CHAPTER 16

COASTAL STRANDS; INTERTIDAL HABITATS; AND SEABIRDS

16. 1. BEACH STRAND COMMUNITY DESCRIPTION

The **coastal strand** (sometimes just "**strand**") is that portion of a body of land which borders the seashore. This is a relatively narrow belt, beginning at the foot of a beach, or on coastal rocks just above the high tide level. The strand extends inland to the extent that salt spray from the sea regularly reaches.

There are many kinds of coastal strands. Beach strands are one type, rocky coastal strands are another. As mentioned, the distance to which the sea's salt spray extends inland defines the landward border of the strand. Ecologists classify plant species that can tolerate salt spray as "strand vegetation."

By definition, **beaches** are an accumulation of sand or rock fragments affected by regular wave action. Beaches come in many sizes and shapes. There are small pockets of sand narrowly gathered between a cliff and the water's edge. There are also long and wide expanses of sand, like those lining the Saipan Lagoon, Teteto Beach on Rota, and Tatchonya Beach on Tinian.

The CNMI's northernmost islands have several beaches that are grayish-black. This is due to their andesite-rich volcanic rock origin.

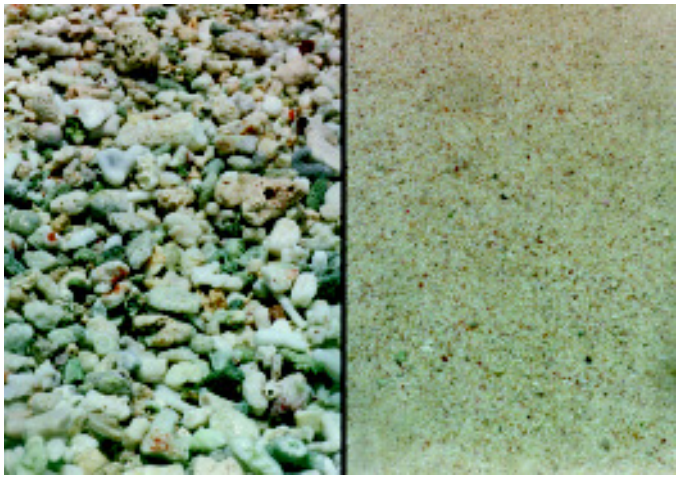
Beaches are always in motion. Small ones can appear and disappear from time to time as waves carry sand towards and away from land. Natural current shifts and storms, as well as human activities such as channel dredging, shoreline construction, and removal of vegetation can affect the size and shape of our beaches.

Life within the beach strand is dynamic. Coastal beaches are sometimes described as the interface—the meeting place—of land and sea. Species from the land crowd in from one side; species from the sea crowd in from the other. They compete with each other or, in some cases, help each other to live within the changing conditions of the beach strand.

The CNMI has several permanent beach residents. There are also many visitors; some come regularly, others come only rarely. The beach strand is an always-changing scene.

There are many kinds of coastal strands. Beach strands are one type.

The CNMI's northernmost islands have several beaches that are grayish-black. This is due to their andesite-rich volcanic rock origin.



Broken coral and shells, the remains of calcareous red algae, and the remains of a green algae called Halimeda make up parts of beach sand. Coral rubble is shown on the left and fine sand is shown on the right.

Parrot fish (Family Scaridae, atuhong, ha'yan, laggua) are known for their coral chewing activities.

16. 1. 1. Formation of Sand

Basically, sand consists of loose particles of hard broken rock or shells and skeletons of plants and animals. Since sand is made up of many loose particles, it has unique characteristics.

Sand does not form a suspension in seawater; instead it quickly sinks to the bottom. Unlike shorelines made of mud or silt, sand beaches allow coastal and lagoon waters to remain clear.

Sands on Saipan, Tinian, and Rota are mostly white to buff in color. They are said to be **bioclastic**, which means they are formed from the remains of living things.

