BIG PACIFIC
Part One: Passionate Pacific

Great white sharks | Guadalupe Island, Mexico / Stewart Island, New Zealand
Clownfish | Okinawa, Japan
Sea otters | Monterey Bay, California
Wolf eels & the Giant Pacific octopus | British Columbia, Canada
Blue-ringed octopus | Monterey Bay, California
Grunions | Okinawa, Japan
Palolo worms | Samoa
Dugongs | Palawan, Philippines
Big-bellied seahorses | Auckland and Whangarei, New Zealand
South Sea golden pearls | Auckland and Whangarei, New Zealand

Part Two: Voracious Pacific

White shark | Cabo San Lucas, California / La Paz, Mexico / Kimbe, Papua New Guinea / Cebu, Philippines
Giant manta rays | Pohnpei Island, Micronesia
Cormorant-eating anemone | Mornington Peninsula, Victoria
Garrapata Park and Channel Island, California
Hako and Blue sharks | Catlins, Dunedin, New Zealand

Part Three: Mysterious Pacific

Sea turtles | Palawan, Philippines
Pufferfish | Okinawa, Japan
Long-finned eels | Mornington Peninsula, Victoria
Carnivorous sea cucumber | Cook Strait, New Zealand
Firefly squid | Okinawa, Japan
Severing shark | New Zealand
Chambered nautilus | Pohnpei Island, Micronesia
Horseshoe crab | Hong Kong / Lord Howe Islands, Australia
Seven-gill shark | New Zealand

Part Four: Violent Pacific

Humpback whales | Hawaii, Alaska and Monterey Bay, California
Pink dolphins | Taiwan and White Island, New Zealand
Ring of fire | Indonesia
Accelerated evolution | Lembeh, Indonesia

Part Five: Big Pacific – behind the camera

Doing whatever it takes to get the perfect shot | Micronesia

Prehistoric Pacific | Neskowin, Oregon, United States
Yellow-eyed penguin | Queenstown, New Zealand
Snake island | Neskowin, Oregon, United States
Saltwater crocs | Philippines / Papua New Guinea
Dragon tide | New Caldeonia
Turtle tombs | Tokyo, Japan

Skull caves | Milne Bay, Papua New Guinea
Pink dolphins | Guangdong Province, China / Hong Kong
Malapascua monster sharks and hammerhead highway | Malapascua Island, Philippines
Forbidden zone | Vancouver and British Columbia, Canada

Tongue-eating lumpsucker | Okinawa, Japan
Tongue-eating lumpsucker | Okinawa, Japan
Urchins eating kelp | Pohnpei Island, Micronesia

Invasion of the pink dolphins | Guangdong Province, China / Hong Kong
Prehistoric Pacific | Neskowin, Oregon, United States
Humpback whales | Hawaii, Alaska and Monterey Bay, California

War in the Pacific | Kimbe Bay, Papua New Guinea / Air Show, Houston, Texas

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“Consider the subtility of the sea; how its most dreaded creatures glide under water, unapparent for the most part, and treacherously hidden beneath the loveliest tints of azure.” — Herman Melville

Passionate Pacific
from awe and avarice to war and wanderlust, the Pacific Ocean has attracted every passion ever experienced by humankind. It has been the focus of our fascination for as long as we have lived around and in it, and we will continue to love and learn from it well into the future.

Perhaps its vast, life-giving body speaks to our own primordial origins within its expanse. Perhaps we respond to an innately human need to understand its place on our planet. Or we marvel at its capacity to create and sustain a seemingly infinite variety of life—our lives included. Whatever the reason for our enchantment, there is no doubt the Pacific holds a place in our hearts. Driven by that passion, we explore its remotest reaches, harvest its bounty and delve into its myriad mysteries.

