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Ecologically or Biologically Significant Marine Areas (EBSAs)

Special places in the world's oceans

WIDER CARIBBEAN AND WESTERN MID-ATLANTIC

Areas described as meeting the EBSA criteria at the CBD Wider Caribbean and Western Mid-Atlantic Regional Workshop in Recife, Brazil, 28 February to 2 March 2012

UNEP

Convention on Biological Diversity

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Photo courtesy of Projeto Tamar Image Bank

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Octopus Insularis in den. Photo courtesy of Tatiana Leite

Orange icing sponge, Jamaica. Photo courtesy of Ken Marks/Living Oceans Foundation

Areas described as meeting the EBSA criteria*

*Please note that for technical reasons, there is no area no. 7.

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FOREWORD

Activities related to ecologically or biologically significant marine areas (or EBSAs) have been an important part of the CBD's programme of work on marine and coastal biodiversity since 2008. This work has significantly contributed to global, regional and national efforts to expand scientific knowledge on marine biodiversity and improve conservation and sustainable use in support of the achievement of the Aichi Biodiversity Targets in marine and coastal areas.

The CBD's work on EBSAs began with the development of the EBSA criteria, which were adopted in 2008 at the ninth meeting of the Conference of the Parties (COP) to the CBD. At this meeting, the COP urged Parties, and invited other Governments and relevant organizations to apply, as appropriate, the EBSA criteria to identify ecologically or biologically significant marine areas, with a view to assist the relevant processes within the United Nations General Assembly and further enhance conservation and management measures, in accordance with international law, including the United Nations Convention on the Law of the Sea.

At its tenth meeting, in 2010, COP requested the CBD Secretariat to convene a series of regional workshops to facilitate the description of EBSAs. Since then, the CBD Secretariat has embarked on a remarkable collaborative effort, working with many global, regional and national partners around the world, to describe areas meeting the CBD's scientific criteria for EBSAs (decision XI/20, annex 1) through a series of regional EBSA workshops that started in the Western South Pacific region in November 2011.

The regional EBSA workshop process has facilitated the sharing of scientific information and the networking of experts across disciplines at the regional scale, and has enhanced collaboration between various initiatives for marine conservation and sustainable use by providing a global platform for scientific assessment of the ecological or biological significance of marine areas.

The reports of the regional EBSA workshops are the product of expert scientific discussions, and therefore, often contain very detailed and technical descriptions of various features of the marine ecosystems and species. This booklet, which was produced with the kind support of the Government of

Germany, is part of a series of booklets that aims to present the information compiled at each regional EBSA workshop in a concise,engaging and easily understandable way. The purpose of this publication is to expand the recognition and understanding of these important marine areas across a broad range of stakeholders and the general public.

I encourage you to read this booklet and gain a greater appreciation of the breadth, depth and complexity of the unique features of the marine environment and their important role in a healthy functioning planet.

Braulio Ferreira de Souza Dias
Executive Secretary, Convention on Biological Diversity

Wrasse and fire coral, Turneffe Atoll, Belize. Photo courtesy of WWF

EBSAs: AN INTRODUCTION

The ocean encompasses 71 per cent of the planet's surface and a large portion of its habitable space. Whereas life on land is almost exclusively contained within a thin strip of breathable atmosphere overhead, in the ocean it is found from the waves that wash against the shore to the deepest canyons that plunge thousands of metres beneath the sea floor.

Life is found throughout the ocean, from coastal zones to the open sea, from coral reefs to kelp beds, in forms as varied as algae that cling to the underside of polar ice floes, humpback whales that migrate from the Antarctic to the equator and back, and multitudes of marine viruses that, if laid end to end, would span farther than the nearest 60 galaxies.[1]

But the distribution of life in the ocean is varied. Whether caressed by currents, sheltered by the shore, nurtured by nutrients, or heated by hydrothermal vents on the sea floor, some areas boast life that is more plentiful, diverse or unique than others. For example, scientists with the Census of Marine Life found that white sharks congregate in an area off Hawaii that they dubbed the "white shark café", and that several species of whales, turtles, seabirds, seals and sharks all congregate at "hotspots", such as the California Current.

The top 100 metres (m) of the open ocean hosts the great majority of the sea life with which we are more familiar—turtles, fish and marine mammals—as well as the microscopic plankton that form an integral part of the ocean food web and provide so much of the oxygen that we breathe. Far below the surface, in the dark depths, seamounts—underwater mountains that rise 1,000 m or more from the ocean floor—provide habitat for rich and diverse communities. Hydrothermal vents and cold-water seeps form the basis of unique ecosystems and species that might seem to belong more comfortably in a science fiction movie than the real world.

Yet, much of this unique and special biodiversity is facing major threats related to such factors as habitat destruction, overfishing, pollution and climate change. The global community has recognized the need to address these threats and to take measures to support the health and well-being of marine and coastal biodiversity.

In 2010, at its tenth meeting, the Conference of Parties to the Convention on Biological Diversity (CBD) adopted a new 10-year Strategic Plan for Biodiversity, including 20 "Aichi Biodiversity Targets". A number of these targets focus specifically on marine and coastal biodiversity, including targets to achieve sustainable fisheries and protect at least 10 per cent of the world's marine and coastal areas by 2020.[2]

Diploria coral. Photo courtesy of Elizabeth Galeano

But in order to protect and preserve marine biodiversity effectively, we need to know where to focus and prioritize conservation and management. We must have a good understanding of the many different types of marine ecosystems in different regions, including which areas are the richest in life, which boast the greatest diversity and abundance of species, and which possess the rarest species and the most unique communities of marine flora and fauna.

It is in this respect that the CBD's work on ecologically or biologically significant marine areas (EBSAs) plays a key role. In 2008, the Parties to the CBD adopted a set of seven scientific criteria to be used in identifying EBSAs. The EBSA criteria are as follows:

1	Uniqueness or rarity
2	Special importance for life history stages of species
3	Importance for threatened, endangered or declining species and/or habitats
4	Vulnerability, fragility, sensitivity, or slow recovery
5	Biological productivity
6	Biological diversity
7	Naturalness

These criteria provide guidance on the key types of features to be considered when identifying areas that are critically important to the functioning of marine ecosystems.

In 2010, the Parties to the CBD requested the CBD Secretariat to collaborate with Parties, other Governments and a range of partners in different regions in convening regional workshops to facilitate the description of EBSAs using the EBSA criteria. Through an inclusive and science-driven process involving experts from all over the world and an enormous amount of scientific data, these regional EBSA workshops have described the areas of the oceans that are the most crucial to the healthy functioning of the global marine ecosystem.

EBSAs can be as varied as the life within them. They can address large ocean areas or individual features. They can be static or move with seasonal variations in certain oceanographic features. But they all, in one way or another, have been described as important in the context of one or more of the seven EBSA criteria.

Furthermore, there are many different types of measures that can be used in regard to the EBSAs, and include, but are not limited to, marine protected areas and other area-based management tools, impact assessments and fisheries management measures.

The description of an area as meeting the EBSA criteria is a scientific exercise aimed at supporting the prioritization of management efforts of governments and relevant authorities. It does not necessarily mean that new management measures will be put in place, and it does not prescribe what types of management measures should be used.

These booklets, one of which is being produced for each region in which an EBSA workshop has taken place, provide snapshot summaries of the pages upon pages of data compiled by participating experts, to provide a detailed guide to some of the most biologically or ecologically significant ocean areas in the world.

This booklet, the second in the series (see also Volume 1: Western South Pacific), provides summaries of the areas described during the Wider Caribbean and Western Mid-Atlantic Regional Workshop to Facilitate the Description of Ecologically or Biologically Significant Marine Areas, in Recife, Brazil, from 28 February to 2 March 2012. The workshop was organized in collaboration with the United Nations Environment Programme – Caribbean Environment Programme (UNEP-CEP) and hosted by the Government of Brazil, with the financial support of the European Commission, the Government of Japan, through the Japan Biodiversity Fund, and the Government of Brazil. Scientific and technical support was provided by a team from the Marine Geospatial Ecology Lab of Duke University. To find out more about this and other EBSA workshops, see www.cbd.int/ebsa. The full report of this workshop is available at www.cbd.int/wsp-ebsa-report

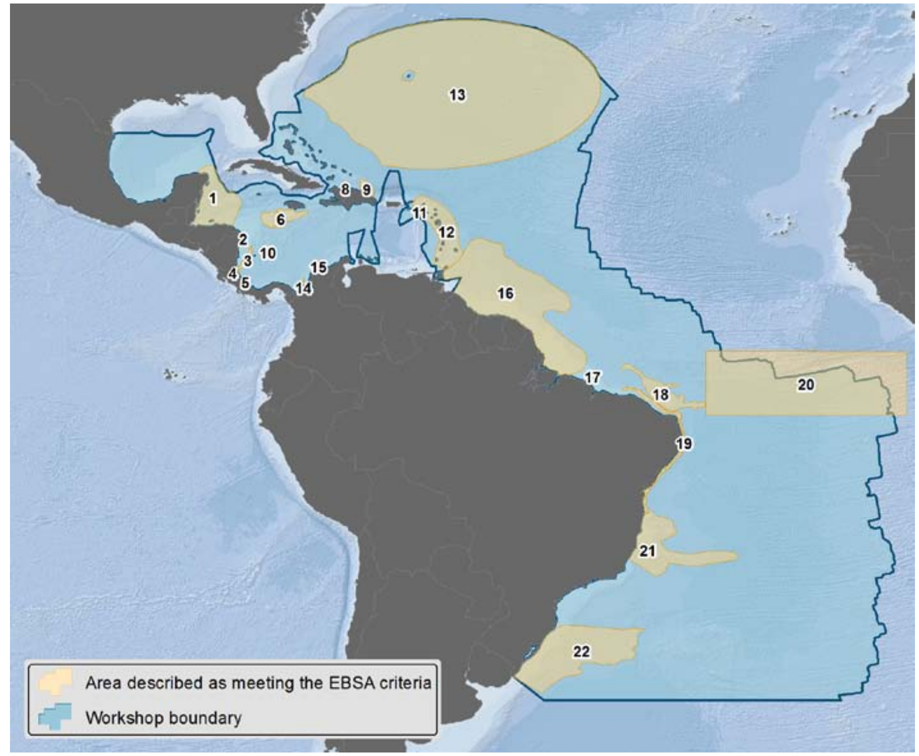
Opposite page: Green turtle hatchling, Fernando de Noronha, Brazil.
Photo courtesy of Projeto Tamar Image Bank

THE WIDER CARIBBEAN AND WESTERN MID-ATLANTIC REGION

Relative to some ocean regions, the waters of the Wider Caribbean and Western Mid-Atlantic are among the world's most extensively explored, well-studied, densely populated and heavily trafficked. Nevertheless, along much of its coastline, there are still areas of surprising remoteness and richness. Off the coast of Nicaragua, for example, the Miskito Cays remain largely unvisited by all but the hardiest souls.

The largest barrier reef in the western hemisphere is found here, stretching 1,000 km north to south, and lying within a slightly larger area that has been identified as one of the world's hotspots for marine biodiversity[2]. Coastal waters in much of the wider Caribbean and western mid-Atlantic are influenced by output from some of the largest rivers in the world, including the mighty Amazon, from which nutrients and fresh water erupt at a prodigious rate and across an area of around 2 million km^2. A beach in Costa Rica, Tortuguero, long a secret to western scientists, has for the last 50 years helped cast light on the ecology and behaviour of sea turtles. After hatching and heading out to sea, many of those sea turtles spend their formative years in the comparative safety of *Sargassum* mats in a sea named after the vast expanses of seaweed that are its defining ecological feature, and which is an area of rich life and profound importance.

