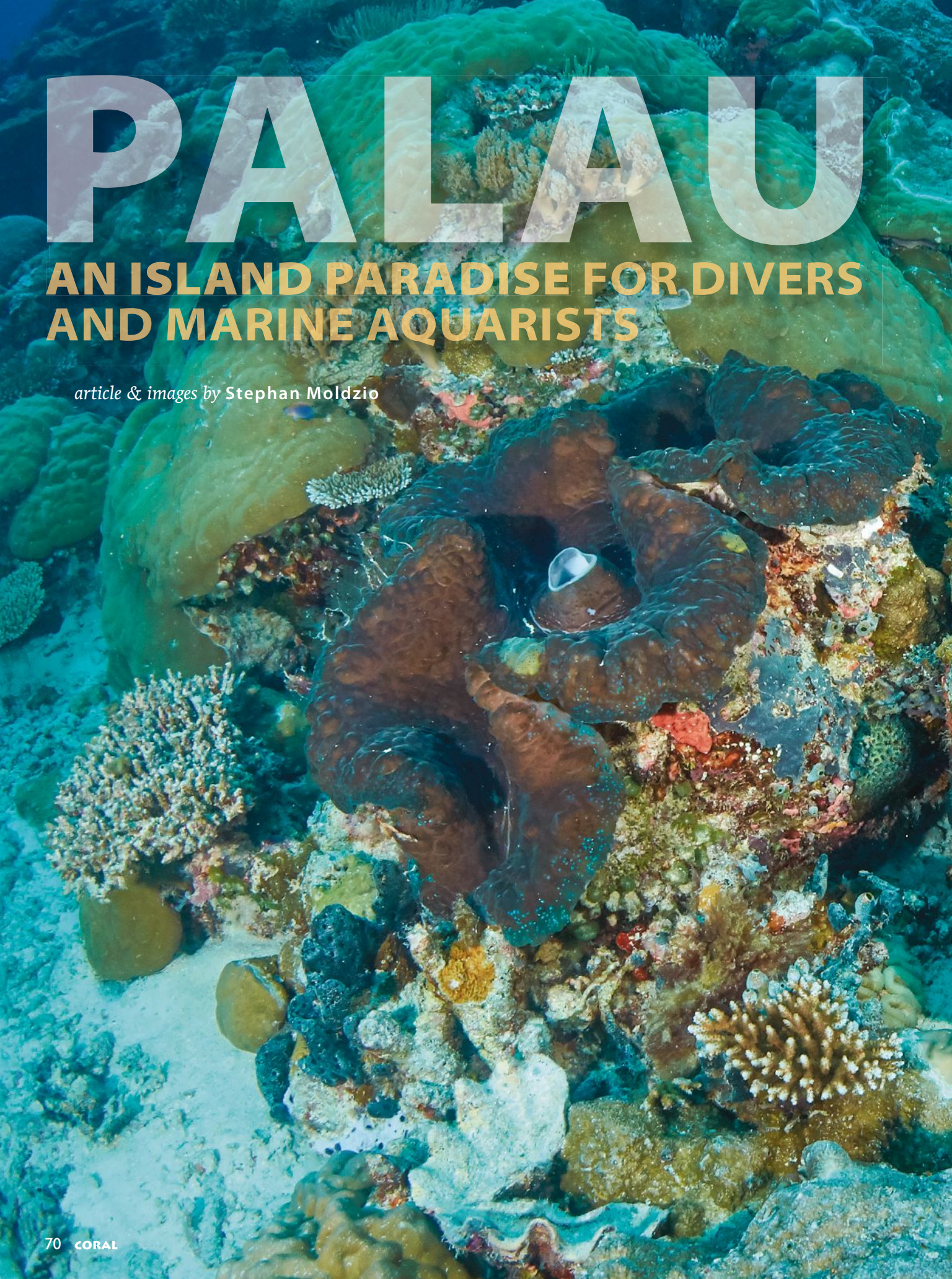


PALAU

AN ISLAND PARADISE FOR DIVERS AND MARINE AQUARISTS

article & images by **Stephan Moldzio**

The South Seas state of Palau, whose immigration cards welcome travelers to "the End of the Rainbow," lies in the Pacific Island region of Micronesia and was originally a submerged chain of coral reefs that was long ago lifted above sea level by continental drift. Beneath the water's surface today there is enormous marine biodiversity, and the reef aquarist will encounter a wealth of creatures familiar from the home aquarium in their natural habitat.