Much of its allure lies with the creatures that inhabit it, from the mammals, birds, fish and invertebrates that populate its shallows and shores to the enigmatic species that thrive in its depths. But these animals demonstrate their own remarkable passion for life: the enduring commitment of a mate to its partner, the selfless devotion of a parent to its offspring, the all-consuming but doomed drive to procreate. These passions are an inexorable part of life in the Pacific, each one an everyday miracle in its own way and an integral part of the passionate force of nature that is the Big Pacific.

Despite the fact that seahorse dads only ever carry the eggs of one female, seahorses have a reputation for promiscuity because they may dance with more than one partner during courtship. Scientists think this may be their way of checking out suitors for their next successful mating.
Unlike most other fish, Great whites are endothermic, which means they can maintain parts of their body at temperatures above that of the surrounding water. This enables them to survive in sub-temperate as well as temperate and tropical seas.

Great white wanderers

Peripatetic pilgrims of the Pacific, Great white sharks have one of the widest geographic ranges of any marine animal. Individuals migrate vast distances — even across whole ocean basins — and in the Pacific they can be found as far north as Alaska and as far south as Stewart Island, at the southernmost tip of New Zealand.

Every year, however, a great many of these oceanic wanderers congregate around La Guadalupe (Guadalupe Island), 241 kilometers (150 miles) off the western coast of Mexico. First to arrive, in spring and summer, are males. The females — who generally dwarf the males — arrive in the fall. It’s thought mating occurs in the late fall, although no one has ever witnessed Great whites in the act.
The pores on a shark’s snout allow it to sense electrical currents, helping it to find prey.

Shark cage diving enables adventurous tourists to observe the world’s largest predatory fish from the relative safety of an aluminium frame. The activity is becoming common in areas Great whites are known to frequent, such as Guadalupe Island.

With little obvious differentiation other than the size disparity, it can be tricky to distinguish between male and female Great whites. Males, however, have claspers – twin organs broadly equivalent to a penis with which they inseminate females during mating. Bite marks commonly seen on the heads of females at Guadalupe suggest mating is a vigorous encounter, with the male likely using his impressive array of teeth to maintain a grip on his larger, stronger partner.

Pregnant females spend a year or more at sea while as many as ten embryos develop inside their bodies. At birth the pups measure a meter (4 feet) or more. Like their parents, these youngsters disappear into the deep blue, perhaps using their remarkable ability to read the magnetic fields of the Earth’s crust to navigate their way across the ocean.

Unsurprisingly for such a highly evolved predator, Great white sharks are endowed with keen sensory organs. Their sense of smell – which enables them to pick up a single drop of blood in 10 billion drops of water – is legendary and helps give rise to their fearsome reputation as hunters. But their vision is also good: the retina of a great white’s eye is dually adapted for day vision and low light. Even more impressive is their ability to detect electrical currents through pores on their nostrils which are filled with cells called the Ampullae of Lorenzini.

Passionate Pacific —
Great white sharks

Like many terrestrial apex predators, the Great white shark has suffered significant population decline. The species was officially protected by South Africa in 1991, by California and Australia in 1994 and New Zealand in 2007.
Seals at the seashore

The waters around Guadalupe Island are abundant in prey species for the Great white shark. Both Northern elephant seals and Guadalupe fur seals breed here, and pups of both species – unaware of the local hazards lurking just offshore – make an easy meal for an apex predator. The elephant seals like to lounge along the island's beaches, while the smaller fur seals frequent the rocky coastline. Adult members of both species must head out to sea to hunt, however, leaving their pups behind to play in the shallows. This is when youngsters are most vulnerable to the sharks. Northern elephant seals are the second largest true seals. Females grow up to three meters (10 feet) in length and weigh as much as 600 kilograms (1,300 pounds), but the gargantuan males can measure four meters (13 feet) or more and tip the scales at more than 2,000 kilograms (5,000 pounds). All adults sport the elongated proboscis that, along with their size, lends elephant seals their name, but it is more pronounced in males. These appendages actually act like ‘re-breathers’ that re-absorb moisture when the animals exhale, minimizing the loss of water when they are hauled out on land to bask in the Guadalupe sun. When things get too hot, some seals flip sand over themselves ostentatiously to cool down, a trait known as ‘sand flipping’. A seal’s whiskers, or vibrissae, are thought to assist in the detection of prey.
Protecting the Pacific — seals