From coral reefs and mangroves to the deep-sea fracture that is evidence of the violent birth of the Atlantic Ocean, this is a region of variety and contrast, of importance not just for the species that live here but also for the many migrating through.



Marine Geospatial Ecology Lab, Duke University (2014)

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*Please note that for technical reasons, there is no area no. 7.

Coastal mangroves, Belize. Photo courtesy of Nadia Bood-WWF

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MESOAMERICAN BARRIER REEF

The Mesoamerican Reef covers over 1,000 km of the continental shelf from the northernmost part of the Yucatán peninsula in Mexico, through Belize and Guatemala, to the Bay Islands in Honduras. It is the Atlantic Ocean's largest coral reef and the second-largest barrier reef in the world. It is characterized by diverse reef types, including atolls, thousands of patch reefs, extensive seagrass beds and myriad associated ecosystems. The reef supports a high diversity of corals and fish, along with many threatened and endangered species, such as sea turtles, groupers and manatees.

Spanning over 1,000 km north to south along the coasts of four countries, the Mesoamerican Barrier Reef region was once the setting for "one of the greatest seafaring traditions of the ancient New World". Over the centuries before European contact, Maya traders plied the waters from Quintana Roo to the Gulf of Honduras, their massive dugout canoes filled with goods from across Mesoamerica.[3]

And while much has changed over the intervening 500 years or so, the region remains a spectacular mix of extensive coral reefs, mangrove forests, sandy beaches, seagrass beds, saltwater marshes, lagoons, cays and coastal ocean. It has been identified as one of the world's hotspots of marine endemism and biodiversity,[4] and includes habitats important for endangered and critically endangered species such as the Nassau and goliath grouper, largetooth and smalltooth sawfish, great and scalloped hammerhead shark, red porgy (common seabream) and social wrasse, four species of sea turtle, elkhorn and staghorn coral, a fire coral and two species of star coral.[5] This region hosts one of the Caribbean's largest population of the threatened Antillean manatee (in Chetumal Bay, Mexico) as well as the world's most impressive congregations of the massive whale shark, another threatened species.[6 7]

The Mesoamerican reef region comprises six distinct subregions, each with its own highlights, characteristics and qualities. The first, Mexico's northern Quintana Roo, encompasses the northeastern portion of the Yucatán peninsula from Ría Lagartos south to the Tulum coast, including four offshore islands. Beaches between Río Largartos and Isla Holbox are important nesting areas for the critically endangered hawksbill sea turtle[8], while Isla Cozumel is noted for those of the green and loggerhead. Many hundreds of newborn blacktip sharks roam the shallow waters of Laguna Yalahau during the early summer months, a primary nursery for this heavily fished species.[9] The offshore waters of the region are host to two globally significant aggregation sites for the world's largest fish, the whale shark, including by far the largest single gathering of this species – 420 animals – ever to be reported.[10]

Left: Elkhorn and brain corals, Hol Chan, Belize. Right: Nassua grouper on reef, Hol Chan, Belize. Photos courtesy of Nadia Bood-WWF

Moving south, the second sub-region runs along the Yucatán peninsula from Tulum in Mexico to the southern tip of Ambergris Cay in Belize and reveals magnificent white sandy beaches interspersed with coastal lagoons and an almost continuous fringing reef. Located here is Mexico's Sian Ka'an Biosphere Reserve, encompassing an assemblage of ecosystems including two broad shallow bays, coral reefs, fresh- and saltwater marshes, large swathes of dwarfed and fringing mangroves, seagrass beds, flooded savannahs and much more. Twelve species of waterbirds breed on the many islands dotting the bays[11], while in the surrounding waters can be found four species of breeding sea turtles, manatees, some 400 types of fishes and the largest numbers of spiny lobster in the region.[12] Farther south along the Mexican coast and bordering Belize lie the shallow waters of Chetumal Bay, likely one of the most important manatee mating and calving areas in the entire western Caribbean.[13]

The third sub-region extends from the southern end of Ambergris Cay to the Sapodilla Cays and includes the Belize Barrier Reef system, described by Charles Darwin in 1842 as "the most remarkable reef in the West Indies".[14] The impressive assemblage of reef types found here, including a 220 km barrier reef, numerous patch and fringing reefs, offshore atolls, faro formations and large mangrove islands, along with vast seagrass meadows, sand cays, lagoons and estuaries, all contribute to extraordinary biodiversity. In shallow waters alone (less than 30 m) reside at least 61 species of stony coral, while some 500 species of fish – including perhaps 20 that are endemic – and 350 species of molluscs have been catalogued.[15 16 17] Yet even within this overall profusion of marine life can be found hotspots of species richness, perhaps none more so for this region than in the shallow waters of the Pelican Cays along south-central Belize. Within an intricate network of mangrove-lined channels, coral ridges and lagoon-like ponds reside a stunning proliferation of fishes (168 species), sponges (147 species), ascidians or "sea squirts" (70 species), bryozoans (31 species), seaweeds (139 species), seagrasses (4 species), echinoderms (44 species) and corals (9 species), to name just some of the life-forms making up the cays' colourful and unique communities.[18 19 20 21 22 23]

The fourth sub-region includes the southern end of the Barrier Reef and most of the Gulf of Honduras, with the shoreline border running from the Río Grande in Belize and along the entire coast of Guatemala to the Ulúa River in northern Honduras. Offshore, a steeply dipping shelf margin drops off quickly into the abyssal Cayman Trench. The high productivity within

Whale shark, Belize. Photo courtesy of Wolcott Henry 2005/Marine Photobank

the Gulf is maintained by pervasive seagrass beds, large mangrove stands, coral reefs and terrestrial nutrients transported into the Gulf basin by numerous rivers, and supports a variety of commercially important species including spiny lobster, conch, shrimp, sardine and a variety of finfish.[24]

The fifth sub-region spans much of the northern coast of Honduras, including the offshore Bay Islands, and is characterized by long expanses of sandy beaches interspersed with large rivers, bays, and coastal lagoons. The Bay Islands, situated approximately 70 km north of the Honduras mainland, contain a significant proportion of Honduran reefs and mark the southern extent of the Mesoamerican Reef. The first confirmed documentation of *Lophelia pertusa* along the Mesoamerican reef system was recorded off of Isla de Roatán of the Bay Islands in 2011;[25] this deep-sea, reef-building coral is a noted "ecosystem engineer", promoting the colonization of thousands of invertebrate and fish species within its habitats.[26] A renowned aggregation site for whale sharks is located off the coast of Isla de Utila[27] and numerous seamounts dot the area, including some with relatively high coral cover and important fish spawning areas.[28]

The last sub-region, the open ocean, includes the pelagic waters from the 1,000 m contour out to the Swan Islands of Honduras and then north across the Cayman Trench to the submerged banks of Rosaria and Misteriosa. These waters are the habitat for fishes such as Spanish mackerel, kingfish, bonito, various tunas, blue marlin and whale sharks, among many others. Strong westerly currents bring larvae into the region from upstream sources in the central and southern Caribbean and eventually carry larvae out to the Gulf of Mexico and the Florida Keys.[29 30] In this sense, the ecological and biological value of the Mesoamerican Barrier Reef region extends far beyond the reef itself.

West Indian manatee. Photo courtesy of U.S. Fish and Wildlife Service

2

MISKITO CAYS

Located along the northeast coast of Nicaragua, this area includes coastal lagoons and estuaries and an archipelago of 80 mangrove cays surrounded by coral reefs and seagrass beds. This remote, largely unspoiled region has high coral cover and diversity, exceptional seagrass meadows and extensive mangrove forests, providing myriad interconnected wildlife habitats. The region is especially important for foraging green sea turtles. Small numbers of manatee and Guiana dolphin are found here as well.

In 1991, Nicaragua declared the Miskito Cays a marine biological reserve (Cayos Miskitos y Franja Costera Immediata). Encompassing 512,795 ha along the country's northeast coast, the reserve includes an offshore component, the Miskito Cays, covering approximately 50,000 ha within a 50-km radius centred around Cayo Mayor, and a coastal and marine belt 20 km wide and 190 km long (from the Honduran border to just south of the town of Wouhnta). The reserve's wetlands are recognized as wetlands of international importance by the Ramsar Convention (an international treaty for the conservation and sustainable use of wetlands), and the region has been recognized as an Important Bird Area by BirdLife International.

The offshore Miskito Cays include 80 small mangrove islands surrounded by a dazzling, interconnected mosaic of habitats: shallow lagoons, seagrass meadows, sand patches and rocky bottoms, octocoral gardens, seaweed beds, patch and fringing coral reefs, reef crests and coastal ocean[31,32] Thirty-nine species of scleractinian (stony) coral are found here, with an abundance of elkhorn coral (*Acropora palmate)*, fused staghorn coral (*A. prolifera)* and staghorn coral (*A. cervicornis),* in particular.[33] Some reefs are characterized by deep walls extending down to about 50 m and are cloaked with a great diversity of reef organisms. The reef system itself extends up to 20 km from the cays, and corals can be found in profusion on the seaward slopes. The high abundance and diversity of live coral cover, as well as its low mortality make the reefs, according to a recent assessment, "suited for a high conservation status in the Caribbean".[34]

Four species of seagrass, predominately *Thalassia* and *Syringodium*, make up the extensive and lush seagrass meadows, and roughly 100 types of seaweed are interspersed throughout the cays.[35] Three species of sea turtles – green, leatherback and hawksbill – forage throughout the seagrass meadows, and the region has long been known for its profound importance for green sea turtles, in particular.[36] Also found here are sharks, spiny lobster, queen conch, nearly 120 reef fish species, sea urchins and sea stars, comb jellies, sea anemones, sponges, zoanthids and a host of other life forms.

The coastal component, and indeed the whole Miskito coast, is one of the richest shallow-water marine regions in Central America and the Caribbean. Mangrove-lined lagoons and rivers form a continuous estuary and provide habitat critical to numerous species of fish and invertebrates. Within the reserve, there is also a wide variety of wildlife, including caimans and crocodiles, macaws and ibises, and jaguars and manatees.

The coastal zone is also home to the recently recognized Guiana dolphin (*Sotalia guianensis*), a small coastal dolphin species that was previously considered to be an offshore variant of the tucuxi (*Sotalia fluviatilis*).[37] Though well-known to the region's inhabitants, it was not until the early 1990s that *Sotalia* dolphins were recorded by marine mammalogists as even occurring in Nicaragua. Research into Guiana dolphins resident to Cayos Miskitos appears not to have been conducted since 1998 when approximately 50 animals were counted. While abundant throughout their range (discontinuous from Honduras to southern Brazil) numbers may be in decline within the Cayos Miskitos Reserve as residents report that fewer are seen each year; in some areas they are no longer seen at all.[38]

Queen conch egg mass. Photo courtesy of Heins Bent

Yellowtail snappers. Photo courtesy of Andrew Bruckner

3

CORN ISLAND

The Corn Island region – including Great Corn Island and Lesser Corn Island – is located approximately 80 km off of the Nicaraguan coast and comprises an area of almost 17,000 km^2. The region is characterized by fringing coral reefs, mangroves and seagrass meadows, high fish diversity and robust numbers of spiny lobster.