These two Giant Clams (*Tridacna gigas*) reminded me of an old married couple.

Swimming through hundreds of Bigeye Trevallies (*Caranx sexfasciatus*)—an unforgettable experience!

The island realm of Palau lies around 500 miles (800 km) east of the main Philippines island of Mindanao in the Western Pacific. The pulsating, almost overflowing wealth of life, the breathtaking profusion of marine species in a wide variety of habitats in a small space, and an ambitious national policy of environmental protection have made Palau famous worldwide.

Palau's allure is often represented in aerial travelogue photographs of the Rock Islands, which rise out of the water like green mushroom caps in the southern part of the Palau lagoon. They are fossil reefs that rose out of the water 650 feet (200 meters) by the forces of plate tectonics some 25 million years ago. The majority of these islands are strictly protected and have been declared a UNESCO World Nature Heritage Site.

Palau is a special place that makes the hearts of marine enthusiasts beat faster; 60 percent of the tourists drawn here come for the diving and reef exploration.

A HUGE LAGOON AND A MIGHTY BARRIER REEF

Geographically, Palau belongs to the area of islands known as Micronesia, but it has been a politically independent country since 1994. The densely forested main island of Babeldaob, roughly central in the east, makes up the largest part of the land area. The rest is divided among 356 islands, only eleven of which are inhabited. The population is concentrated mainly in the former capital, Koror, which is a lively city—a melting pot of cultures, influenced by Micronesian, Western, and Southeast Asian influences.

The climate is humid and tropical, with an annual precipitation of almost five feet (1,450 mm) and water temperatures between 80–86°F (27–30 °C). It rains frequently, but not always heavily. The Palau islands and a huge lagoon are bounded by a mighty barrier reef. During the last ice age, when sea level was about 400 feet (120 meters) lower than today, the entire lagoon was a flat, wooded island. This was flooded as sea level rose, with areas of mangroves and expanses of sea grass developing in the shallow water. A further rise in sea level finally gave rise to the lagoon habitats that exist today.

The marine lakes, which are separated from the sea but connected to it via tunnels in the porous limestone, are another special feature of Palau. The only lake of this kind accessible to tourists, Ongeim'l Tketau, is also called Jellyfish Lake, on account of its Golden Jellyfishes (*Mastigias* cf. *papua etpisoni*). As a result of millennia of

A pair of Raccoon Butterflyfishes (*Chaetodon lunula*) with an azooxanthellate gorgonian.

isolation, these jellyfishes, which occur here in large numbers, have evolved into a new subspecies that has lost its stinging venom, while their common ancestors still live in the lagoon. Four additional subspecies live in other marine lakes, but these are not accessible to tourists.

