SAMPLE

Mapping of the Extent of Coastal and

Marine Habitats and Coastline Types in Singapore The Story of an Island Nation's Vanishing and Reinvented Shores

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Free sample: Introduction & Chapter 1

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Introduction

On most maps, Singapore is a single red dot. On the maps that matter to the people who study it, Singapore is a shape that will not hold still.

Few places on earth have remade their own outline as deliberately, as completely, or as fast. In the two centuries since its founding, Singapore has been measured, surveyed, dredged, drained, filled, and drawn again so many times that the island's coastline exists today in two parallel forms: the coastline nature made, most of which is gone, and the coastline the nation built, most of which is younger than the people walking on it. The land itself has been growing — from roughly 580 square kilometres at independence to well over 700 today — a national expansion of about a quarter of the country's original size, manufactured from sand, granite, and intention.

This book is about what that expansion did to the shores, and what remains. It is a mapping of two coastlines: the one on the charts, and the living one beneath it. Because the paradox of Singapore's coast is that for all its transformation, it is not empty. The island republic sits in some of the busiest, most sediment-choked, most heavily trafficked waters in the world — and still holds more than half of the planet's known mangrove species, hundreds of species of hard coral in its southern waters, lush seagrass meadows that appear and vanish with the tide, and mudflats that feed shorebirds flying from Siberia to Australia on one of the world's great migration routes. A country with less than a thousandth of the earth's land surface carries a disproportionate share of its coastal biodiversity — squeezed, altered, and armored, but measurably, stubbornly there.

Mapping the extent of these habitats is not a historical curiosity. It is an active national discipline, and a matter of survival. The same sea that built Singapore's fortune has been rising around it; the same coast that carries the port carries the country's natural heritage. Every habitat survey, every coastline classification, every hectare counted is a decision point: what to defend, what to rebuild, what to let the water take.

The chapters that follow move from the island's origins through the great transformation, then walk the coast habitat by habitat — mangrove, mudflat, beach, rock, reef, seagrass, and the vast artificial shore — before turning to the mappers themselves: the agencies, scientists, and volunteers who count Singapore's natural wealth tide by tide, and what their maps say about the island's next fifty years.

The story of Singapore's coast is, in miniature, the story of every coast on a developed planet: what we keep when we grow, what we lose when we build,

and what it costs — in both directions — to decide which is which.

Chapter 1: The Island Before — Geology,

Origins, and the First Coastlines

To understand what Singapore's coast is, you must first understand what it was made of, because every coastline type on the island begins as geology.

The habitat map is shaped by the water as much as the land. Singapore sits at the pivot of two seas: the Johor Strait to the north — narrow, shallow, brackish, sheltered, a strait so gentle that mangrove and mudflat thrive along its shores

— and the Singapore Strait to the south, the deep-water highway that carries a substantial share of world trade past the island's reefs. The two waters could hardly differ more, and Singapore's two coastal biogeographies are their products: the soft, muddy, vegetated north — estuary country — and the harder, saltier, clearer-water south — reef country, or what remains of it.

The monsoons set the rhythm. The northeast monsoon (roughly December to March) drives wind and wave from the open South China Sea, reshaping the eastern sands and pushing water down the strait; the southwest monsoon (June to September) reverses the pattern, and between them the inter-monsoon calms give the intertidal seasons their survey windows. The tides are moderate — a range of roughly two to three metres — but the effect of that range on a flat coast is enormous: at spring low tide, Singapore's intertidal habitat briefly expands by square kilometres, and the entire volunteer-survey economy of the coast schedules itself against the published tide tables of the port authority. The tide table, on this island, is a habitat map that updates itself twice a day.

Singapore is geologically far older than its skyline suggests. The island's core is a fragment of the ancient Sunda Shelf — the continental margin that, in cooler eras of lower sea levels, connected the Malay Peninsula to Borneo and Sumatra as one vast landmass. When the oceans rose at the end of the last ice age, roughly ten thousand years ago, the shelf drowned slowly, and its hilltops became islands. Singapore is one of those hilltops.