There are not many inhabitants of the Corn Islands – roughly 7,000 in total – and the fact that many of those islanders "still bear surnames such as Quinn and Campbell" is evidence of their history as "coconut-tree-lined refuges for the likes of the ruthless privateer Captain [Henry]

Caribbean spiny lobster. Photo courtesy of NOAA, National Ocean Service

Elkhorn coral. Photo courtesy of Bonaire 2008: Exploring Coral Reef Sustainability with New Technologies, NOAA-OE.

Morgan."[39] Nicaragua has claimed the islands – Great Corn Island and its smaller, neighbouring sibling Lesser Corn Island, located 15 km to the northeast – since 1894, and although they are diminutive in size, they are renowned for the abundance of their marine life.

More than 300 species of fish have been recorded in the waters of the shallow Nicaraguan Caribbean, and recent studies have also cast light on the abundance of fish, such as several species of snapper and grouper, that inhabit the continental slope. Spiny lobster are particularly prevalent in the waters surrounding the Corn Islands, making use of the varied habitats throughout different phases of their life cycle. During its young benthic stages, the species inhabits shallow waters on and around mangrove roots, seagrass meadows, seaweed patches or sponges, where it feeds on local invertebrates. By the time they are four years old, they will have left the shallows for deeper, offshore reef environments to shelter themselves within reefs and rocky outcrops.

Approximately 15 per cent of the island's wetlands are composed of freshwater plants and mangroves located on three separate sections of the island. A direct connection between those wetlands with the sea is blocked during most of the year by a beach dune system surrounding most of the island. During the wet season, however, heavy rains flood the wetlands and the increased hydrostatic pressure forces openings in the dune system; this allows the temporary release of the nutrient-rich wetland waters, and the migration of crustaceans and fish between the coastal wetlands and environments offshore.[40]

Surrounding Great Corn Island are numerous seagrass meadows. Dense mixtures of *Syringodium filiforme*, *Thalassia testudinum*, *Halophila* spp., and *Halodule wrightii* are commonly found in the nearshore backreef lagoon, whereas *T. testudinum* and *S. filiforme* dominate deeper offshore environments. The largest reef associated with Great Corn Island is Cana Reef, composed of fringing and patch reefs located on the northeast corner (windward side) of the island, which extends seaward two km and then curves towards the south. In general, there is little reef development on the leeward side of the island, presumably due to an island wave "shadow" effect that reduces current and wave activity behind Cana Reef. Farther offshore, patchy seagrass meadows and more robust corals abound. The outer coral reefs receive most of the incoming wave energy directed at the island; *Acropora palmata* and *Montastraea annularis* are the dominant frame-building corals throughout the fringing reef system.[41] There is also evidence that black corals may be abundant in waters between 30 and 60 m deep.

4

Nesting green turtle. Photo courtesy of Michelle Kalamandeen

TORTUGUERO — BARRA DEL COLORADO

This area is extends north from Tortuguero National Park to Barra del Colorado on the border with Nicaragua, lying fully within Costa Rican jurisdictional waters. Featured here is a rich diversity of ecosystems, including rivers, swamp forests and other wetlands, sandy and rocky beaches and coastal lagoons. The area is extremely important for green, leatherback and hawksbill sea turtles, and harbours the largest remaining rookery for green turtles in the Atlantic basin.

This region was well-known by the early European explorers for its immense numbers of sea turtles, and by the late 1700s, *Tortuguero*, meaning "place of turtles", appeared on Spanish maps. Some 150 years later, biologist Archie Carr would place sea turtle research and conservation on the map with his seminal studies conducted within this same region.

In 1945, Carr took a leave of absence from the University of Florida to begin a five-year position teaching biology at the Escuela Agricola Panamericana.[42] Seven years later, he would publish his first technical book, *The Handbook of Turtles*. At the time of his arrival in Central America, Carr, like other turtle specialists, remained in the dark about many aspects of sea turtle ecology, not least the location of some of their key nesting beaches, or where they went after heading out to sea.[43] But inhabitants of the region did know some of those secrets, and thanks to his student Guillermo Cruz, soon Carr did, too.[44] The key to the puzzle was a Costa Rican beach near the village of Tortugero.

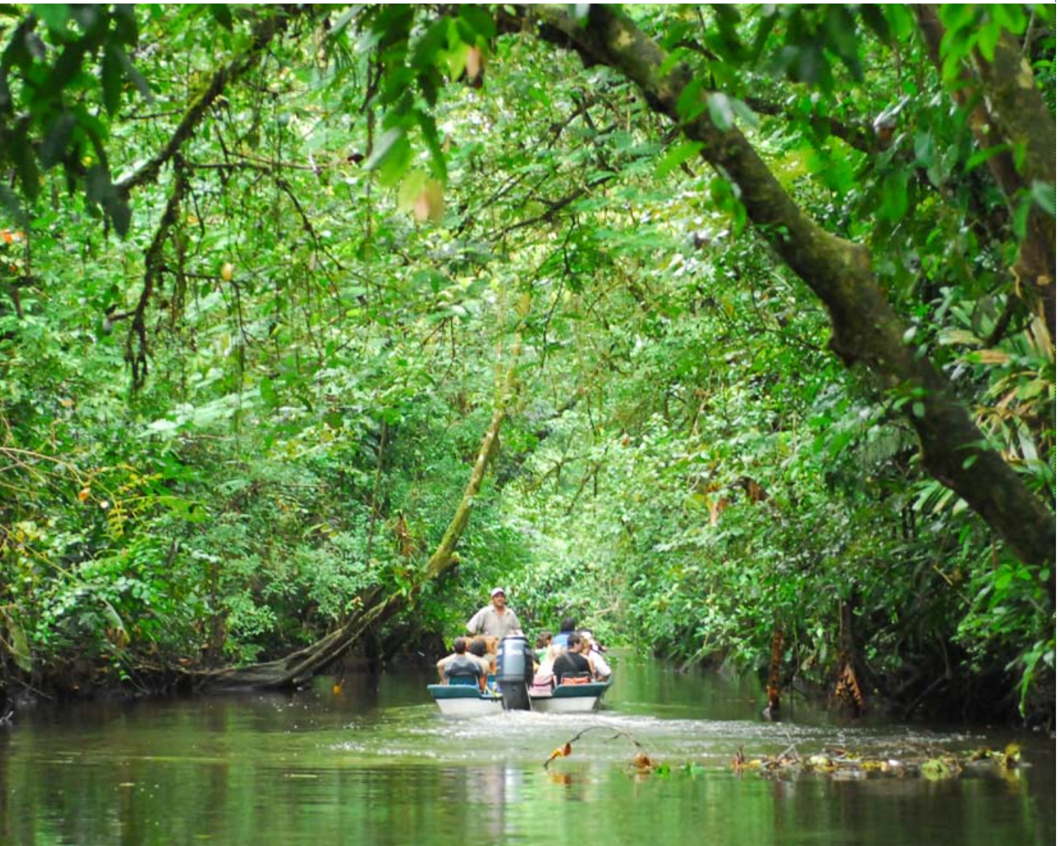
The villagers knew that the beaches contained heavy nesting concentrations of green turtles; and Cayman Island fishers knew that that those turtles swam from that beach to the Miskito Cays, where they would feed on abundant patches of turtle grass.[45] That information would lead to the development of a research programme that continues more than 60 years later, making Tortuguero one of the best-studied turtle-nesting sites in the world. Those studies have led directly to the establishment of the Caribbean Conservation Corporation and indirectly to the beginnings of the Costa Rican National Park System. In 1970, Tortuguero became one of the first national parks in the country.

Yet, turtles are just part of the story. Barro del Colorado, which adjoins Tortuguero to the north and was established as a wildlife refuge in 1985, is known for its highly diverse ecosystems, including rivers, islands, swamps and wetland vegetation that protect a great number of fish species and both resident and migratory birds. The nearshore waters and wetlands of Tortuguero also host what is thought to be a small and fragile population of the endangered and sparsely distributed West Indian manatee. However, the focus of research, tourism and conservation efforts is on three species of sea turtle.

Those turtles are the critically endangered leatherback, the largest of all turtle species, a small and declining population of critically endangered hawksbills,[46] and endangered green turtles at their largest remaining rookery in the Atlantic basin.[47] The site of their attraction is a 30 km strip of sandy beach at Tortuguero where, at different times of the year, they arrive to deposit their nests. The second-largest nesting concentration of green turtles in the world occurs here (the first being at Raine Island in northeastern Australia); each year over 100,000 nests are deposited by as many as 37,000 females.[48]

Turtles have been using Tortuguero at least as far back as 1592, as evidenced by written records from that time, and it is safe to assume that they had been doing so for millennia before that. The details of sea turtle travels and life history, however, would not even begin to be answered until Carr began his research – research which has led to the conservation of perhaps the most important, and surely the most celebrated, turtle beach in the world.

Tortuguero National Park. Photo courtesy of Peter Prokosch



Guiana dolphin, *Sotalia guianensis*. Photo courtesy of Laura J. May-Collado

5

CAHUITA-GANDOCA

Lying fully within Costa Rican waters, the Cahuita-Gandoca region extends south from Cahuita National Park to the mouth of the Sixaola River on the border with Panama. This area hosts nesting sites for three sea turtle species and is likely the only location within Costa Rica where the Guiana dolphin is present.

In 2009, Costa Rica completed an assessment (GRUAS II) that identified the ecologically significant marine areas in the country in order to determine where additional protection was needed.[49] One of the two areas identified by Costa Rica as meeting EBSA criteria was the Cahuita-Gandoca region, which covers the southern extent of the country's Caribbean coast, from Cahuita National Park and extending south to the Sixaola River on the border with Panama. The Gandoca-Manzanillo Wildlife Refuge is included within these boundaries.

Extensive seagrass beds and the most important coral reef areas on the Caribbean coast of Costa Rica are found in Cahuita. This includes the largest fringing reef, constituting 31 reef-building species – the highest such diversity in Costa Rica – and 19 species of octocoral.[50] The reef, notably, supports high levels of post-larval settlement of spiny lobster; indeed, the settlement levels found here are comparable to locations in other countries with important lobster fisheries.[51]

The Gandoca-Manzanillo Wildlife Refuge, a Ramsar-designated wetland, has the most important of the two mangrove forests along the Costa Rican Caribbean; most common is the red mangrove, a species well-adapted to salt water, whose prop roots form important habitats for a wide range of marine life.[52] [53] Gandoca also hosts important leatherback and hawksbill sea turtle nesting areas.[54] [55] There appears to be a resident population of Guiana dolphin within the refuge as the species has not been reported elsewhere in Costa Rica; this suggests that this is an extremely vulnerable population.[56] Bottlenose dolphins regularly visit the area and mixed groups of these two species are commonly seen throughout the year.[57]

Twenty-nine species of reef-building coral have been described from the Gandoca region, and it is the only non-Panamanian site in Central America where the coral *Meandrina meandrites* occurs. Aggregations of spiny lobster and conch are notably present within the reef's confines.[58] [59]

Young red mangrove tree. Photo courtesy of Katie Fuller 2009/Marine Photobank

Brown Pelican. Photo courtesy of Ben Lascelles

6

PEDRO BANK, SOUTHERN CHANNEL AND MORANT

This area is located in oceanic waters south-east to south-west of Jamaica and encompasses the Pedro Bank and Cays in Jamaica; the Morant Cays and deep channels around the Rosalind Bank in Honduras and Nicaragua; and the Serranilla Bank, Alice Bank and New Bank in Colombia and Jamaica. One of the largest seabird breeding colonies in the Caribbean is located here, and the entire area supports substantial queen conch, spiny lobster and reef fish fisheries.