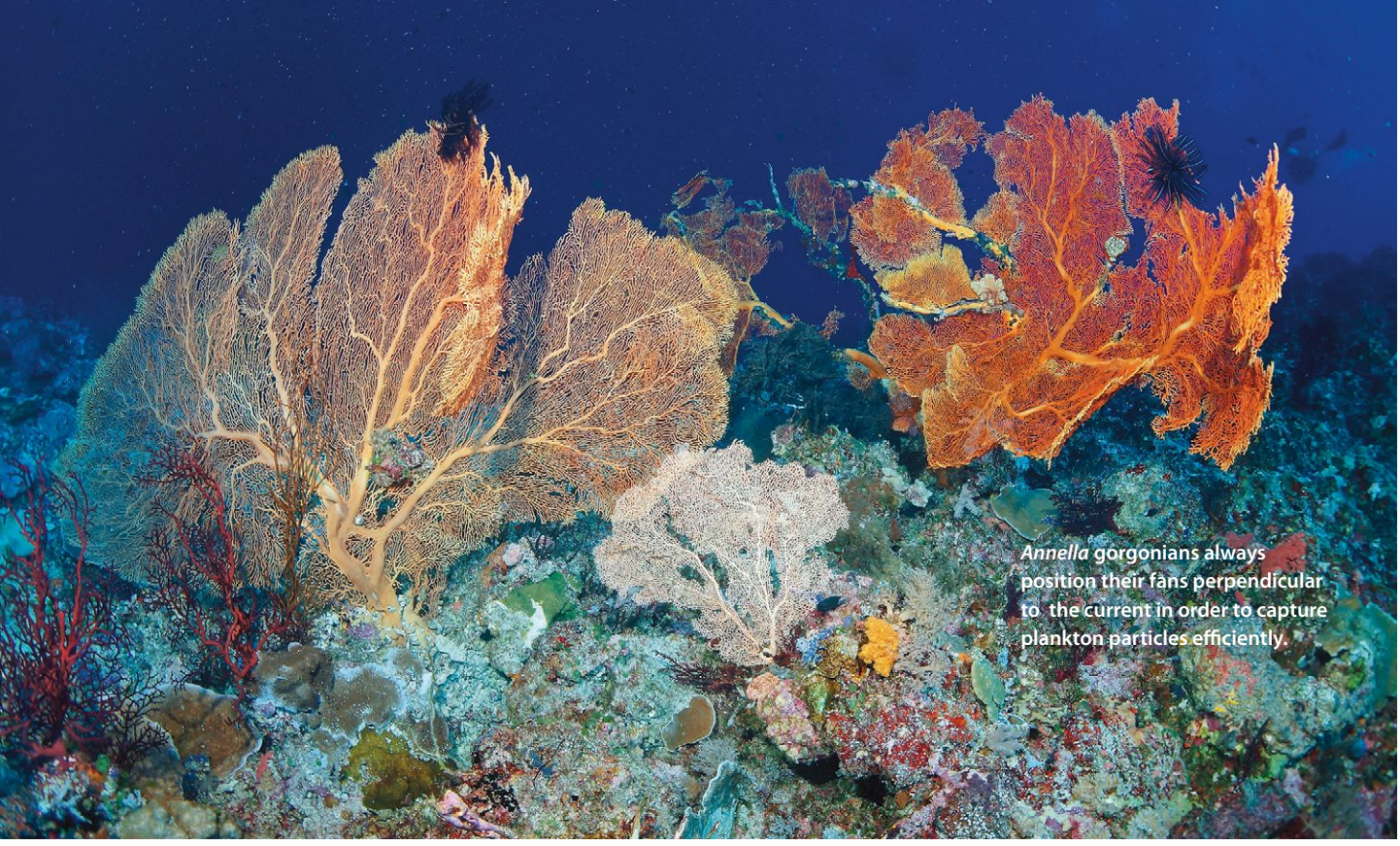
IMMENSE BIODIVERSITY IN A SMALL SPACE

Palau has an extraordinarily high biodiversity relative to its small land area. The main reasons for this are the large number of different habitats in a small space and the close interweaving of their communities: there are oceanic sea mounts, the barrier reef and the outer and inner fringing reefs over the channels, spot reefs and bottoms of sediment in the lagoon, sea grass meadows and mangroves, and the basins and marine lakes, more or less isolated from the sea, in the Rock Islands—all in close proximity, all connected with one another. Palau also has a longer-than-average and richly structured coastline because of its large number of small islands.

To the west of Palau lies the Philippines and to the south is Indonesia, both of which are part of the much-cited Coral Triangle, the marine area with the highest biodiversity in shallow water. Palau's reefs are also supplied with larvae from there by the currents. It has been proven for the majority of marine animal groups that the number of genera and species decreases with increasing distance from the Coral Triangle.

If we consider the islands of Micronesia from west to east, this can be impressively demonstrated by the example of reef-fish species: Fishbase.org lists a total of 1,336 reef-bound fish species for Palau, among them, of course, many species that we keep in our domestic marine aquariums. There are 1,069 species in the vast area of the Federated States of Micronesia, 869 in the Marshall Islands, and only 455 in Kiribati in the Central Pacific.

Stony corals are represented here by more than 400 species in 78 genera, and soft and horn corals by more than 200 species in 76 genera. The very popular genus *Sinularia* alone is represented by almost 40 species! The



Annella gorgonians always position their fans perpendicular to the current in order to capture plankton particles efficiently.

number of marine species in Palau is lower overall in comparison to the Philippines, but we must take the much larger area of the Philippines into account.