Broken coral and shells, the remains of calcareous red algae, and the remains of a green algae called *Halimeda* make up parts of our beach sand. Many of the shells are from tiny **foraminiferans**, small microscopic shell-making **protozoans** related to the amoeba. Others come from mollusks and crustaceans.

Parrotfish (*Family Scaridae*, ATUHONG, HA'YAN, LAGGUA) are known for their coral chewing activities. Geologists have found that parrotfish "chewings" account for a large percentage of our beach sands' granules.

At some of our beaches, downstream from upland volcanic rock formations, we can find small bands of black sand grains. A check with a piece of iron shows they are magnetic. These are remnant fragments of a volcanic mineral called **magnetite**.

As mentioned in earlier chapters, black sand beaches predominate in our northernmost islands. These beaches are derived entirely from the weathering and eroding of volcanic rock.

The looseness of our beach sand below the low tide mark lets many sand-dwellers burrow into and live within them. At higher tides, water reaches organisms in the intertidal zone. Later this water drains off as the tide ebbs. Water percolating through the sand carries nutrients to these buried and hidden organisms. Worms, clams, and small crustaceans live here.

16. 1. 2. Beaches Present Difficult Growing Conditions

On an annual basis, our coasts receive less rainfall than our interior lands. Additionally the western, or **leeward**, sides of our islands are more sheltered from non-tropical storms and waves than our eastern, or **windward** sides. All coasts are equally vulnerable during tropical storms.

Plants growing along our coasts have a high tolerance for salt, whether in the air or in the soil. Many of the plants along the coast flourish in direct sunlight. However, some others grow only in the understory shade of nearby trees and shrubs.

Beaches, and sand flats with small dunes immediately behind them, present even more rigorous conditions than other strand situations. This is because they are made of loose, shifting sands. Sand provides a shifting substrate not easily inhabited by vegetation. Few plant species have developed adaptations to cope successfully with this limiting ecological condition. Those that can are com-

monly known throughout the tropics. These relatively few species grow where no others can.

It is difficult for germinating seedlings to get a foothold in loose shifting sand where they are in danger of being covered and uncovered. Also, the high temperature, the high salinity, the strong sunlight, and the drying effect of winds are four other conditions that plants must overcome to live within the strand belt.

Regardless of whether it is fresh or salty, water does not adhere well to sand grains. Despite all the surrounding water, ecologically the strand resembles desert conditions.

16. 1. 3. The Wrack

As waves, particularly storm waves, wash the beach, seaweed and other debris are thrown onto the upper beach area. This debris is referred to as the **wrack**. Here it decays and becomes mixed with sand.

Decomposition is very active within the wrack. The debris is then interpersed with sand and small organic matter. Pieces of it fill the little spaces among the grains and make the sand more stable.

Organisms such as hermit crabs, sand hoppers (amphipods), isopods (pill bugs), and millipedes flourish here. More abundant, however, is the population of microscopic protozoa and bacteria.

Seaweed and other debris thrown onto the upper beach area by waves are referred to as the wrack.

16. 1. 4. Time and Geographic Extent of Our Strand's Growth

Because our CNMI islands are relatively small and the distance from any point on land to the ocean is relatively short, many of our native plants are strand types. The strand vegetation species, that are here now, have been here for a long time, long before the arrival of people. With few exceptions, plants growing on the strand can be found elsewhere on our islands, but usually not as the dominant part of the community.