Princess parrotfish, *Scarus taeniopterus*. Photo courtesy of Ken Marks / Living Oceans Foundation

Laughing gull. Photo courtesy of Ben Lascelles

This area includes cays and shallow, soft sediment seabed, sea turtle nesting sites, conch and lobster fishery areas, and deep banks populated by sponges and corals. It extends from the Rosalind Bank off the coasts of Honduras and Nicaragua, in the west, to the Morant Cays in the east. The Morant Cays are 64 km south-east of Jamaica, while the Pedro Banks to their west are 158 km south-west of Kingston. The Pedro Channel separates the Pedro Banks and cays from mainland Jamaica, while the Morant Ridge lies between the island and the Morant Cays.

Pedro Bank is the largest feature in the area, approximately three-quarters the size of Jamaica and covering a total area of 8,040 km^2. It is also the site of Jamaica's largest offshore fishery, with the Morant Cay containing the second-largest. As one of the most sizable offshore banks in the Caribbean, the Pedro Bank's rich waters support a variety of marine life, including whales and dolphins, while Morant and Pedro Cays are regionally important seabird and turtle nesting areas. The bank may also be a potential refuge for larvae of threatened *Acropora* coral. It is today an important fishing ground for conch, lobster and fish in Jamaica and is one of the largest queen conch producers in the Caribbean and the world.

The Morant Cays and Pedro Cays together harbour one of the top 10 largest seabird breeding colonies in the Caribbean, which is used as a nesting site by more than 100,000 seabirds and incorporates the majority of key feeding grounds for species that breed there. Morant Cays alone hosts more than 200,000 sooty and perhaps 15,000 bridled terns, as well as populations of royal tern and brown noddy. Similarly, the Pedro Cays holds significant numbers of magnificent frigatebirds, brown boobies and masked boobies, as well as populations of laughing gull, sooty tern, royal tern and brown noddy.

To the south and west of the area, Baja Nuevo Bank and Serranilla Bank host an abundance of reef fish species: 154 in the former, 106 in the latter – and 74 in the nearby Alice Bank. Although Alice Bank does not break the surface of the water, Baja Nuevo and Serranilla Bank do, and in the process provide habitat, like the Morant and Pedro Cays, for a variety of seabirds. At least 14 seabird species make use of the oceanic cays of Serranilla Bank and the non-permanent sandy cays of New Bank and, though quantitative information is lacking, these cays may also provide important nesting areas for sea turtles.

It is believed that the marine life of both the Pedro Banks and Morant Cays is relatively undisturbed by human activities.

Red mangroves, Caracol Bay. Photo courtesy of FoProBiM – Haiti

8

CARACOL/FORT LIBERTÉ/MONTE CRISTI (NORTHERN HISPANIOLA BINATIONAL AREA)

This coastal area along northeastern Haiti and northwestern Dominican Republic hosts extensive mangroves, reefs and seagrass beds, important spawning areas for fish, molluscs and crustaceans, and important habitat for turtles and manatees.

Caracol Bay, in northeastern Haiti, consists of fringing mangrove forests; seagrass beds; and a coral reef that bounds its outer limits. The Bay includes a reef that extends over 20 km with an estimated area of 900 ha, and an estimated 5,250 ha of healthy mangroves (mainly red mangrove) representing some 18 per cent of the remaining mangroves in Haiti.

These protected bays, mangroves, seagrass beds and reefs are important spawning and nursery areas for fish, mollusks and crustaceans; many of these species serve as important sources of protein for local communities. These habitats also protect the northern shoreline from erosion, wave action and storm surges. Caracol Bay is an important habitat for endangered species, including turtles and possibly manatees.

With over 1,771 km of coastline, several areas of Haiti have been identified as areas of interest for the development of coastal and marine protected areas. The country's Ministry of Environment has recently succeeded in declaring the area of Northeastern Haiti, which includes the bays, mangroves and coral reefs of Bord de mer Limonade, Caracol and Fort Liberté as an MPA. It includes the BirdLife International Important Bird Area of Lagon-aux-Boeufs and stretches from the Grande Rivière du Nord east to the Haiti/Dominican Republic border. This area extends farther east into the waters north of the Dominican Republic into the Monte Cristi National Park under the umbrella of the Northern Hispaniola Binational Area and is a part of the Caribbean Biological Corridor, which runs from Cuba through Haiti and to the Dominican Republic under the Protocol concerning Specially Protected Areas and Wildlife (SPAW Protocol).[61]

One of Haiti's last remaining stands of large, intact red mangroves at "Fou-a-Sho". Photo courtesy of FoProBiM – Haiti

Humpback whale, Silver Bank Marine Mammal Sanctuary, Dominican Republic. Photo courtesy of Simon Hutchins, OPS (Madre/Cria) and Robin Hooked, CCS, (MONAH)

9

MARINE MAMMAL SANCTUARY: BANCO DE LA PLATA Y BANCO DE LA NAVIDAD

This marine mammal sanctuary, encompassing 32,915 km^2, is located off the northern coast and of the Dominican Republic. It contains the most important breeding grounds for the entire population of endangered North Atlantic humpback whales.

In the 1970s, researchers determined that every humpback whale in the world has a unique set of pigmentation and scarring patterns on the ventral side of its tail fluke; in the same way that fingerprints can identify any human, so these patterns could be used to identify individual humpbacks, build a photographic catalogue of those whales, and use that catalogue to track their movements and add to knowledge of their behaviour.[62] Initially, many of the North Atlantic humpbacks catalogued were photographed on summer feeding grounds on and around Stellwagen Bank, in the waters of the northeastern United States of America. But over time, as photo-identification

Humpback mother and calf. Photo courtesy of Simon Hutchins, OPS (Madre/Cria) and Robin Hooked, CCS, (MONAH)

databases were added to and other areas included, researchers have reached a point where they are able to determine which feeding and breeding grounds are used by which individual whales.

That the waters off the north coast of the Dominican Republic attract large numbers of humpback whales has been long-known; written records from the 17th century confirm that they “often times appear like those Rocks in ye water”.[63] What was not known until much more recently was that those whales spent their summer months scattered as distinct feeding aggregations in particular areas throughout the North Atlantic, stretching from Stellwagen Bank to Norway.[64] Indeed, of all the humpback whales roaming the vast North Atlantic, 85 per cent return to this area to breed and calve in winter. In this regard, Samana Bay, on the eastern coastline of the Dominican Republic, appears to be particularly attractive as more whales are seen here on a regular basis than anywhere else.[65]

In 1986, the Government of the Dominican Republic established the Silver Bank Sanctuary and then enlarged it to its current size in 1996, renaming it the Sanctuary for the Marine Mammals of the Dominican Republic. Ten years later, the Dominican sanctuary and the Stellwagen Bank National Marine Sanctuary entered into a “sister sanctuary” partnership in an agreement between government agencies from the two countries. Both sanctuaries provide critical support for the same population of around 900 whales, which spend spring and summer at Stellwagen Bank before heading to the warmer waters of the Dominican Republic in late fall. The agreement was designed to enhance coordination in research and management efforts between the two sanctuaries and, ultimately, further support humpback whale recovery in the North Atlantic.[66]

San Andres Island. Photo courtesy of Martha Prada

Squid. Photo courtesy of Heins Bent

10

SEAFLOWER

Seaflower – both a marine protected area (65,000 km²) and a UNESCO Biosphere Reserve (300,000 km²) – is an open-ocean area that comprises the diverse coastal and marine ecosystems of the Archipelago of San Andres, Old Providence and Santa Catalina, featuring barrier and fringing reefs, lagoons, atolls, seagrass and seaweed beds, mangroves and beaches.

Seaflower – named after the ship that carried the original English Puritans to the region in 1631 – has been recognized as a jewel in the waters of the Caribbean. It was established as a UNESCO Biosphere Reserve in 2000, encompassing the entire San Andres Archipelago, and designated an Important Bird Area by BirdLife International four years later. In 2005, an area of 65,000 km² within the Biosphere Reserve was declared the Seaflower Marine Protected Area (MPA), becoming Colombia's first MPA and continuing as the largest MPA in the wider Caribbean.

The Seaflower MPA contains the largest open-ocean coral reefs in the Caribbean[67] and protects approximately 2,000 km² of coral reefs, atolls, seagrass beds and mangroves.[68] This includes rare, unique and unusual reef environments, remote areas with little anthropogenic influence and a continuum of habitats that support significant levels of marine biodiversity. With the presence of 192 Red List species (marine and terrestrial), it is an important site for endangered and threatened species of global concern.[69]

Of an estimated 60 to 70 stony coral species residing in the Caribbean, at least 48 are known to occur here. Fifty-four species of octocoral have so far been recorded, including 11 that have yet to be described, suggesting that there may be a high degree of endemism for this subclass (Octocorallia) within the region[70]. Two hundred and seven seaweed species have been reported at Seaflower – yet these flora *still* remain "greatly overlooked" according to researchers.[71] A study published in 2002 documented 96 sponge species;[72] in a little more than a decade since, that inventory has climbed to 130 species.[73]

Redspotted hawkfish. Photo courtesy of Mark Schrope

The beaches of the islands and atolls of the Seaflower region are used for nesting by four IUCN Red List sea turtle species: the loggerhead, hawksbill, green and leatherback.[74] To date, 126 migrant bird species have been documented in the area, and it has been estimated that of these at least 85 specifically use the mangroves, wetlands and cays as stopover sites. There are an additional 31 resident bird species, including two that have been introduced.

Seaflower also supports important commercial fish populations, such as queen conch, spiny and spotted spiny lobster, snappers and groupers. Of an estimated 500 to 600 fish species found in the wider Caribbean region, 407 have been recorded at Seaflower; 52 species (13 per cent) are on the IUCN Red List.[75] In total, Seaflower is home to no fewer than 192 IUCN Red List species, including five species of marine mammals, the aforementioned four species of marine turtle and 52 species of fish, 43 scleractinian corals, two hydrocorals and 86 bird species. It has been confirmed that at least seven seabird species on the Red List breed in the Seaflower area.[76]

Recent studies have shown that whereas local currents ensure that the great majority of coral larvae spawned within Seaflower remain there, approximately four per cent may be carried elsewhere within the southwestern Caribbean. It is therefore likely that Seaflower has a role in sustaining the coral diversity of reefs in Nicaragua, Costa Rica and Panama.[77]

Opposite page, top: Baby nurse shark. Bottom: Queen conch. Photos courtesy of Felipe Cabeza.

11

Deepwater sea fan, *Iciligorgia schrammi*. Photo courtesy of Franck Mazéas

SABA BANK

This submerged atoll, one of the three largest atolls on Earth, is located in the Dutch Windward Islands, approximately 4 km west of the tiny island of Saba and about 250 km southeast of Puerto Rico. Aside from the sheer size of its platform area, which covers some 2,200 km^2, the Saba Bank is noted for its extensive and virtually pristine coral reefs and seaweed beds, along with its high species diversity.