BLUE CORNER: CURRENT SYSTEMS AND A WEALTH OF FISHES

Palau is influenced by various current systems. The North Pacific Equatorial Current travels from east to west. There are also the Equatorial Countercurrent and some large-scale eddy currents, whose influence varies depending on the season. Every marine aquarist who has stuck his nose underwater at various places as a diver or snorkeler knows that the wealth of fishes must be connected with the currents.

We were on board a boat, on our way to the world-famous "Blue Corner" site on the outer barrier reef. The zigzag course took us past the fabulously beautiful Rock Islands; salty foam sprayed our faces and everyone was silent, taking it all in. The fantasy world of the movie *Avatar* came to mind when I looked at the little islands, undercut and partially hollowed out by the water. How often has science fiction been inspired by ocean worlds and their bizarre inhabitants? I was eager to get into the water. With a backward roll from the edge of the boat, I let myself fall head-first into the sea and sink slowly, surrounded by fishes and rising air bubbles. When I was finally attached to the reef edge with the "reef hook" and able to relax, observing this incredible natural spectacle of fishes of every family, the influence of the current was evident, right before my eyes: it was bringing a continuous stream of plankton. This meant that the food source for all the fishes and established sessile invertebrates drifted past their mouths or feeding tentacles. Plankton includes all living things—animals and plants of all sizes—that can only float passively in the water or cannot move against the marine currents.

Hardly anywhere else in the sea is obtaining food as easy as in the plankton-rich marine currents there, and the constant availability of food shows how hard it is to mimic natural conditions for our aquarium residents that are dependent on plankton.

Vast shoals of Big-Eye Trevallies (*Caranx sexfasciatus*) created huge curtains of innumerable fish bodies, mixed with several Big-Nose Unicornfishes (*Naso vlamingii*), various snappers (Lutjanidae), marine chubs (*Kyphosus* spp.), and emperorfishes (*Lethrinus* spp.). They hung effortlessly in the water and chased after small prey organisms.

The top predators, such as Blacktip and Whitetip Reef Sharks (*Carcharhinus melanopterus* and *Triaenodon obesus*), which target these fishes, were numerous. They swam around idly or allowed parasites to be picked from their gills at the cleaning stations of wrasses (*Labroides* spp.). Their time would come after the sun went down. This really was high drama; no wonder, I thought, that Blue Corner is one of the best dive sites in the world.

In the final analysis, however, the currents not only provide food for the fishes, but also supply plankton, and all the rest of the reef community, with nutrients. Innumerable different current patterns develop between the islands, as turbulences or laminar currents along the sediment bottom. Coupled with the other environmental factors, this results in a virtually infinite network of different living conditions, which are habitats for countless species.

Here the marine aquarist receives a vivid impression of how important water movement is for corals in reef tanks, and not just for supplying food and nutrients. Currents also affect their habit of growth and are indispensable for the exchange of substances with the environment—for excretion and respiration.

PALAU'S BARRIER REEF

Sea fans of the genus *Annella*, which can reach a height of around 10 feet (3 m), are typical of the current-rich outer slopes of the barrier reef. Here they are positioned perpendicular to the main current in order to filter zooplankton out of the water. Beautiful spreading *Siphonogorgia*, *Subergorgia*, and *Ellisella* corals line the steeply sloping reef walls. Unfortunately, all these colorful corals have so far failed to survive, let alone multiply, in the aquarium. Why is that? The same was thought about stony corals 30 years ago, and only time will tell how far the hobby can progress. One reason is undoubtedly the lack of a continuous food supply, but another is probably the fact that in our aquariums they don't receive the types and strengths of currents they require.

"Shark City" juts out like a hook from the barrier reef into the open ocean. Here, every month, around the time of the full moon, mass spawning by the Twospot Snappers (*Lutjanus bohar*) takes place. This provides the opportunity for an unforgettable experience. If you set off in the morning before sunrise, you can arrive as the fishes assemble in the gray light of dawn. Thousands of these large fishes create the impression of a huge cloud, from which smaller groups regularly ascend in spherical formation to entrust their eggs and sperm to the ocean, while in the deeper waters Bull Sharks (*Carcharhinus leucas*) patrol and wait for a careless fish. I witnessed this and felt like I was watching a BBC documentary—not only 3D, but live! After only a few minutes the spectacle was over, and the countless fishes spread out over the reef again.