Hunted to near extinction in the eighteenth and nineteenth centuries, the Guadalupe fur seal has made an encouraging comeback. Similarly, Northern elephant seals, once much in demand for oil and blubber, were considered extinct by the late 1800s. However, a remnant population was discovered on Guadalupe Island and the Mexican government enforced protection in 1922. Thanks to this measure, every elephant seal on the North American mainland today is a descendant of the Guadalupe survivors.

Northern elephant seals belong to the Phocidae family of ‘earless’ seals so are regarded as true seals, whereas their Guadalupe neighbours, the fur seals, are not because they have visible ear flaps. Can you spot the difference?
Clowning around

The bond between a Clownfish and its Sea anemone host is one of the Pacific's most endearing partnerships. Clownfish are even commonly referred to as anemonefish, so strongly are they associated with their invertebrate pal.

There are thirty species of Clownfish, each sporting its own combination of striking markings. They all live in the shallow waters of sheltered reefs or lagoons, and all display the same passion for anemones, forging with them a relationship that gives new meaning to the term 'co-dependency'.

The contract between vertebrate and invertebrate is relatively simple. An anemone may host up to a dozen members of the same species at any time, providing its fishy friends with a safe haven from predators and a sheltered nesting place. In return, the Clownfish rid their anemone of parasites and help circulate water around its tentacles — effectively delivering it food.
This may seem a marriage of convenience, but the symbiosis is so strong that a Clownfish may not survive if separated from its anemone. So — understandably — Clownfish are extremely territorial. They can live for up to ten years, and during this time they never stray far from their ‘home.’

In a strange quirk of nature, all Clownfish are born male, and only the most dominant member of the colony will develop into a female. The newly minted female holds all the reproductive rights and the rest of the group adheres to a strict hierarchy under her rule. Only one fish — selected by the ‘queen’ — is able to mate with her. All the other Clownfish remain unable to reproduce, although just how the dominant pair is able to suppress the development of the remaining members of the group remains a mystery.

Female Clownfish spawn roughly every two weeks, laying hundreds of eggs at a time. The favoured male then fertilizes them and faithfully guards them around the clock, constantly fanning them with his fins. After ten days the eggs hatch and the larvae drift towards the sea surface. They return back to their reef as juveniles, following the scent of the anemone that was imprinted upon them at birth.

The toxic tentacles of an anemone provide Clownfish-with protection from predators. Nature cleverly endows Clownfish with a mucous-like covering which protects them from their host’s venomous sting. However, acclimation must occur for the Clownfish to become immune. To achieve this, the Clownfish swims around and through the anemone, rubbing its ventral side and fins on the tentacles.

Sheltered in the arms of the anemone, a male Clownfish tends a cluster of eggs by circulating water, oxygenating the eggs and providing fresh food for the anemone at the same time.

a. Shaded in the arms of the anemone, a male Clownfish tends a cluster of eggs by circulating water, oxygenating the eggs and providing fresh food for the anemone at the same time.
Marine monogamists

Beneath the green waters of the Emerald Sea, off the coast of British Columbia, one species sets the bar for enduring long-term relationships. The Wolf eel — actually a type of fish called a blenny, rather than a true eel — lives out its entire life with its chosen mate, even remaining single for the rest of its life when its partner dies.