The wholly underwater Saba Bank is considered to be a remarkable geological feature for the large size of its generally rectangular surface or platform – 65 km by 40 km at the 200-m isobath for an overall area of 2,200 km^2 – and its virtually flat top. Rising almost two km from the surrounding seafloor and relatively isolated from larger, populated landmasses that might introduce pollution or eutrophication, Saba Bank provides a large area of potential substrate and food for myriad forms of fauna and flora.

The presence of this underwater bank and its rich fishing grounds has been known and exploited by nearby Saba Islanders for generations. It was a source of interest and intrigue to western scientists during the early 20th century, and then was largely forgotten by much of the outside world until the 1970s, when Caribbean nations began to investigate resource development within their Exclusive Economic Zones. That prompted a new wave of research into the region's fishery potential and, subsequently, its marine environment more generally. Yet Saba Bank received scant attention, to the extent that it was not until 2007 before the first detailed biological assessment and sampling programme was completed.

The results of that survey, preliminary as they were, were nothing short of astonishing: between 150 to 200 seaweed species, with possibly 12 new to science, and three new seaweed community types;[78] 270 fish species with perhaps 50 or more likely remaining to be discovered;[79] 43 stony coral species;[80] at least 48 soft coral species with two new species[81]; and more than 84 types of sponge, including numbers of the giant barrel sponge, a species that can live for centuries.[82]

Peacock flounder. Photo courtesy of Erik Meesters

Coral reefs are present along the eastern and southeastern edges of Saba Bank – although individual colonies can be found over the whole bank. Thousands of years of hard coral growth have resulted in significant structural complexity,[83] and the lengthy uninterrupted growth has produced a reef structure that may be the largest within the Dutch Caribbean.

Hawksbill, leatherback and loggerhead sea turtles have been sighted here, though to what extent they feed on the bank's seaweed and sponge growth is unknown. Sharks also appear to be relatively common, and whales and dolphins have been recorded frequently, but there have been few population surveys. However, a few reported sightings of humpback whale mother-and-calf pairs on the bank suggests that this area – with its relatively warm and shallow habitat – may serve as a calving ground for the recovering western Atlantic population.[84] Fifteen species of seabirds breed on nearby islands,[85 86 87] and some of those, such as the brown booby, Audubon's shearwater and red-billed tropicbird, have been sighted over the bank.[88]

Below: Horse-eye jack. Photo courtesy of Franck Mazéas. Opposite page: Giant barrel sponges. Photo courtesy of Erik Meesters

Flying fish. © Steve N. G. Howell

12

EASTERN CARIBBEAN

The Eastern Caribbean consists of an arc of approximately 15 small islands separating the Caribbean Sea from the Atlantic Ocean and lying just north of the continental shelf off the northeast coast of South America.

Prevailing currents carry nutrient-rich outflow from the Orinoco and Amazon rivers to this region, resulting in highly productive ecosystems that support a plethora of species, such as coral reefs, mangrove and seagrass ecosystems. In addition, there are less studied ecosystems farther offshore, associated with several seamounts and hydrothermal vents. Biological diversity in the region is further enhanced by the temporary residence of many migrant species of fish, cetaceans, sea turtles, sharks and seabirds.

Many of these islands are volcanic in origin,[89] and some of them remain volcanically active. Recently, a renewed period of eruptions by the Soufriere Hills volcano on Montserrat covered coral reefs with lava, in the process expanding the island's size and creating new potential coastal habitat for reef-related species.[90] Beneath the waves, rising 1,300 m from the sea floor off the north coast of the island of Grenada, lies "Kick 'em Jenny", the only active underwater volcano in the region, and the seafloor of the island arc is punctuated by cold water seeps and at least three known hydrothermal vents. The presence of seamounts in the region suggests the existence of communities of deep sea corals, which are frequently found taking advantage of the substrate and the comparatively shallow depth that seamounts offer. The currents that swirl and eddy around these undersea mountains are magnified by the islands themselves and the deep water trenches and submarine canyons that frequently separate them, the effect of which may be effectively to constrain the dispersal of larvae of coral reef fishes and thus result in the ecosystems of individual islands boasting communities that are distinct from their neighbours'.

Great hammerhead shark, *Sphyrna mokarran*. Photo courtesy of flickr/wendellreed

Among the coral species in the islands are three evolutionarily distinct and globally endangered hard coral species, two of which are listed as critically endangered on the IUCN Red List.[91] These coastal habitats provide ideal nesting and foraging zones for green, hawksbill and leatherback turtles (with the southeast coast of Barbados home to the largest density of hawksbill nesting zones in the wider Caribbean),[92] and the area includes the feeding sites of 16 species of seabird, totaling over half a million individuals, breeding at 52 Important Bird Areas, as designated by BirdLife International. Dog Island, off the coast of Anguilla, hosts a colony of more than 100,000 breeding pairs of sooty tern alone.

Historically an important breeding area for hammerhead sharks, it is also an important calving and nursing area along the migratory route of humpback whales in the North Atlantic, especially in the coastal waters of Dominica – where a small resident population of sperm whales can also be found. Several species of tuna and billfish migrate through the area, while a distinct stock of flying fish exists in the eastern Caribbean, and all its life stages are believed to be supported here. Indeed, the water between Grenada and Tobago yields the highest concentration of flying fish in the region.

Below: Coral, Saba. Photo courtesy of Franck Mazéas. Opposite page, top: Octopus on methane seep of the underwater volcano known as Kick 'em Jenny. Bottom: Coral fan, Kick 'em Jenny. Photos courtesy of Ocean Exploration Trust / Sea Research Foundation

Sargassum seaweed. Photo courtesy of Philippe Rouja

13

SARGASSO SEA

The only sea without any land boundaries, the Sargasso Sea is situated within the western North Atlantic southeast of Bermuda and is bounded on all sides by major ocean currents. It covers an area in excess of 4 million km^2 with ocean depths reaching in excess of 5,000 m. The area — "a floating golden rainforest" — is characterized by extensive floating mats of *Sargassum* seaweed, which provide vital habitat for various life stages of numerous species, including flying fish, sea turtles and eels.

Histrio historio, *Sargassum* fish. Photo courtesy of Philippe Rouja

There are few areas of the world ocean as iconic, and yet at times so misunderstood, as the Sargasso Sea. It was first definitively documented by Christopher Columbus in 1492.[93] Columbus marveled at the presence of the large amounts of *Sargassum* seaweed, believing it suggested that he was close to land. At least some of his crew, on the other hand, feared that the algal mats hid reefs on which they would run aground, or that they would become trapped in the still waters at the centre of the slowly circling currents. That latter concern in particular persisted among mariners for centuries, but such anxieties rarely apply to the vessels that ply the North Atlantic in the 21st century, and fears of hidden reefs or thick, entangling seaweed have long since been dispelled.[94]

Today, the Sargasso Sea remains a source of fascination, but less for its alleged navigational impediments than for its unique ecological qualities.

Long perceived as an area of low nutrients and low productivity, the Sargasso Sea actually boasts a net annual rate of primary production that, per unit area, matches levels in some of the most productive regions in the global ocean. And at its figurative centre is the ecosystem that is based on an estimated one million tonnes of two species of floating

Sargassum, the only seaweeds in the world that spend their entire life cycle afloat and do not have an attached stage at any time.[95]

The *Sargassum* supports ten endemic species from a variety of taxa, including the *Sargassum* anglerfish and pipefish, which lay their eggs in the algal mats; they are just two of the numerous species that use the seaweed for various stages of their life cycles.[96] As well, the early life stages of 20 species of cephalopod, including the endemic *Leachia lemur*, have been documented in this area.[97] Flying fish build bubble nests for their eggs within the mats and lay eggs with long extensions for attaching to the algae. Other fish, including white and blue marlin and possibly albacore tuna, also spawn in the sea.

Several species of turtles – including green, hawksbill, loggerhead and Kemp's ridley – use *Sargassum* as a nursery habitat. For decades, scientists wondered where North Atlantic turtle hatchlings went after entering the ocean – the "lost years" as it came to be known – before discovering that at least some of them made their way to the Sargasso Sea, where they hide in the *Sargassum* to feed and grow in relative safety and even, perhaps, use it as a type of thermal refuge.[98]

Numerous species – including humpback whales, eight species of seabirds, leatherback turtles, Atlantic bluefin, yellowfin and bigeye tuna, whale and tiger sharks and manta and spotted eagle rays – migrate to or through the Sargasso Sea, and satellite tagging of white and porbeagle sharks has revealed that large, possibly pregnant, females visit the area, raising the intriguing possibility that it functions as a hitherto-unknown nursery for these species.

Altogether, more than 145 invertebrate species and 23 species of seabirds have been recorded in association with floating *Sargassum*, which also provides habitat for over 100 species of fish.[99] This diverse community of organisms living at the surface also interacts with oceanic fauna, many of which migrate vertically up at night and down during the day, connecting the surface and deep-sea communities. The overall importance of *Sargassum* for fish has led the United States of America to recognize it as essential fish habitat.[100] In addition, the Sargasso Sea is especially important for American and European eels. These species spend their

Opposite page: Floating *Sargassum*. Photo courtesy of Philippe Rouja adult lives in freshwater in North America or Europe, then migrate thousands of kilometres to spawn in the Sargasso Sea, where their larvae develop before taking between seven and 24 months to follow the Gulf Stream back to their respective freshwater habitats to become juvenile "glass eels".

Both species spend their adult lives in freshwater and then migrate thousands of kilometres to spawn in the Sargasso Sea, where their larvae develop before taking between seven and 24 months to follow the Gulf Stream back to their respective freshwater habitats, where they grow into juvenile "glass eels". The exact location and circumstances of eel spawning in the Sargasso Sea remain uncertain, but enough is known to underline the fact that, far from it being the lifeless trap feared by sailors past, the sea is one of the most vibrant patches of marine biodiversity in the world ocean.

Flying fish eggs in *Sargassum*. Photo courtesy of Philippe Rouja

14

Left: Close-up of the plume of the undescribed Lamellibrachia sp, collected during the NOAA Ocean Explorer Expedition to the Deep hydrocarbon-seep communities deeper than 1,000 m in the Gulf of Mexico. Photo courtesy of Expedition to the Deep Slope 2006, NOAA-OE. Right: *Tubos Lamellibrachia*, lab specimen. Photo courtesy of INVEMAR

LA REGIÓN TALUD CONTINENTAL SUPERIOR DEL SINÚ

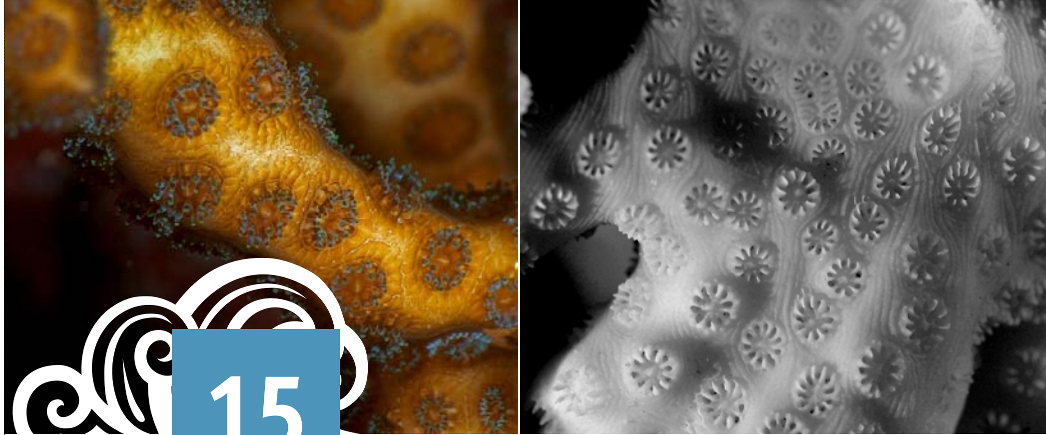
Located in the southern part of the Colombian Caribbean, in a depth range from 150 to 1750m, this area is characterized by a variety of undersea geological formations, from channels, canyons and slopes to hills, steeps, domes and depressions. The presence of cold-water corals and cold seeps suggests high levels of diversity and possibly endemism.