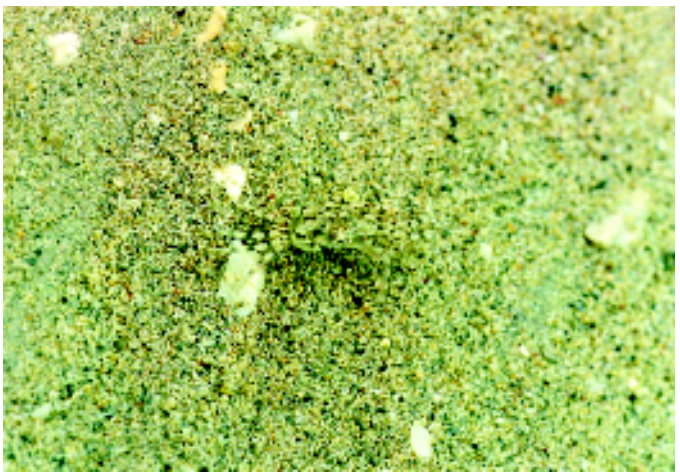
Throughout Micronesia, and, in fact, throughout the tropics, one finds many of the same species of strand plants which grow on other seashores. Biologists call such species, 'pantropical'.

16. 1. 5. Soil Along Our Beach Strand

Within the intertidal zone of the beach itself there is no soil. Hence there are no soil-rooting plants. Here the common ghost crab *Ocypode sp.* dominates. During the day these are mostly evidenced by their many crab hole refuges.

Adults usually only come out in late evening to feed and find mates and are always back in their holes come morning. Juvenile ghost crabs, however, sport such remarkable camouflage that they blend perfectly with their surrounding beach's sand grains. These 'ghosts' can safely roam around even in the daytime.

Within the strand zone but behind the intertidal zone of the beach, soil does develop. Soil along the beach strand of the CNMI is known as Shioya soil. The Japanese soil scientist who first described it, named it thus. Several of our present day soil and geologic formations, e.g. Densinyama and Sankakuyama formations, carry their original Japanese scientific name designations.



Within the intertidal zone of the beach the common ghost crab Ocypode sp. dominates. This juvenile ghost crab's coloration hides it well from potential predators.

Vegetation on our rocky shores is often stunted and bent shoreward, due to strong winds.

This soil type makes up about 1% of Saipan's surface, and 2% of Rota's and Tinian's.

Behind the beach, native plants anchor in the loamy sand of Shioya soil, and remain. They hold the sand with their root systems, and eventually provide more organic material to enrich the sandy soil.

This provides a well-aired, well-drained, more nutrient-rich growing medium for plants. If proper shoreline setbacks are established and adhered to by our regulatory authorities, such as is required by our Commonwealth's CRM Program, development can occur in harmony with the shoreline strand community.

Shioya soils are relatively deep and quickly drained of any fallen rain. Water-deposited limestone sands formed these soils. Typically the surface layer is a very dark gray loamy sand. Underneath this is very pale sand. At a depth of about 1½ meters, the sand is usually cemented into rock.

16. 1. 6. Freshwater Seeps

In some places along our beaches, if one digs down into the sand, fresh water may be found. When swimming in coastal areas near beaches, one can come across cool water currents that are blurred in their visibility.

These are evidence of our **freshwater seeps**—drainage of our islands' groundwater coming out of the **aquifers**. If the water is very calm, they can be readily seen when viewed from above as contrasting surface hues.

16. 2. COASTAL STRAND VEGETATION

16. 2. 1. Rocky Shore-adapted Plants – Introduction

Vegetation on our rocky shores is often stunted and bent shoreward, due to strong winds. This is particularly true of our eastern coasts but can be seen on our north, south, and western exposures as well. The sea's spray from breaking waves is often laden with salt. Plants growing here tend to be uniform in height, with wide spreading branches. These form a dense canopy with little undergrowth.

The height of vegetation here seemingly flows with the contours of the land. Branches of trees that would extend high above this flow are regularly broken by strong storm winds. Such an effect is called **wind pruning**.

16. 2. 2. Beach-adapted Plants – Introduction

Beach plants are tough. They live in hot sun, strong winds, and shifting sands. They often have little freshwater, and much saltwater. They may only grow low, and have tip branches that break off, offering little resistance to strong winds.