Here in the Pacific’s Northeast, the sea is cold, with an average annual water temperature of around 10° Celsius (48° to 50° Fahrenheit). Cold water is richer in oxygen and this gives the entire food chain a boost, leading to larger, albeit slower-growing, organisms. The Wolf eel is no exception to this rule; it can grow up to 2.5 meters (8 feet) in length, weigh up to 40 kilograms (88 pounds), and live for as much as 14 years. They feed on the bottom, relying on their sense of smell to locate their prey. Wolf eels are in fact very shy and would never show their tentacles, which are deadly weapons. Their large heads and fierce-looking mouths make them appear dangerous, but they are very aggressive towards other Wolf eels.

Wolf eels move through the water by making deep S-shapes with their bodies, like a snake. Their large heads and fierce-looking mouths make them appear dangerous, but they are very aggressive towards other Wolf eels.
kilograms (88 pounds) and live for more than 30 years, most of it spent tucked away in a rocky crevice with its partner. Female Wolf eels settle down with their chosen mates at around seven years of age, when they will lay up to 10,000 eggs at a time. A fiercely protective mother, the female coils herself around her brood, settling the eggs into a spherical cluster, before the male coils around her in his own shielding embrace. Once hatched, Wolf eel larvae leave their parents’ lair to drift in sea currents. Juvenile Wolf eels spend their early lives in the mid-depths of the open ocean, but as they mature they head to shallower water. Eventually they find a mate and a den, and spend the rest of their lives together in the security of their home, emerging only to hunt for prey.
Many-armed molluscs

With their bizarre form, intelligent behaviour and mastery of the art of disguise, octopuses have long fascinated us. They may seem in a class of their own, but officially they are molluscs. This means they are invertebrates, because they have no internal or external skeleton, and it can be helpful to consider them an ‘inside-out’ mollusc in which the soft body is exposed and the shell has been reduced to two small plates onto which the head muscles are anchored.

The eight arms of the octopus are covered with powerful suction cups. These chitin-ringed discs power the octopus’s sense of touch and taste and endow them with an uncanny ability to cling onto almost any surface.

Developing in the cold coastal waters of the northern Pacific, the Giant Pacific octopus can weigh twice as much as the average human and stretch more than seven meters (23 feet) from tentacle tip to tentacle tip — although one specimen stretched 6.2 meters (20 feet) across and weighed more than 272 kilograms (600 pounds).
The Pacific Ocean is home to many different species of octopus. These include the world’s largest, the Giant Pacific octopus, and the very latest species to be discovered, the enigmatic Larger Pacific striped octopus. The tiny Blue-ringed octopus may be shy but its bite is power-packed with a lethal cocktail that makes it the only octopus species capable of killing a human.

The Larger Pacific striped octopus was only recently revealed as a resident of the Pacific coastal waters of Central America. In many ways it is similar to other better-known octopi — its skin flashes and ripples with the color changes typically associated with these masters of disguise — but its mating behaviour is strikingly unique.

Unlike most other octopus mating rituals, in which the male briefly injects a sperm-laden arm into the female’s oviduct, female Larger Pacific striped octopuses envelop males in a lengthy embrace that may last hours. The male curls his special appendage into position inside the female’s mantle, but in return the female snakes an arm around his mantle and tightens her grip into a stranglerhold.

Also unlike many other octopus, female Larger Pacific striped octopuses don’t die after laying their eggs, instead going on to lay again and again. The female meticulously tends her eggs, jetting water over them with her siphon to keep them healthy with oxygenated water and regularly cleaning them to remove bacteria and algae. Once the larvae are mature, the mother triggers their hatching with her siphon. Escaping the egg sacs is a challenge. The baby octopuses must coil and stretch themselves to squeeze out of their natal shells. Then, newly independent, the tiny aquanauts must brave an ocean full of predators. Those that survive eventually sink to the sea floor to take up residence and renew the cycle of octopus life.

A female Larger Pacific striped octopus takes up residence in a large shell, an ideal place to care for her eggs (right) until they escape from their egg sac.
Mermaid mums

The word ‘dugong’ originates from the Tagalog word for ‘lady of the sea’, and while the marine mammals that carry the name may not match the traditional western image of a mermaid, they certainly evince a beguiling, serene nature.