If scientists were surprised by the discovery of communities living in the seemingly inhospitable environs of hydrothermal vents – where superheated gases and chemically enriched water erupt from beneath the seabed at temperatures of over 400 ºC – they were equally stunned by the subsequent discovery of “cold seeps”. Unlike hydrothermal vents, the water and gases do not come gushing out of cold seeps; nor are they superheated – although, despite their name, they are not cooler than the surrounding water, either. But communities around cold seeps, like those around vents, do not rely on photosynthesis. Instead, they are driven by energy from the chemicals and gases, such as methane, that are released through fissures in the seabed.

The organisms that live around cold seeps tend, therefore, to be largely static, remaining close to the source of their sustenance for as long as it lasts, and partly as a consequence, cold-seep communities tend to develop high degrees of endemism – species found at particular seeps and nowhere else. It is likely that this is the case for the cold seeps that have recently been discovered in the Sinú continental margin and is one of the reasons why this area is ecologically important.

Waters in this area, between 100 and 300 m deep, host a number of different species of cold-water corals, including members of the order Anthipatharia, otherwise known as black corals, soft or octocorals and scleractinian or hard corals.[101] There are a total of 43 known species of hard corals in the area, in three different forms – recumbent, bushy and solitary – each of which provides different habitat options for other fauna. The most common of the scleractinians is the bushy coral *Madracis myriaster*, which, despite being found elsewhere in the region, is not known anywhere else to be the dominant structuring species.[102]

A total of 115 invertebrate and fish species have been recorded as being associated with these coral communities, with an especially high diversity of echinoderms, and three species of shrimp – royal red, giant red and pink specked – which are particularly abundant.[103]



Left: *Madracis asperula*, in situ. Photo courtesy of Rafael Mesa Hernández
Right: *Madracis myriaster*, lab specimen. Photo courtesy of INVEMAR

15

LA REGIÓN TALUD CONTINENTAL SUPERIOR DE MAGDALENA

The oceanic bottoms that include the Magdalena and Tayrona areas are found in the central sector of the Colombian Caribbean in a range of depth between 200 and 3,000 m. They are characterized by the presence of submarine canyons and hills that provide habitat for high species biodiversity. The area is highlighted by an atypical deep-water coral community.

While the crashing of waves against cliffs or onto beaches suggests an environment of obvious dynamism, the world beneath those waves, in the relative cold of the deep ocean, is comparatively still – a world that changes slowly.

The topography of the seabed of the Magdalena continental margin is an example of just such a change. Here, the Magdalena River delta carries sediment from the western foothills of the Sierra Nevada of Santa Marta and the rivers associated with the Cienega Grande of Santa Marta, creating a series of channels and hills that fans across the sea bottom. This relatively new topography combines with the previous morphology – such as submarine canyons and seamounts – and a mixture of hard and soft substrate to provide a variety of habitats for deep-water organisms.[104]

The deep-water coral community found in this area is atypical, since the main structuring species are the branching finger corals *Madracis myriaster* and *Madracis asperula*,[105] scleractinean (stony) corals not typically associated with being habitat-forming in other regions of the world. However, other species that more commonly perform that role are also present. The branching finger coral communities have been found around sites of irregular seabed topography, such as the channels and small mounds that characterize much of this region. This suggests that a more rugged landscape may provide a favourable hydrodynamic regime where deep-sea corals can settle and thrive.[106]

One hundred and two species of fishes, echinoderms, molluscs, crustaceans and other cnidarians, several of which were reported for the first time in Colombia and the South Caribbean, have been catalogued thus far in these coral communities, though sampling has been minimal.[107]

Rio Magdalena delta. Photo courtesy of NOAA

Ocean meets wetland at Shell Beach, Guyana.
Photo courtesy of Michelle Kalamandeen

16

AMAZONIAN-ORINOCO INFLUENCE ZONE

The Amazonian-Orinoco Influence Zone is located off the north-eastern coast of South America and encompasses the offshore waters of coastal eastern Trinidad, Guyana, Suriname, French Guiana, and northern Brazil. The shoreline borders extend from the Orinoco River in the north to the Amazon River in the south. This region is particularly characterized by high productivity associated with the massive influx of nutrients delivered by the Amazon River.

The Amazon River is one of the great natural wonders on Earth. The total length of the river – as measured from the headwaters of the Ucayali-Apurímac river system in southern Peru – is at least 6,400 km, which makes it slightly shorter than the Nile River but still the equivalent of the distance from New York City to Rome. Its westernmost

Warrau fishers, Waini River mangroves. Photo courtesy of Michelle Kalamandeen

source is high in the Andes Mountains, within 160 km of the Pacific Ocean, and its mouth is in the Atlantic Ocean, on the northeastern coast of Brazil. Its basin has an area of about 7 million km^2 and is nearly twice as large as that of the Congo River, the Earth's other great equatorial drainage system.[108]

Ultimately, of course, the Amazon spills into the Atlantic, and it does so with tremendous force and great volume. Approximately 219,000 cubic metres of water flow from the river into the Atlantic every second, a total discharge equivalent to approximately one sixth of that of all the rivers in the world combined, containing one fifth of all the freshwater released into the planet's oceans. The resultant plume can reach more than 3,000 km across the tropical Atlantic Ocean, and cover 2 million km^2, bringing with it a huge influx of nutrients that have an enormous impact on life in the Atlantic.[109] The nutrients feed microscopic, surface-dwelling, phytoplankton, which in turn support higher trophic levels, while the sediments carried by the river create a series of shifting sand bars and mud flats that cover the continental shelf out to a depth of about 40 m. Sand gradually becomes dominant beyond this depth and is replaced by coral at about 100 m depth. The mud supports a rich invertebrate fauna that nourishes a variety of demersal species.

The river mouth and coastal area boast a complex mosaic of geological and geomorphological features, comprising shelf-edge reefs, canyons,

Leatherback turtle, Guyana. Photo courtesy of Michelle Kalamandeen

ravines, seamounts and large, continuous areas of relatively pristine mangroves.[110] The area has some of the highest values of chlorophyll biomass and primary productivity recorded in the world's ocean waters; contains endemic species such as the squid *Doryteuthis surinamensis*, the daggernose shark and the Colares stingray;[111] is a feeding and reproduction area important for the life-history stages of a number of fish and crustaceans, including the Caribbean sharpnose shark and the endangered nurse shark; and is also an important migratory route for various species of fish, such as the Laulao catfish. The coast is home to the largest seabird colonies in northern South America; nine colonies are recognized by BirdLife International as Important Bird Areas (IBAs) and are thought to hold over 100,000 seabirds and waterbirds, including magnificent frigatebirds, laughing gulls, brown pelicans and several species of terns. It includes important nesting sites for five species of marine turtle – leatherback, loggerhead, green, hawksbill, and olive ridley – and is inhabited by West Indian and Amazonian manatees and by the tucuxi dolphin, which is endemic to coastal and estuarine areas of northeastern Latin America.[112]

Unsurprisingly, Suriname, Guyana and other countries have established protected areas or natural reserves within this zone; perhaps more surprisingly, remarkably little is known about some aspects of the region's fauna and flora, including the full extent of its fish and soft coral diversity.

17

Phyllogorgia dilatata, a gorgonian octocoral endemic to Brazil.
Photo courtesy of Carlos Eduardo Leite Ferreira

PARCEL DO MANUEL LUIZ AND BANCO DO ÁLVARO

Parcel do Manuel Luiz is located some 86 km off the northern Brazilian coastshore, 180 km from the major town of São Luís, and 50 km from the edge of the continental shelf. Banco do Álvaro is located 90 km to the northwest. These two areas represent the northernmost coral communities in Brazil. They harbour endemic species of octocoral and fire coral, important breeding and feeding areas for sharks and are an apparent "stepping stone" for species between Brazil and the Caribbean.

They look like coral, are named after coral, and are found in association with corals, but fire corals are not actually corals at all. So dubbed because they contain stinging cells that produce a painful, burning sensation in anyone who brushes up against them, they are in fact hydrozoans and thus more closely related to sea jellies. In addition to their appearance, they share certain similarities with many coral species. Like coral, they have a symbiotic relationship with zooxanthellae – algae that live within their tissues and, as with reef-building corals, provide them with their colour and photosynthetically derived energy.

There are about a dozen species of fire corals, all of them in the genus *Millepora* and generically known as "milleporids"; of the dozen or so species worldwide, one – *Millepora laboreli* – is endemic to Parcel do Manuel Luiz. Milleporids are often the dominant species on the reef walls of these northernmost coral communities in Brazil, a component of the 16 species of true corals and calcified hydroids found here. At both Parcel do Manuel Luiz and Banco do Alvaro, coral take the form of a concentration of isolated pinnacles, each up to 300 m in diameter. The bases of these pinnacles lie at depths of between 25 and 45 m, and the pinnacles of some of them may reach the low tide level, although the tops of most of them are generally around 14 m below the surface. After the milleporids, the most dominant species on many of the pinnacles and reef slopes is the octocoral *Phyllogorgia dilatata,* which is endemic to Brazil.

Altogether, 50 per cent of the hard coral species recorded in Brazil have been found in this area, including six that had previously not been known to exist within in the larger northeastern Brazilian marine region, such as *Favia leptophylla*. Parcel do Manuel Luiz and Banco do Álvaro are also an important feeding and breeding area for a number of shark species, including Caribbean sharpnose and endangered nurse sharks. The large numbers of Caribbean reef biota that occur only along this part of the eastern coast of South America, such as the purple reef fish *Chromis scotti*, strongly suggests that the Manuel Luis reefs may be a major "stepping stone" for species between the Caribbean and the Brazilian coast.

This area has been a marine state park, covering 354 km^2, since 1999 and is also recognized as a wetland of international importance by the Ramsar Convention.

18

Rocas Atoll. Photo courtesy of Projeto Tamar Image Bank

BANKS CHAIN OF NORTHERN BRAZIL AND FERNANDO DE NORONHA

This region is located off the coast of the states of Ceará and Rio Grande do Norte in northeastern Brazil. Large banks and a seamount chain, including the only coral atoll in the South Atlantic, are featured here. The region is a hotspot of biodiversity and endemism, and includes the largest colony of seabirds in Brazil.