The nearby Ulong Channel, a "blind alley" in the barrier reef with magnificent coral growth, awaited us. The walls were densely covered with stony corals of various habits of growth, with colorful gorgonians in between, despite the shallow depth. A pair of Raccoon Butterflyfishes (*Chaetodon lunula*) hovered close together in front of an *Euplexaura* sea fan.

Wherever large specimens of the azooxanthellate stony coral *Tubastraea micranthus* are encountered in the shallow water, you can assume constant strong currents. A splendid Saddle Grouper (*Plectropomus laevis*), with its large subterminal mouth, confidently crossed our path; this was its territory. Then, at the end—an absolute highlight of this dive—we glimpsed two adult Giant Clams (*Tridacna gigas*), both measuring more than

Travel tips

GETTING THERE

Palau International Airport (ROR) is serviced by United, Korean, Asiana, and China Airlines. U.S. residents typically fly from California to Hawai'i to Palau, landing near Koror, a little town that offers a wide variety of places to stay, restaurants, museums, tourist sites, shopping, and spare-time activities.
Overview: www.palauvisitors.com
Dive travel: https://travel.padi.com/d/palau/

SIGHTSEEING FOR MARINE AQUARISTS:

BIOTA Marine Life Nursery
www.biotapalau.com
Coral Reef Research Foundation
www.coralreefpalau.org
Palau International Coral Reef Center
www.picrc.org
Belau National Museum
www.belaunationalmuseum.net
Etpison Museum
www.eptisonmuseum.org

a meter in shell length, and close together like an old married couple.

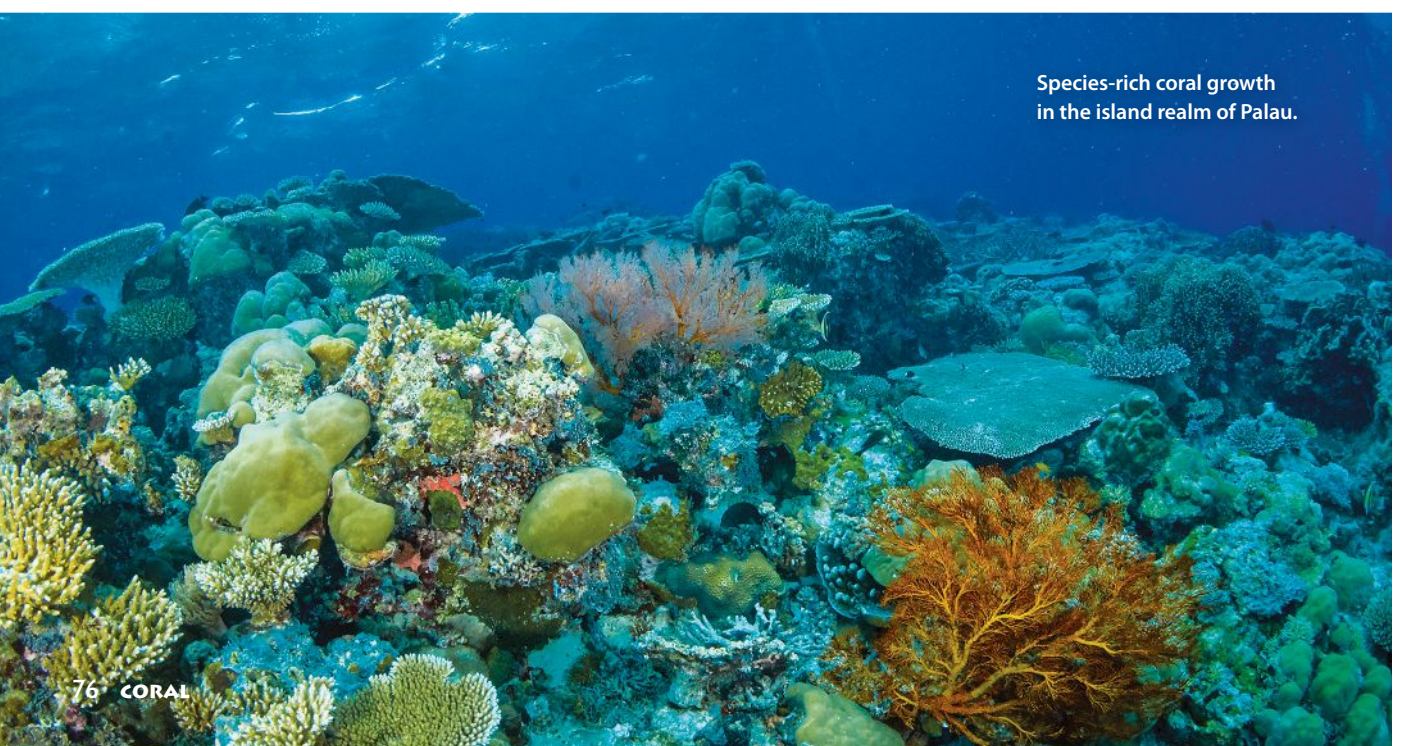
In all these places there is a moderate to strong movement of water associated with the changing tides, but the maximum current can be found at the Peleliu Express at the southern tip of Palau. We began our dive at the Yellow Wall, which got its name from its dense growth of azooxanthellate *Scleronephthya* soft corals. A Slender Grouper (*Anyperodon leucogrammicus*) and a Whitespotted Grouper (*Epinephelus caeruleopunctatus*) shared a cave in the steep wall; they were resting, waiting for nightfall. Two Blueface Tilefishes (*Hoplolatilus starcki*), a species known for frequenting steep walls, were a rare sighting.