Found throughout the warm waters of the Pacific’s tropical west, Dugongs are the only entirely vegetarian marine mammal, which gives rise to their other nickname of ‘sea cow’. Their grazing habits lend them the un-mermaid-like appearance of living vacuum cleaners for, using their muscular snout with its large sensitive bristles, they forage for sea grass on the seafloor, suctioning it up roots and all.

Much shyer than their Atlantic cousin, the Manatee, Dugongs may look ponderous and slow but are capable of bursts of speed, and long, deep dives. They are known to travel great distances in search of a particular field of sea grass, but on the other hand may remain in one range for most of their lives. The sheer size of most adults affords them protection from predators such as sharks and crocodiles, but young Dugongs depend on their mothers for safety.

Preserving the Pacific – Dugongs

With a lifespan of 70 years or more and a slow rate of reproduction, the Dugong is especially vulnerable to extinction. Dugongs have long been hunted by indigenous peoples, but modern human activity such as gill- and mesh-net fishing, shipping and habitat loss has exacerbated their population decline alarmingly. The species is officially classified as Vulnerable to extinction by IUCN and listed on CITES.
Conserving Pacific coral

Corals are some of Earth’s most primitive animals, but also among the most ecologically important. Coral reefs foster the ocean’s highest levels of biodiversity, supporting a quarter of all marine species by providing food and shelter for myriad fishes and invertebrates. They also protect coastlines from the destructive forces of storms and typhoons. In short, they play a vital role in the overall health of our planet.

Unfortunately corals are also fragile organisms – even those that produce hard, calcium-carbonate skeletons – and so are highly susceptible to environmental degradation and destructive fishing practices. They are also incredibly slow-growing: it can take 10,000 years for coral polyps to form a reef, and many more hundreds of years for the reef ecosystem to reach maturity.

On Hainan Island near southern China the country’s largest coral conservation project – a collaboration between the South China Sea Institute of Oceanology and the Nature Conservancy – has established a coral nursery, with the aim of re-building a reef.
Scientists carefully clip coral fragments from larger coral heads that have broken off. Then they attach the fragments to nursery structures designed and built for securing the coral fragments. Playing ‘Mother Nature’ with extremely slow-growing animals is a complicated, time-consuming endeavor, but corals do have one biological advantage that assists them: they reproduce asexually, essentially cloning themselves. If a small piece of coral breaks off, it may settle, grow and propagate. The team hopes to use this special ability, known as fragmentation, to enhance coral populations in areas that desperately need it.

First, an optimal location must be chosen as a nursery site. Corals require perfect conditions to grow—the right amount of sunlight, the correct water temperature, and adequate shelter from waves. Since the delicate pieces can’t just be scattered around, structures for securing the coral fragments must be designed and built.

When it’s time to place the structures underwater, the team must anchor and buoy them simultaneously in place. The metal reef frames must float at an optimal height for sunlight and nutrients to reach the new corals. This reef-rebuilding method has been successful in the Caribbean Sea, but conditions in this part of the Pacific Ocean can be considerably different. Every year, typhoons tear through the region—just one moderate storm could easily wipe out the fragile coral nurseries. The team’s solution is to make the structures height-adjustable. This allows the baby corals to sit near the sunlit surface for most of their development, while ensuring they can be lowered to calmer depths when a storm approaches.

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Jewels of the sea

The protected Pacific seas of Palawan in the Philippines are home to the world’s largest and rarest pearl-producing oyster, the Golden pearl or Gold-lipped oyster. As its name suggests, this mollusc produces a golden-hued pearl that is today one of the most coveted in the world.

While considered giants of the oyster family — they can grow up to 30 cm (12 in) in diameter — Gold-lipped oysters are notoriously sensitive in nature. Coaxing the perfect pearl from them is a highly invovled and carefully managed process aimed at managing the many variables that can affect the oyster, and therefore the pearl within.