Alternatively, they may grow tall, and have flexible trunks to bend in the wind, like ironwood and coconut palms. Most have thick, waxy, or hairy leaves, and salty sap. These characteristics help them live in conditions of direct sun and salt spray that would dry out other plants. Harsh conditions ensure one thing: relatively few competitors for their place on the sand.

Certain plants affect the ground beneath their branches in such a way as to keep even their own seeds from developing. To survive, their seeds must germinate in another place.

Shade is one factor in this intra- and inter-specific competitive struggle. Another is acids leached from a parent plant's fallen leaves. To compensate, however, parent strand plants provide their seeds with an uncommon ability. This is the ability to survive and float in the sea. Most other plants' seeds will not stay viable for very long in seawater.

This ability, along with their gene-inherited ability to grow in the beach strand's harsh conditions, explains why the same strand species growing on Rota, Tinian, and Saipan also grow on islands throughout the Pacific and throughout the tropics.

16. 2. 3. *Pemphis*

Pemphis acidula is in the ***Family Lythracea***. Its common names include ENGI and NIGAS. *Pemphis* grows as a shrub or small tree. It is always very close to the sea. *Pemphis* has small gray-green leaves and small white flowers.

Pemphis acidula, Family Lythracea, has small gray-green leaves and small white flowers.

On leeward rocky beaches, this plant may grow into a fair-sized tree with a gnarled trunk and a large woody root system. On exposed shores, it is bent shoreward or prostrate, twisting its roots into coral crevices for support.

Pemphis is tolerant of salt spray, and sometimes even grows below the high tide mark.

Typhoons may remove upper parts, but the gnarled roots will sprout again. Shore plants often hold their place by bending, or having soft renewable branches that break off in high winds. Tough *Pemphis* crouches low and hangs on strong.

On a wind-swept coast, it may grow as a low, flat plant, out onto spray- and wave-swept rocks. Farther back, it grows as a low bush or small tree.

A clump of *Pemphis* is a living wind sculpture. *Pemphis* leaves are kind of salty-sour, like pickles and capers, fruit of another coastal plant. The durable wood is used in woodwork, spears, and fishhooks.

16. 2. 4. *Bikkia*

Bikkia tetranda is in the ***Family Rubiaceae***. Its common names include torchwood and GAUSALI. *Bikkia* is a shrub with pale green, rounded leaves. The long tubular flowers are pure white and square-shaped. They have an exceptional geometric attractiveness.

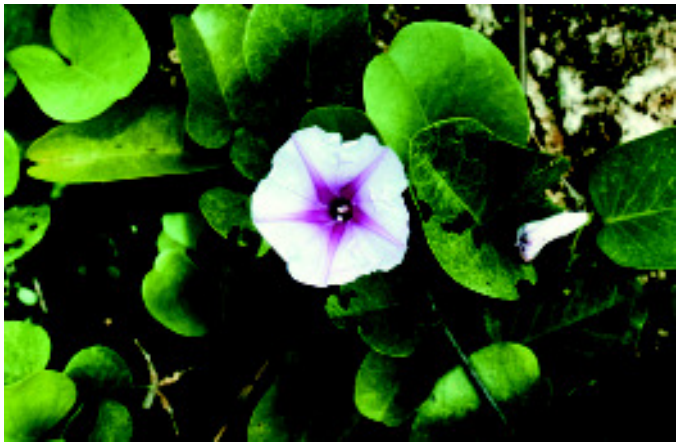
Bikkia tetranda, Family Rubiaceae, is a shrub with pale green, rounded leaves. The long tubular flowers are pure white and square-shaped and have an exceptional geometric attractiveness.

This species is **endemic** to our islands. It grows on exposed limestone cliff faces and on limestone boulders near the sea. The stems contain a flammable element and can be used as candles for lighting when cut into short sections.

16. 2. 5. *Ipomoea*

Ipomoea pes-caprae, subspecies *brasiliensis,* is in the ***Family Convolvulaceae***. Its common names include beach morning glory, ALAHAI TASI, and ARABWAL.

