance properly to celebrate the great achievements of conservation—the 'Shockington Conservation Awards'. This global initiative will promote all that is beautiful, true and just in our noble cause, and honour, properly, the hardworking people who labour so tirelessly for it.

Laureates of our awards will receive a personalised, bespoke certificate, which has our unique signature upon it, their citation and an IOU for a substantial sum of money, that will be exchangeable for actual gold pieces just as soon as we have found the appropriate corporate sponsor with a sufficiently guilty conscience.

We have listed the initial achievements for which we have set out prizes, with current nominees, and we would welcome further additions to it.

AND THE NOMINEES ARE.....

1. The Most Powerful Protected Area Generating Machine

After careful consideration we have decided to present this award to the **David Attenborough Building** in the University of Cambridge because it is home to the world's largest concentration of conservation planners devising new large-scale protected area distributions. The DAB may in fact have the unusual distinction of housing more plans that might entail the relocation and/or economic displacement of people than any other place on the planet (other than perhaps the White House).

Unfortunately, a small technical hitch has meant that this great building has itself been located in the wrong place, and needs to move a couple of hundred feet to the right in order to make way for a small but important new protected area on Grafton St. But as soon as this move is accomplished, the DAB will be eligible to receive this great accolade. We look forward to the occasion.

2. The Most Assiduous Forester

Awarded to **Prof T. Crowther's Laboratory** for their repeated tree-hugging, tree-supporting and tree-affirming publications.

3. Most Efficient Use of the Same Idea (I)

The judges were unable to make an award in this category.

4. Most Efficient Use of the Same Idea (II)

The **first prize** is awarded to **Kartel Shockington** (yes that's us!), for repeating the same idea for a prize within two lines. That's panache that is.

Second prize to **Linus Blomqvist, Ted Nordhaus and Michael Schellenberger** for their publication of *Nature Unbound*, a book about conservation that is, unwittingly, clearly a sequel to *Nature Unbound*, also about conservation, by **Dan Brockington, Rosaleen Duffy, and Jim Igoe.**

If other budding authors wish to be eligible for this award in the future then other titles they could reproduce include *The Jungle Book, A Tale of Two CITES* and *Sense and Sustainability.*

5. The Ostrich Award for Nailing, and Solving, the Problem.

Our Laureate for this award is the software Marxan for enabling a vital strategic move for conservation planning.

There are two basic approaches to human despoilation of the environment. One approach observes that our economies are governed by greed, encourage excess, and economic strategies and metrics are all about ramping up treadmills of economic growth. Therefore, we need to tackle the incentives and systems which are at the root of these evils.

Whilst a worthy task, this is difficult. Opposing capitalism risks offending Americans, who would label us as socialists. It would also threaten our vital corporate funding. Conservation cannot go there. So, we need a second approach, and in Marxan we have one which can ease our consciences brilliantly. It allows us to move the despoilation into a different place, and recategorise the planet so there are still some nice bits left for rich tourists to enjoy.

Marxan, if you will forgive an inappropriate metaphor, kills two birds with one stone. It deals with the strategic task AND it solves the mathematical problem of resource allocation. In the process it even produces thousands of beautiful maps that we can publish in the Greatest Journal Ever. Not only is it a brilliant tool for optimally identifying appropriate allocation of conservation resources at small scales, but in the hands of the right planners (especially anyone located in the DAB), it can re-invent the planet as if capitalism caused no problems at all.

6. The Dodo Award for Making Wildlife Disappear

This may seem a strange award to make to any conservationist, but the point here is that if there is too much wildlife, well we wouldn't have conservation at all. It is important therefore to introduce wildlife deficiencies strategically to make sure that conservation always has relevance and purpose.

Our Laureate for this award goes to Bernado Strassburg and colleagues for *a brilliant paper on restoration* that *removed all wildlife from any agricultural land.* That's 33 percent of the planet cleansed of all biodiversity in a line of code! It is one of the neatest solutions to the land sharing / sparing debate that we have ever encountered.

Better still, these wildlife distributions have now been imported *en masse* into other *models*, including an attempt to identify places where wildlife are threatened. Thus, no wildlife are now threatened on agricultural lands, because no wildlife are there! This has made it rather easy for several large fertiliser companies and farming unions to come on board and sponsor this award.

Kartel Shockington *is a failed comic book creation with special powers of rapid hair loss. He sometimes appears as Kartik Shanker, and at other times as Dan Brockington. Kartik Shanker is at Indian Institute of Science & Dakshin Foundation, Bangalore, India. Email: kshanker@gmail.com*
Daniel Brockington is at University of Sheffield, UK. Email:d.brockington@sheffield.ac.uk.

Amit Kaikini *is a freelance illustrator, with a decade of experience in digital advertising. He loves to explore Sci-Fi & Horror genres, with an inclination towards nature & a desire for surreal storytelling, he is working towards self-publishing his own comics in the near future.*

In addition to these allocated prizes the judges would welcome nominations for:

1. The Barbie-Saviour award for the conservationist whose life is most likely to be optioned by a major film-maker.

Eligibility: Any white conservationist working in an exotic environment.

2. The Most Compassionate Conservationist

Eligibility: Any conservationist who is in touch, and we mean seriously in touch, with their feelings.

3. Burton-Speke Most Original Re-Discoverer Award.

Eligibility: Anyone who claims an original first sighting of something locals have known about for ages or completely reinvents an already existing field of study.

4. Biggest Map (Any map, about anything, just so long as it is enormous)

Eligibility: Has to have been published in a very important journal, but in a tiny and scarcely legible way