The Northern Brazilian Chain consists of several banks – the Aracati, Continental, Mundaú – that rise from the seabed 4,000 m deep to reach between 300 m and a mere 20 m below the surface. Overlapping it to the south and east, the Fernando de Noronha chain comprises the Rocas Atoll, the Fernando de Noronha archipelago (itself made up of 21 islands and islets) and a number of seamounts.[113]

Green turtle hatchlings, Noronha. Photo courtesy of Projeto Tamar Image Bank

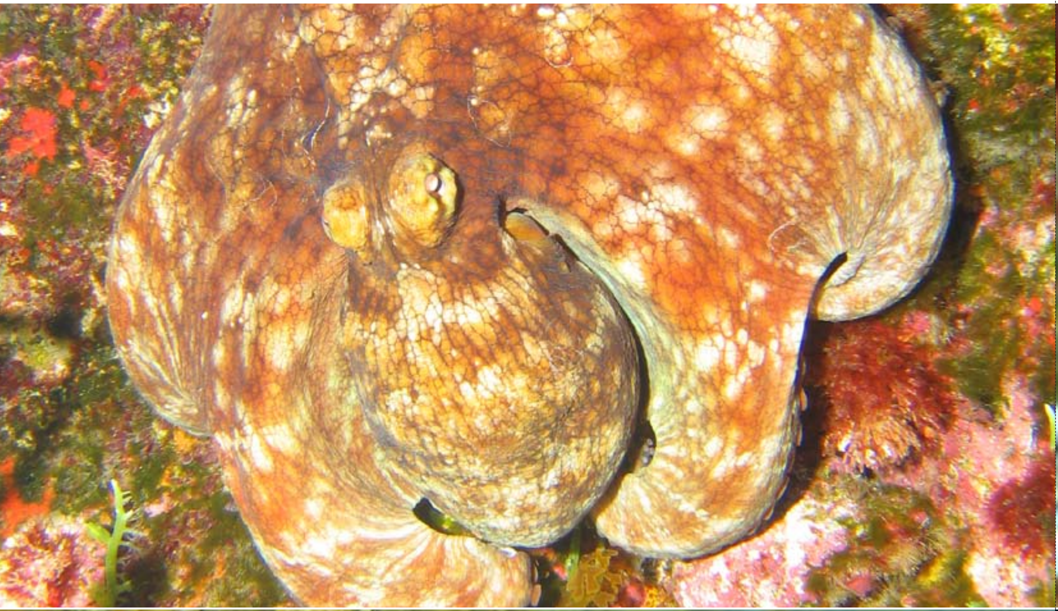
As the North Brazilian Current meets the topographic obstacles posed by the banks and islands, it eddies, swirls and upwells, transporting nutrients, boosting local production of phytoplankton, stimulating the area's marine ecosystem and supporting local fisheries. The fisheries in the area are more productive than, for example, those on the continental shelf and adjacent continental slope, as evidenced by the higher abundance of larvae at the Northern Brazilian Chain and around the Rocas Atoll.[114] Altogether, 169 species of fish have been recorded in Fernando de Noronha and 117 in Rocas, including endemics such as the wrasse (*Thalassoma noronhanum*) and damselfish (*Stegastes rocasensis*).[115]

The Rocas Atoll, the only atoll in the South Atlantic, has the largest colony of seabirds in Brazil, numbering some 143,000 individual birds of five nesting species: masked and brown booby, brown and black noddy, and sooty tern.[116] Two species that breed in the southern hemisphere, great shearwater and sooty shearwater, pass through the site during migration to and from non-breeding areas in the Northern Hemisphere, with over 50 per cent of the global population of the former (amounting to five million individuals) and 30 per cent of the latter potentially using use the site during May and June each year. Four species that breed in the Northern Hemisphere – Fea's and Zino's petrels and the Manx and Cory's shearwater – also pass through the site on their migrations south of the equator. As is also the case on Fernando de Noronha, the atoll is a nesting site for the green turtle and a feeding area for juvenile green and hawksbill turtles,[117] while the olive ridley turtle uses the area for feeding and as a migration route.[118]

The benthic macrofauna is more abundant on seamounts than the continental shelf; overall, 34 species of sponges, seven corals and 18 crustaceans have been recorded, including two species of crustaceans that occur only on oceanic islands: the land crab (*Gecarcinus lagostoma*) and aratu (*Grapsus grapsus*). Rocas Atoll and Fernando de Noronha also harbour the shallow-water octupus, *Octopus insularis*,[119] a species endemic to the waters of northeastern Brazil.

The Fernando de Noronha Chain has an unequivocal ecological importance due to high biological productivity and for providing important key habitats that are used as nurseries, feeding, breeding and sheltering sites of various species. The area is considered a hotspot due to its high biodiversity and endemism, and Fernando de Noronha and Roca Atoll have been designated as a national marine park and biological reserve, respectively, in recognition of their importance in the region.

Octopus inslularis. Photos courtesy of Tatiana Leite.



Top: *Stegastes rocasensis*. Photo courtesy of Osmar Luiz Jr. Bottom: *Thalassoma noronhanum*. Photo courtesy of João Paulo Krajewski.

19

Loggerhead turtle, Northeastern Brazil Shelf-edge Zone.
Photo courtesy of Projeto Tamar Image Bank

NORTHEASTERN BRAZIL SHELF-EDGE ZONE

This area is located along the Brazilian outer shelf and upper slope, from depths of 40 m to 2,000 m, extending from the south of the State of Bahia up to the State of Ceará. Found here are ancient fringing reefs which provide vital habitat for an abundance of species and a "fauna corridor" between the South American shelf region and the Caribbean. Three species of sea turtles, humpback whales and endemic reef fish species all use the region for different life stages.

Roughly 8,000 years ago, agriculture was making its first tentative footholds in Europe, where it had been introduced from southwest Asia; the first cattle were being domesticated; the earliest rice cultivation was taking place in what is now Thailand; and, off the northeastern coast of what is now Brazil, reef-building corals began to grow along the outer continental shelf. Over millennia, they have continued to grow, building up and retreating in response to changes in sea level. They were already 2,500 years old before the invention of the wheel, 3,000 years old at the time construction began on Stonehenge, and 3,500 years old when plans were drawn up to build the first of the Great Pyramids of Egypt.

Now, eight millennia later, they have in places grown to be 3 km thick, and they form the basis of a remarkable ecosystem. Rare and endemic fishes thrive on the reefs, migratory seabirds flock through, and sea turtles and whales return year after year.

This is an important nesting, foraging and migration area for three species of sea turtles: olive ridley, loggerhead and hawksbill. Using satellite telemetry, scientists have discovered that some loggerheads stay in the region for two to three years at a time, and return here repeatedly to forage.[120] The area is also an important part of the regional breeding grounds for humpback whales and is important habitat for other cetaceans, including Bryde's whales, dwarf minke whales and bottlenose dolphins.

Many of the resident species that spend part of their life history on the reefs also spend life stages in other, nearby habitats, such as seagrass meadows or mangrove forests, demonstrating the interconnectedness between the reefs and those habitats, and the importance of each for the life found in the others. The recent discovery of submarine canyons and varied micro-habitats within them only adds to the complexity of the environments within the area. There is also evidence that the reefs act as a fish "corridor", linking species along the shelf-edge zone in South America with those in the southwestern Atlantic and Caribbean.

It is important to improve knowledge on this area, including regarding patterns of cross-shelf connectivity, to inform appropriate policy and decision-making regarding the areas resources.

Bottlenose dolphin. Photo courtesy of Felipe Cabeza

20

ATLANTIC EQUATORIAL FRACTURE ZONE AND HIGH PRODUCTIVITY SYSTEM

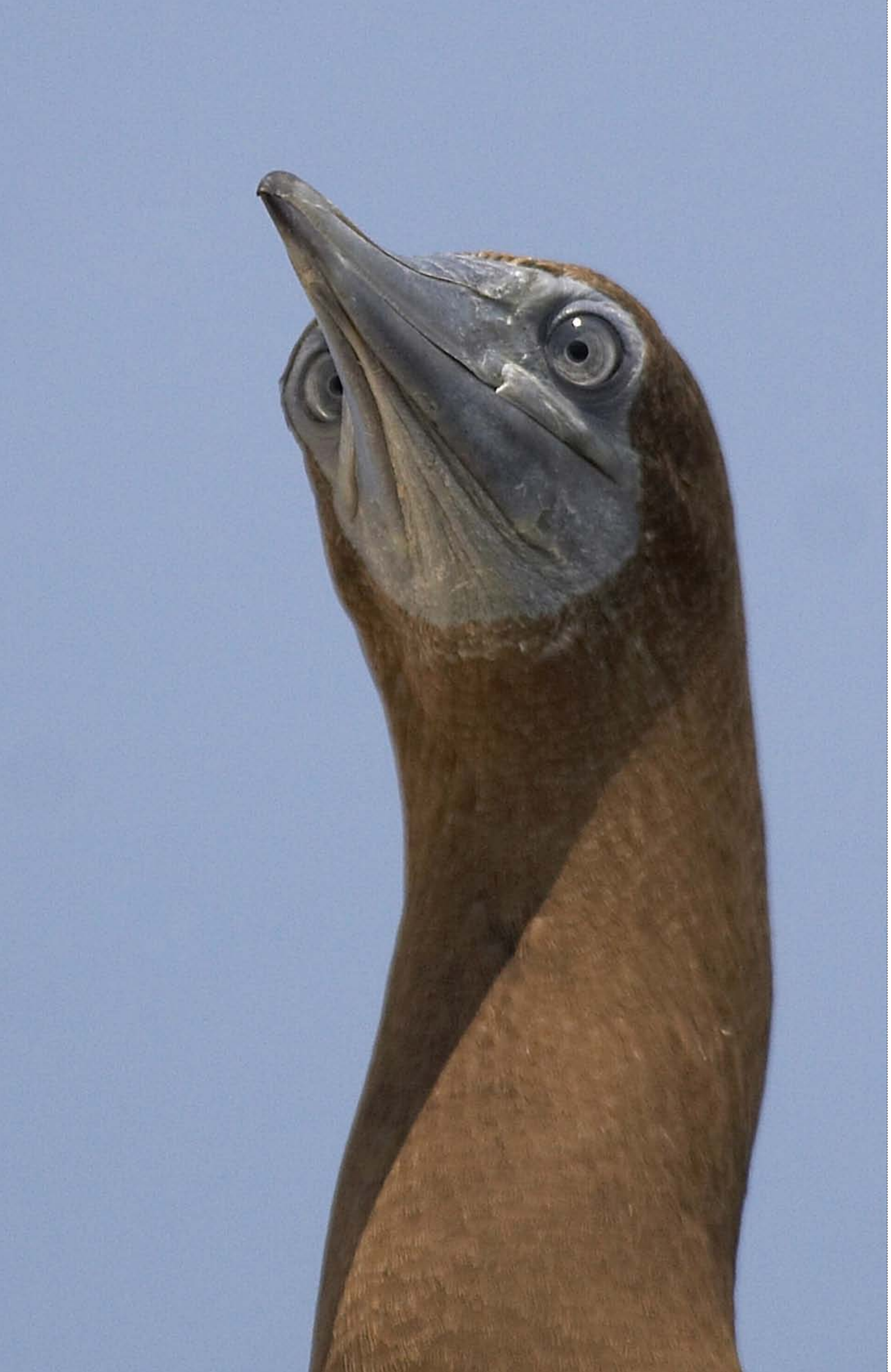
This area comprises approximately 1.9 million km² of the Equatorial Atlantic Ocean, from the western border of the Guinea Basin in the east to the north-eastern limit of the Brazilian continental margin in the west. It features a series of massive mid-ocean ridges and crests, breaking the surface to form an isolated archipelago at one end, and with a range of hydrothermal vents on the seabed. Seasonal phytoplankton blooms make this area an ecological hotspot. The hydrothermal vents are among the hottest ever recorded, while some of the archipelago's endemic fish species may have the most restricted range of any marine life.