ARABWAL was the name given to the first Carolinian village on Saipan, now more commonly called Garapan. This species of *Ipomoea* is a creeping, rather fleshy, vine with large, glossy, rounded leaves. It grows on sandy or rocky beaches and sometimes in open fields.



Ipomea pes-caprae, subspecies brasiliensis, is in the Family Convolvulaceae. This species of Ipomea is a creeping, rather fleshy vine with large, glossy, rounded leaves which have a distinct cleft at the tip. Rose-colored flowers with purple in the throat appear at intervals.

Ipomoea is a true pioneer, often rooting in bare sand. It first sends down a deep taproot. Then, when conditions are favorable, it grows out over the sand. When conditions are harsh, it may die back, until only the part nearest the root is alive, waiting for a chance to extend itself again.

The leaves are dark green and have a distinct **cleft** at the tip. This is what earns it the specific epithet "pes-caprae" which translates to "goat-foot."

The flowers are rose-colored, with purple in the throat. The petals of the flowers, like all Convolvulacea flowers, are fused. The fruit is a black, rounded capsule, containing hairy seeds.

Beach morning glory grows pan-tropically. Different subspecies grow in different regions. Our subspecies grows in dense mats on sandy or rocky beaches just above the high tide mark.

The leaves can be boiled into a medicinal tea used in the treatment of chicken pox. The leaves can also be crushed and applied as a poultice directly to skin abscesses, to aid in healing.

Local SCUBA divers know *Ipomoea pes-carproe* well, as it is the preferred plant for rubbing on the inside surface of diving mask lenses. This keeps the interior mask glass free of fogging.

Interestingly, unknowing SCUBA divers world-wide spend up to several dollars an ounce for a similar solution, originally prepared by astrochemists. The scientists who formulated this similar solution did so to keep astronauts' facemasks clear on Apollo moonwalks.

Scaevola sericea, Family Goodeniacea, is a large spreading shrub with many branches. It has white "half-flowers" (several together) and white, round, fleshy fruits.

16. 2. 6. *Scaevola*

Scaevola sericea is in the ***Family Goodeniaceae***. Its common names include half-flower, NANASO, and LLAT. It is a large spreading shrub with many branches. It has white "half-flowers" (several together) and white, round, fleshy fruits.

The "half-flowers" are really there in their entirety. However, they look as though they have been cut in half. The mature fruits contain a juice like the water in our eyes. Island residents occasionally use it as an eyewash.

The fruits are saltwater-tolerant. They are also buoyant, and currents easily disperse them. The wood is soft, and breaks easily.

The leaves are pale green, spiraled and may be covered with "hair." The flowers vary considerably. Some plants have pure white flowers, while other plants may have flowers tinged with purple.

Scaevola is a native plant ranging from India to Polynesia and Hawaii. It is well-adapted to beach strand conditions. It has a strong root system and thick leaves. It also has leaves at the ends of long, flexible branches.

Strong winds may bend these branches, and break off the tips. This reduces resistance to the wind and lessens its chances of being entirely uprooted. After the storm, new leaves sprout, and the bush may grow back a little more tangled than before.

16. 2. 7. *Cocos*

Cocos nucifera is in the *Family Arecaceae*. Its common names include coconut palm, NIYOK, and LUU. It is a tall graceful palm. Reaching heights of 30 meters, coconut palms bear very large leaves up to twenty feet in length. The midrib of the palm **frond** has about 100 leaflets on each side.

Between its third and tenth years of growth, *Cocos* begins a continual bloom of flower clusters that continues until it dies. In its earlier stages of development, the cluster is surrounded by the green colored **spathe** that eventually opens, progressively exposing the numerous male flowers and sparingly few female flowers.