The speed at which we were drifting along the outer reef increased as the Express began. We flew over the outermost reef projection of Palau, past a shoal of Red-Toothed Triggerfishes (*Odonus niger*). Around us there were shoals of fusiliers (*Caesio* spp.) and a number of requiem sharks (*Carcharhinus* spp.). I was filled with adrenaline. Like helpless plankton, we floated past a large Humphead Wrasse (*Cheilinus undulatus*) and a genuine Hawksbill Turtle (*Eretmochelys imbricata*). The flat bottom, at 66 feet (20 m) deep, had hardly any corals; it resembled an airstrip. I tried to imagine what enormous physical forces probably roll through here, at the most exposed tip of Palau, during a storm.

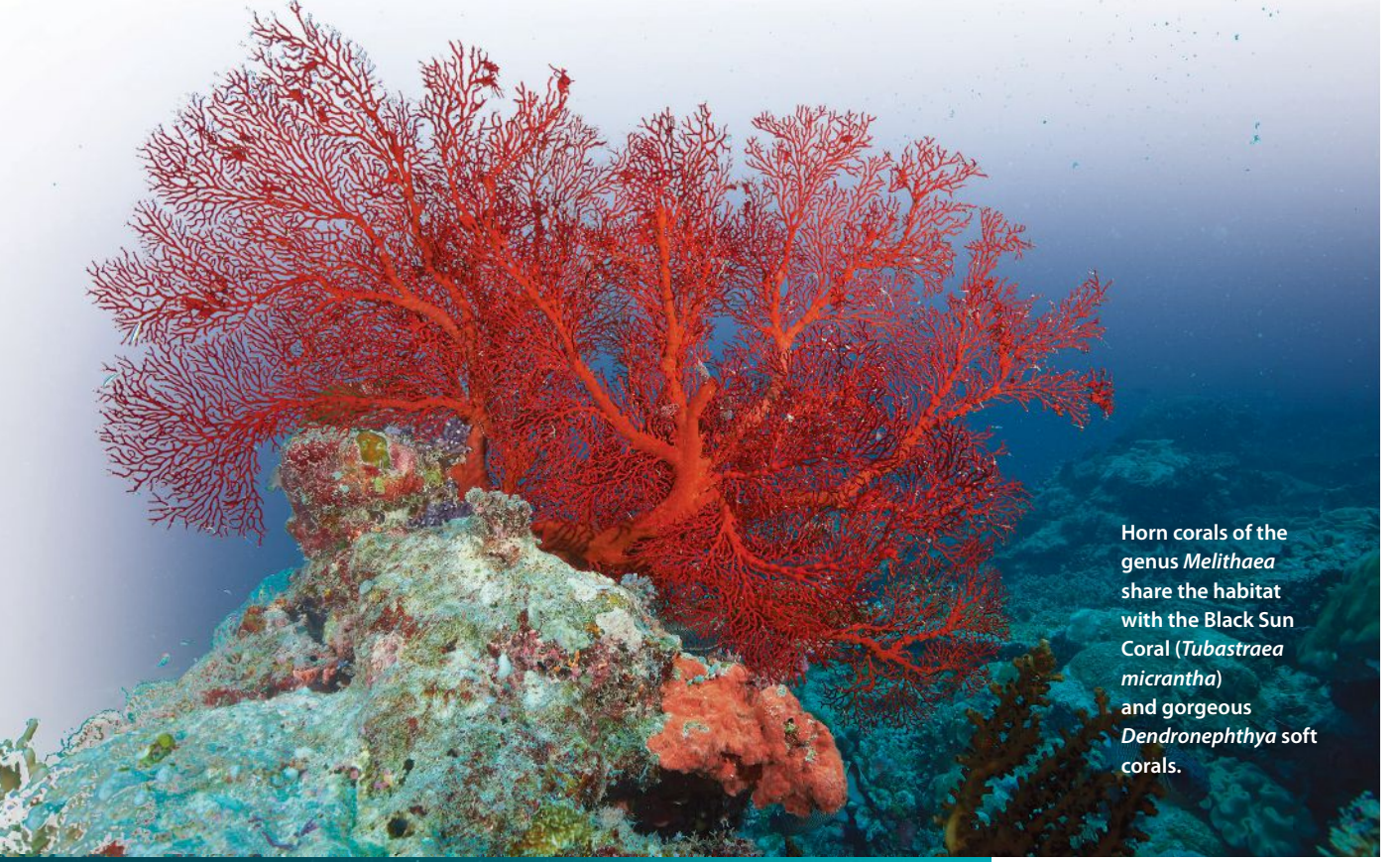
DEEPER SCREES AND WRECKS

The scree bottom in the lagoon, from about 80 feet (25 m) of depth downward, which is covered with loose coral boulders and skeletons, held more surprises for us. It is still little researched, much less than the communities of the reef. Here you will encounter unusual species that don't normally occur on the reef slopes; where they do occur, they do so *en masse*—whole forests or meadows of a single coral genus or even species. Imagine a 5,300-gallon (20,000-L) aquarium with just one species of coral!

The rate of water exchange in the lagoon is high. The ocean water, which flows rapidly over the sediment bottom in many places, will likely remain there for days rather than weeks, except in strictly demarcated areas. At the same time, mangrove and sea grass leaves are broken down in the lagoon, making a high level of plankton possible there. In other words, these are ideal conditions for filter feeders, all kinds of digging invertebrates, and a virtually unlimited wealth of fishes. The powerful laminar