The oldest rocks on the island — and the reason its colonial name, "the Granite Island," stuck — belong to a belt of granites and related rocks running from the island's center through its northern reaches, part of the same geological family as the Main Range of the Malay Peninsula. Around and over them lie newer sedimentary and volcanic formations: the Jurong Group in the west, whose sandstones, mudstones, and shales form the ridges and valleys of Singapore's southwestern quarter; patches of old alluvium in the northeast; and the young, soft marine clay and river mud that underlie the coastal plain — the material that makes reclamation both easy to begin and expensive to engineer.

The pre-development coastline followed this geology faithfully. Granite headlands resisted the waves and became the rocky promontories. The soft western and northern shores, facing gentler seas, accumulated mud and mangrove. The southern and eastern shores, exposed to more open water, took sand. Rivers — the Singapore, the Kallang, the Rochor, the Serangoon, the Jurong — cut valleys to the sea and built the estuaries where fresh water met salt. The first map of the coast was drawn by erosion and deposition, over millions of years, in three materials: rock, mud, and sand.

The oldest habitat map of Singapore is written in its place-names, and the names classify the coast with the precision of any survey. The Malay coastal vocabulary maps the shore type onto every headland and river: Tanjong (a cape or headland — Tanjong Pagar, Tanjong Rhu), Telok (a bay — Telok Blangah, the "cooking pot bay"), Sungei (a river — Sungei Buloh, the "bamboo river"), Pulau (an island — some sixty-plus in the archipelago), Pasir (sand — Pasir Ris, the "beach of the sawmill," and Pasir Panjang, the "long sand"), Batu (rock — the hard points of the coast), Muara (a river mouth), and the kampung names that preserve the coastal economy of the pre- industrial shore. Read the modern street directory with this glossary and the drowned coast reappears: the container terminals of Tanjong Pagar stand where the name says a headland stood; Pasir Panjang's long beach lives on as a road on reclaimed ground; Sungei Buloh's bamboo river is now the reserve that keeps the name honest.

The names are a map with no author, updated by every generation of coastal users, and they carry the historical layer a satellite cannot: what the shore was, feature by feature, in the language of the people who worked it. Modern Singapore preserves them on street signs and MRT stations — a coastline's obituary posted as infrastructure, or, more fairly, its memory kept in daily use. Either way, the toponymy is the first habitat survey the island possesses, and its most durable.

People have been reshaping Singapore's shore for far longer than the port has existed. Archaeology on the island and its neighbors records settlements going back well over a thousand years — coastal communities that fished, traded, and farmed the shore. The Orang Laut, the "sea people" of the region, lived aboard boats around the coasts of the straits in numbers that made early European visitors remark on the flotillas following local rulers. The coast these communities knew was a working landscape: mangrove timber for fuel and building, nipah palms for thatch and sugar, fish traps across the estuaries, beaches where prahus could be run ashore.

When Stamford Raffles signed the 1819 agreement that established the

modern settlement, the island's natural geography was still intact — a coastline of swamps and headlands, its hills forested, its rivers tidal almost to their sources. The earliest British surveys, completed within the first decades of colonial rule, mapped that coastline in detail for the first time, and their charts preserve a shape the sea has since erased: a southern shore fringed by reef flats at low tide, river mouths that opened in wide muddy deltas, and coastal hills that came down to the water — including, fatefully, a granite ridge along the southeastern shore that would eventually be leveled into the sea itself.

The historical charts are the first habitat map Singapore possesses, and they teach the two lessons every later survey would repeat. The first is that the coast was already changing before reclamation began: the Singapore River delta grew as settlements dumped fill; beaches shifted with the monsoons; mangrove retreated where woodcutters worked. The second is that what a map records is a choice: the colonial charts note depths, hazards, and shore types useful to a navy — rock, sand, mud, reef — a classification of coastline for navigation rather than nature. It would be more than a century before anyone mapped the same shore for what lived on it.

That shift — from mapping the coast as an obstacle to mapping it as a habitat — is the entire story of this book. The colonial chart asked: what will ground my ship? The modern survey asks: what lives here, how much of it is left, and what will the sea do to it next? Both questions, on an island like Singapore, are questions of national survival. Which is why the great redrawing began almost immediately after the first maps were finished.

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