The nuts of the *Cocos* have a thick outer husk-like layer, and a hard thin inner "shell" layer. This inner structure encloses the edible white endosperm "meat" and "milk." It is a common beach plant and, while its exact origin is unknown, the genus is East Asian or Malayo-Polynesian.

This versatile tree is the 'staff of life' for many Pacific Islanders. Here in the CNMI we greatly appreciate its usefulness, even today. The leaves were used for **thatch** until World War II and the arrival of "roofing tin". They are still woven into baskets and used for festive decoration. The husk and shell are used as firewood.

The heart is edible, and is used to make a crisp salad. The sap from the flower stalk is tapped to make **tuba**. This is a mildly intoxicating drink that eventually turns to vinegar as it **ferments**. The water in the green nut is a sterile, nutrient-laden liquid that is sweet to drink.

The CNMI's first coconuts were once thought to have likely been brought by the ancient Chamorros. Now we know from pollen studies of Lake Susupe's sediments that *Cocos* was here even before people arrived. Coconut palms generally grow just behind the beach, rather than on it. However, they often lean out over it.

The root system of *Cocos* usually goes down about 1 meter and in very good soils, it can reach down 5 to 10 meters. Although LUU cannot grow in waterlogged soils, it can grow near sand beaches. This is true even if its roots are occasionally covered by saltwater, as long as the water drains away.

If left alone, coconut groves tend to become very dense as young trees grow up beside their parents. This could be one reason they lean out over the beach—to get sun. The growing tip is sensitive to light, and will grow toward light. A tree will lean out over the beach, where no other tall plants can compete with it for light.

Trees growing nearest the beach strand maintain a somewhat precarious balance. They lean out into the free sun, avoiding the shade of the trees behind them. But, if they lean too far, they topple.

Cocos nucifera, Family Arecaceae, is a tall graceful palm. Reaching heights of 30 meters, coconut palms bear very large leaves up to twenty feet in length and begins a continual bloom of flower clusters that continues until it dies.

Niyok provides food, oil, vinegar, yeast, and drinks, both fermented and non-fermented. It also gives us thatch-weaving materials, wood, and medicine from roots and bark.

The fruit of the coconut tree is one-seeded. It is surrounded by a fibrous wall and a hard shell.

Another reason suggested for growth outward over the sand is so that the trees can drop their seeds into an incoming tide. The outgoing sea then helps them colonize further.

Cocos roots, though extensive, are anchored in shifting sand and are exposed to strong winds. If a severe typhoon does not occur for a long time, these trees may grow tall, and lean far over the beach. But, when a strong storm comes along, down goes the "monarch of the beach."

In the months that follow, up comes the next "noble" to take his place farthest out in the free sun. We might be surprised by how tall beach coconut trees are on other Pacific Islands. This means they do not have the frequent typhoons that the CNMI has.

We know more about *Cocos* than other beach trees because coconut palms are so much more useful. The nuts ripen in 9 or 10 months, germinate a few months later, and grow into trees that flower in 3 to 10 years. Depending on variety, some can bear continuously at about 6 years, producing around 40 coconuts a year. The dwarf palm, smaller and introduced, produces within 3 years.

Coconuts have a rough, tough, fibrous, and often curved trunk. The base is often swollen. The one main trunk has a crown from which fruits, flowers, and pinnate leaves develop.

Cocos provides food, oil, vinegar, yeast, and drinks, both fermented and non-fermented. It also gives us thatch-weaving materials, wood, and medicine from roots and bark.

The fruit is one-seeded. It is surrounded by a fibrous wall and a hard shell with three "eyes" at the top. The outer husk of the fruit provides a harsh fiber sometimes used for upholstery and other stuffing. This includes **coir**, which we use to make doormats, and **sennit**, for ropes and lashings.

To process the husk fiber, nuts are **retted** (soaked) in salt water for some weeks. Then they are **hackled** (beaten) to separate the fiber, washed and beaten again for further separation, and dried. In the CNMI, the husk is used for potting aerial plants like orchids and ferns. It is also used as fuel.