Species-rich coral growth in the island realm of Palau.



Horn corals of the genus *Melithaea* share the habitat with the Black Sun Coral (*Tubastraea micrantha*) and gorgeous *Dendronephthya* soft corals.

A large expanse of slender-branched *Anacropora* stony corals.

flow over the extensive sediment bottom also washes away suspended particles that complete the constant supply of food for unusual stony corals, azooxanthellate horn and soft corals, sea feathers, sponges, brittle stars, bivalves, and every other sort of filter feeder possible.

It was virtually impossible to swim against such a current, so I looked for "wind shadows" behind coral blocks, tried to cling to a protruding piece of reef rock here and there, and eventually let myself drift with the current, floating past expanses of Black Sun Coral (*Tubastraea micrantha*), sea whips (*Junceella*), and the gorgeous soft and horn corals of the genera *Dendronephthya*, *Melithaea*, *Solenocaulon*, and others.

Suddenly, something large appeared to one side of our trajectory. We tried to swim sideways towards it, as we didn't want to miss it. It was well worth a visit: the *Iro Maru*, a Japanese freighter, one of the many wrecks that were sunk in 1944 during the bitter naval war between Japan and the U.S. It now lay motionless and densely overgrown on the sea bottom. A *Physogyra lichtensteini*, its polyps withdrawn during the day, was growing on the deck next to a *Lobophyllia*; these are two species that I recently fragmented to propagate after several years in the growth phase.