Around 300 million years ago, the super-continent Pangaea began to break apart and, as a consequence, the global ocean Panthalassa divided into several smaller units. That division underwent a number of stages over tens of millions of years: the North Atlantic, for example, formed around 200 million years ago, while the South Atlantic formed from a separate spreading process about 100 million years later.

The two parts of the ocean remained connected at the relatively narrow Equatorial Atlantic, and the contrasting shearing and spreading patterns ultimately resulted in a massive geological feature known as the Equatorial Fracture Zone, 60 million years old and an average of 4,000 m high. It is characterized by parallel ridges and crests that are normally 1,000 m to 2,000 m deep, except at the western extreme, where they emerge above the water and form the Saint Peter and Saint Paul Archipelago. In contrast to the archipelago's peaks, steep trenches plunge as deep as 6,000 m. Hydrothermal vents on the southern edge of the zone – witnesses to the tectonic upheavals that created the formation and continue to tear at Earth's crusts – are some of the hottest in the world.

Because the fracture zone is so vast, it affects the circulation patterns of the main deep-water masses;[121] on its eastern extent, its interactions with the complex Inter-Tropical Convergence Zone result in a seasonal upwelling process that promotes an important equatorial phytoplankton bloom.[122]

The isolated Saint Peter and Saint Paul Archipelago hosts species of reef fish and invertebrates that are also found on the Brazilian and African coasts and on other oceanic islands of the South Atlantic, thus acting as a stepping stone in the dispersal of coastal fauna across the Atlantic. The archipelago is also home to a number of endemics and, because of its small coastal habitat, may have the most restricted distributions of any marine species, including five species that are believed to be found only on the rocky islet's shores and slopes.[123]



Pelagic fish and seabirds also use the islets and surrounding waters of the Saint Peter and Saint Paul Archipelago as feeding, nursery and reproductive grounds. Flying fish species, for example, are widely distributed in the tropical Atlantic but after spawning require the shallow hard substrate found here for their eggs to attach to. The area is also a spawning ground for wahoo and rainbow runner, and there is a resident population of the bottlenose dolphin in the area. The islets provide nesting sites for three seabird species: the brown booby, black noddy and brown noddy.[124]

Highly migratory tuna and swordfish of the Atlantic tend to concentrate in the equatorial areas for reproduction. That is the case of the commercially important yellowfin tuna, which spawns in the western side of the Equatorial Atlantic in association with the areas of high productivity.[125] The same area attracts important concentrations of the leatherback and the olive ridley turtle, which feed in the West Equatorial Atlantic.[126]

Far below the surface, the blistering heat of the hydrothermal vents and the multitude of deep-sea habitats bear witness to this area's convulsive birth. It seems likely that the deep-sea habitats are as critical for benthic life as the coastlines of the archipelago and the seasonal phytoplankton blooms are for life closer to the surface; for now, however, much remains unknown, and even after 60 million years, the Equatorial Atlantic Fracture Zone maintains many secrets that are yet to be discovered.

Opposite page: Brown booby. Photo courtesy of Ben Lascelles. Below: Benthos megafauna sample taken at the Romanche Fracture Zone. Photo courtesy of André Silva Barreto



Left to right: Brown noddy. Photo courtesy of Ben Lascelles. Seagrass bed, Abrolhos Bank. Photo courtesy of Dr. Joel C. Creed. Green turtle, Trinidade Island. Photo courtesy of Projeto Tamar Image Bank

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ABROLHOS BANK AND VITÓRIA-TRINDADE CHAIN

Abrolhos Bank, located on Brazil's continental shelf adjacent to the southern part of Bahia and northern part of Espírito Santo states, harbours the highest levels of biodiversity in South Atlantic waters and the world's largest rhodolith bed. The Vitória-Trindade Chain of seamounts begins slightly south of Abrolhos at 150 km from the coast and extends eastward for 1,200 km, ending at the islands of the Trindade and Martin Vaz archipelago. Some of its many features include one of the major green turtle breeding grounds in the Atlantic, at least 11 endemic fish species, a chain of seamounts, and likely the world's only breeding site for the Trindade petrel.

The Abrolhos Region, which includes the Abrolhos and Charlotte Banks, reaches toward the Atlantic from the continental shelf on the eastern coast of Brazil; a vivid imagination might see it as a bulging bicep extending into the straightened forearm of the Vitória-Trindade chain of islands and seamounts. Encompassing an area of 56,000 km^2, it harbours the highest marine biodiversity in the South Atlantic, boasts the largest and richest coral reefs in Brazil, and contains relatively large populations of several endemic and endangered marine species.[127][128]

This region includes a mosaic of different habitats, from mangroves and seagrass meadows to a range of reef types, and from estuaries and sand flats to small islands. Two particularly unique and unusual habitat structures are found on the Abrolhos Bank itself: enormous mushroom-shaped reef columns, known as "chapeirões", reaching up to 25 m in height, and the recently discovered "buracas", distinctive, sinkhole-like depressions in the shelf plain that drop to 39 m deep and reach 75 m in diameter.[129] The bank features the largest rhodolith bed in the world: almost 21,000 km^2 in area.[130] Rhodoliths – the free-living forms of a number of coralline red algal species – develop hard structures as they grow, before settling on the seabed, where they form vast, brightly coloured fields. The structural complexity of individual rhodoliths (i.e., as substrate) as well as that of their dense aggregations (i.e., as ecosystem engineers) provide habitat for numerous species, including at least 160 types of seaweed in this region alone,[131] many types of invertebrates, such as sea urchins, molluscs and shrimps, and fishes and sea turtles.[132][133]

The shallow, warm waters of the Abrolhos Bank provide the main breeding ground for humpback whales in the western South Atlantic Ocean,[134] and three dolphin species (Guiana, rough-toothed and bottlenose) use the area for feeding and breeding throughout the year – indeed, it is the only site where the Guiana dolphin occurs far offshore.[135] Very small numbers of endangered southern right whale, once very common as far north as Bahia before near extirpation by whaling,[136] appear to use the Abrolhos Bank for breeding and calving.[137]

A submarine volcanic chain of seamounts – the great Vitória-Trindade Chain – begins near the base of the continental slope 150 km off the south-eastern coast of Brazil, adjacent to Vitória, Espírito Santo State, and extends eastward before ending at the small oceanic island complex of Trindade Island and Martim Vaz Archipelago, some 1,170 km from the mainland. The nine seamounts making up the chain rise to between 50 and 150 m below the sea surface, and the summits of at least four of them, as well as the Trindade Island shelf, are predominantly covered by rhodolith beds and associated fauna.[138 139]

Trindade Island harbours at least 35 fish species listed as threatened by the IUCN or Brazilian red lists, and at least 11 species of endemic reef fish.[140 141] It is also the only breeding site for three endemic populations of seabirds, the Trindade petrel (*Pterodroma arminjoniana*), the Atlantic lesser frigatebird (*Fregata minor nicolli*), and the Atlantic greater frigatebird (*Fregata ariel trinitiatis*). All three are found exclusively on Trindade Island, with Trindade petrel numbers recently estimated at 1,130 pairs.[142] It appears to use the island only as a breeding site, and to spend the rest of its life cycle at sea, but, little is known of its oceanic distribution. It has, however, been recorded as far afield as the Azores and South Georgia, and is encountered regularly off North Carolina.[143]

The seventh-largest green turtle nesting area in the Atlantic is located on Trindade Island, and recent observations suggest that humpback whales may use the region as a migratory route into Brazilian waters.[144]

Magnificent frigatebirds. Photo courtesy of Ben Lascelles

Leatherback turtle. Photo courtesy of Projeto Tamar Image Bank

22

SOUTHERN BRAZILIAN SEA

The Southern Brazilian Sea area extends from Chuí, at the Brazil–Uruguay boundary, northwards to the proximity of the Santa Marta Grande Cape in Santa Catarina State and encompasses the waters from the shoreline to the 4,000 m isobath. This is a region of high productivity and, accordingly, is important for numbers of species, including deep-sea corals, whales and dolphins, demersal and pelagic fishes, seabirds and sea turtles.

Atlantic yellow-nosed albatross. Photo courtesy of Fabiano Peppes, Projeto Albatroz

Beginning a short way south of the equator, the Brazil Current carries warm water southward along the coast until it clashes with deeper, colder and nutrient-rich subpolar waters heading north. There is no formal, fixed location at which the two meet. In winter and in spring, the subpolar current is stronger and the encounter begins farther north; in summer, it warms and slightly weakens, allowing the Brazil Current to extend farther south.[145] But the net result is a meeting of cold and warm waters known as the Subtropical Convergence, and interactions between those converging currents, freshwater from the La Plata River and Patos Lagoon (especially in winter and spring), and topographical features such as islands, seamounts and the continental shelf and slope, combine to make this an area of swirling currents, eddies, upwellings and nutrient input.[146]

Accordingly, it is a region of high productivity and an important reproduction, nursery and feeding area for numerous fish stocks, of both subtropical and subpolar origin, and a notable foraging ground for whales and dolphins, seabirds and marine turtles.[147] The shelf and upper slope are used by at least 30 elasmobranch fishes (i.e., sharks, rays and skates),[148] of which 21 use shallower coastal areas as reproductive and nursery grounds.[149] Thirteen species of cephalopods are found within the region, including the ecologically and commercially important Argentine short-finned squid (*Illex argentinus*).[150] Found here, as well, are the only known spawning aggregation sites for the critically endangered Southwestern Atlantic population of wreckfish (or bass groper) *Polyprion americanus*. Although it occurs from Rio de Janeiro to Argentina, its highest abundance is between 200 and 600 m deep, off Southern Brazil.[151] Long-lived – as much as 76 years for males – slow to mature, and predictable in its aggregation, this large demersal fish is especially vulnerable to the impacts of human exploitation, and accordingly is one that the Brazilian Government has sought to protect.

It is an important foraging ground for several species of albatrosses and petrels, including the critically endangered Tristan albatross and the endangered northern royal, black-browed and Atlantic yellow-nosed albatrosses, as well as for the seven seabird species that breed in this region.[152] It comprises migratory and foraging habitats for adult leatherback turtles[153] as well as foraging areas for immature loggerhead and juvenile green turtles.[154] [155] This region is also the main breeding ground in Brazil for the endangered southern right whale,[156] one of at least 35 cetacean species recorded here, and the resident franciscana dolphin, which may be the most endangered marine mammal in the western South Atlantic.[157] It also serves as a migratory corridor for Bryde's, sei and minke whales travelling between wintering habitat in Brazil and their foraging grounds in sub-Antarctic and Antarctic waters.[158]

On the slope between 400 to 900 m in depth, the cold, nutrient-rich waters nurture vast expanses of deep-sea coral reefs, including five of the most important deep-sea reef-building species.[159] Deep-water corals are fragile, slow-growing and long-lived, and they provide complex structural habitat for a diversity of species comparable to that harboured by shallow-water tropical reefs.[160] [161]

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