Pearls are formed when a tiny foreign particle finds its way into the living tissues of an oyster. The animal protects itself by coating the particle with layer upon layer of nacre — a type of calcium carbonate that is the same light-reflecting substance that determines the color inside an oyster’s shell.

Pearl farming aims to exploit the natural process of creating a pearl, but even with careful management perfection is not guaranteed.
Preserving the Pacific – Gold-lipped oyster

The first golden pearls produced in Palawan were cultured from some of the last remaining wild oysters. Now the Jewelmer farm at Palawan supports the species’ survival. After producing several pearls, the oysters from this farm are carefully returned to the ocean to spend the rest of their lives spawning naturally, helping to repopulate the Pacific Ocean with its golden treasure.

Each oyster is monitored daily for signs of stress, while the surrounding water quality is tested for pollution.

Once only naturally occurring, wild pearls are now almost impossible to find, and every slight change in the ocean – temperature or nutrient level, for example – affects the quality of the pearls they produce. Pearl farming now aims to exploit the natural process while controlling some of those variables to meet the world’s voracious appetite for pearls from the deep.

Cultured pearls are rounder and smoother than wild pearls, but there is never any guarantee of perfection, despite a rigorous five-year process. First, the farmers hand-raise gold-lipped oyster babies – called ‘spats’ – for about two years, until they reach pearl-bearing size. With great precision, a miniscule piece of oyster shell is then delicately grafted inside the body of the oyster. The particle will form the nucleus of what will grow to be the world’s only living gem.

Environmental conditions must be perfect for this alchemy to take place. The water temperature cannot fall below 29.5° Celsius (85° Fahrenheit) or the oyster will die. The water must be rich in dissolved oxygen and receive the right amount of sunlight to ensure sufficient plankton is present for the mollusc to eat. The current must be strong enough to deliver this to the oysters, but not so strong that they become stressed. The water must also be free of contaminants that can find their way into the oyster and affect the quality of its pearl.

The oysters – along with their potential pearls – are then placed in trays in the ocean, where they are nurtured for an additional three years. Each oyster is monitored daily for signs of stress, while the surrounding water quality is tested for pollution. Predatory fish are chased away and the exterior shells of the oysters are meticulously cleaned of parasites and algae. All this time – five years – the developing pearl is invisible to its caretakers.

Finally, it is harvest time, when specially trained technicians patiently remove the new pearls, taking care not to harm the oysters. The pearls are then sorted, graded, and those rated close to perfect find their way to the highest-end markets.
Paternal passion

In the temperate coastal waters of New Zealand, the largest seahorse in the world, the Pot-bellied seahorse, brings a whole new dimension to the concept of fatherhood.

These creatures, which have long charmed us with their prehensile tails and equine demeanour, live amongst seaweed and rocky reefs in intertidal and coastal waters. Here they feed on tiny crustaceans such as shrimp, which they vacuum up from the water with their distinctive snouts.

Pot-bellied seahorses engage in a ritualized courtship ‘dance’ that can last up to 20 minutes. To start, the male brightens his distended stomach pouch to a bright yellow hue and inflates and deflates it repeatedly. He then approaches his intended, head tucked down and tiny fins fluttering.

Signaling her interest, the female rapidly enlivens her own usually discreet colors. Then, tails intertwined, the pair embark on an underwater ‘pas de deux’, pirouetting and mirroring each other. At some point, when they are belly-to-belly, the female squirts her eggs into the opening of the male’s expanded pouch. Joined for but a brief moment, the pair then untangle and separate.

Once ‘pregnant’, the male’s color dulls. The baby seahorses remain in his pouch after hatching to be safely incubated for around 30 days, depending on the water temperature. He then releases his brood before dawn, when up to 400 seahorse ‘fry’ float away on the tide.