Spreading *Acropora* table corals were thriving there despite the depth and the murky water. Finely-branched black corals (*Antipathes* sp.) were growing on the middle of the railing—a somewhat spooky sight. In some places the wreck was almost completely overgrown with honeycomb oysters (*Hyotissa* sp.), grinning cheekily in

all directions. To my delight, I saw a large expanse of Cactus Coral (*Pavona cactus*), a species that belongs in every reef tank—it has an interesting leaf-shaped construction, which creates hiding places for innumerable small organisms. It's exceptionally robust, requires little light, and can readily be sited in the shadier areas of a crowded tank.

Next door appeared to be the realm of the mushroom corals (Fungiidae). In one spot I saw members of five different genera: in addition to the common *Fungia*, *Ctenactis*, and *Herpolitha*, a Plate Coral (*Heliofungia actiniformis*) extended its tentacles into the water. All these species are regularly imported for the aquarium hobby, although *Fungia* can be propagated in the aquarium. But the fifth coral was unusual, and I was seeing it for the first time. Later, when I looked at the photos, it turned out to be *Zoopilus echinatus*, the largest of all the mushroom corals.

CHANDELIER CAVE

Chandelier Cave near Koror is an underwater cave created in the soft limestone with a series of five chambers, the fifth of them above water. I encountered the first highlight right in front of the entrance: an area of the thin-branched, fragile *Anacropora* that I had never before encountered on a normal reef. I asked myself what conditions might be critical for this.

At the entrance to the cave there was very fine, chalky mud, in addition to mangrove leaves in various stages of decomposition. I found more mud in the cave itself, which was created by rainwater eroding the limestone over many thousands of years. At the sight of the lime mud, I thought of my kalk reactor filled with coral rubble, where limestone is dissolved by CO_2. Perhaps the protected, reduced-current environment and muddy bottom created ideal conditions for *Anacropora*, giving them an advantage over other corals.

The next surprise came in the interior of the cave: on the walls, I discovered extremely slow-growing calcareous sponges (*Acanthochaetedes wellsi*), which can be several hundred or even thousands of years old. They are living fossils and until a few decades ago were known only from the fossil record. In the last underwater chamber, we turned off the light for the return journey and swam towards the shimmering soft blue of the exit. What a magical experience!

CONSERVATION, THE WAY IT SHOULD BE

The protection of the environment and its natural resources has long been of pivotal importance to the population of Palau—for these people this means nothing less than their livelihood. A long time ago, catch limits were declared for certain key species or on certain reefs in order to guarantee the long-term food security of

the population. Even before the founding of the state of Palau, the individual constituent states had set up protected areas, which were combined into a continuous network in 2003. Next came protective measures for sharks and marine mammals, as well as a ban on trawling.

Finally, in 2015, 80% of the national territory, mainly open ocean, became fully protected by law, which means that any kind of fishing is prohibited in that area. Only a few areas southwest of Koror are open to tourists, who must pay a nature conservation charge. But even this small selection covers a whole range of different habitats, so that visitors leave after a week or two filled with enthusiasm.

The rise in sea level is noticeable on Palau: in the last four decades, spring tides have risen by around 12 inches (30 cm), causing the salinification of formerly fertile soil and ground water. It isn't surprising, then, that Palau, together with other Pacific countries, is a leader in climate, environmental, and marine protection. It was the second country in the world to ratify the Paris Agreement.

WORTH SEEING

In addition to the fascinating underwater world, there are numerous attractions to visit on Palau, and many opportunities for activities on land. A good insight into Micronesian culture and the interesting history of Palau can be found in the Belau National Museum and the Etpison Museum. There are marine biological research centers in Koror; I recommend the Coral Reef Research Foundation (CRRF) and the Palau International Coral Reef Center (PICRC). The Palau Aquarium is connected to the latter, and you can get an insight into the underwater world there without getting your feet wet.

A visit to the BIOTA breeding farm is a must for marine aquarists traveling to Palau. Here, various reef fishes, giant clams, and corals are bred and grown in large tanks, from the larval stage to export size. The new visitor center was completed in 2018, and it provides information on breeding activities using multimedia and information boards. The desire for more sustainability in the marine aquarium hobby is the thread that runs through all the farm activities, as reported in my interview with marine biologist and BIOTA founder Tom Bowling in *CORAL* Magazine, September/October 2019, pages 66–70.

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