If you want your favorite "manha" (green coconut with tender meat) tree to be as productive as possible, do not hack steps on the trunk. Being a **monocot**, *Cocos* has **vascular bundles** (interior plant fluid piping) scattered throughout its trunk.

A coconut tree, a monocot, cannot form bark like **dicot** trees can. Its wounds therefore, remain.

Some people tend to cut steps on alternate sides of the trunk. This is worse than one-above-another steps, because the side-to-side steps cut through the veins on two sides. One step above the other cuts through only one section of the plant's internal vascular system.

If it is necessary to climb a tree often, use a ladder. Better yet, learn to climb island-style, by making a looped rope of cloth, or

more traditionally, of PAGO bark. Put your feet in it, and hop up the tree. Many islanders can do this—even without a rope. Coconut tree climbing is a great sport.

16. 2. 8. *Thespesia*

Thespesia populnea is in the ***Family Malvacea***. Its common names include PULE and BANALO. It is a medium-sized tree (up to 8-10m), commonly found close to the beach on the leeward side of our islands.

The smooth leaves are heart-shaped with a long, tapering tip that points downwards. The flowers are hibiscus-like, yellow in the morning, but turning light purple before they fall off during the day. The fruits are woody, turning brown with age. It has a yellow sap.

Thespesia is found along shores of paleotropical seas. The wood is reddish and, hence, has been given the name "rosewood." The bark yields a yellow dye.

Thespesia populnea, Family Malvacea, is a medium-sized tree commonly found close to the beach on the leeward side of our islands.

16. 2. 9. *Tournefortia*

Tournefortia argentea is in the ***Family Boraginaceae***. Its common names include TSCHEL and HUNEK. It is a small tree with a spreading crown.

Tournefortia has light green down-covered leaves. The white flowers are coiled at the ends of its branches. The fruits are pea-sized. They are green when immature, but turn brown with age.

This umbrella-like tree grows on tropical shores from the Indian Ocean to the Pacific. Originally it was one of the most common beach plants of our islands.

Unfortunately far too many have been cut down and were used as firewood for beach barbecues. *Tournefortia* still grows in many places on our islands, mostly located away from our favorite picnic spots.

Learn what *Tournefortia* trees look like and be sure to never cut off their living branches and stems for firewood. Stop your companions from doing this if you can. These are one of our most beneficial shade-providing and sand-binding trees. Please help them survive!

Tournefortia argentea, Family Boraginaceae, is a small tree with a spreading crown and light green down-covered leaves.

On exposed beaches, *Tournefortia* grows low and mound-like, giving a rounded profile to the winds. The leaves cluster at the ends of the branch and break off during storms. The trunk of *Tournefortia* is very strong. In India, the leaves are harvested for food. These are said to taste somewhat like parsley.

16. 2. 10. *Calophyllum*

Calophyllum inophyllum is in the ***Family Guttiferae***. Its common names include palomaria, DA'OK and RAGHISCH. It is a medium to large tree with dark green leathery leaves.

Its flowers are very pretty. These grow in clusters and are white with beautiful bright yellow-orange stamen accents. The fruit is round, golf-ball sized, and hangs in clusters on long stems. The fruit is also poisonous. A medicinal skin oil, called *calophilic oil*, is extracted from these seeds after they mature.

Calophyllum inophyllum, Family Guttiferae, is a medium to large tree with dark green leathery leaves.

Calophyllum is a familiar strand plant on many Pacific Islands. It is native to tropical Asia as well. The wood is hard and of good quality, and the tree is attractive for landscaping. *Calophyllum* makes a great shade tree.

Casuarina equisetifolia, Family Casuarinacea, is a fast-growing tree that may reach up to 80 feet within ten years. The bark is gray, ranging from light to dark. The wood is very tough and dark red in color.

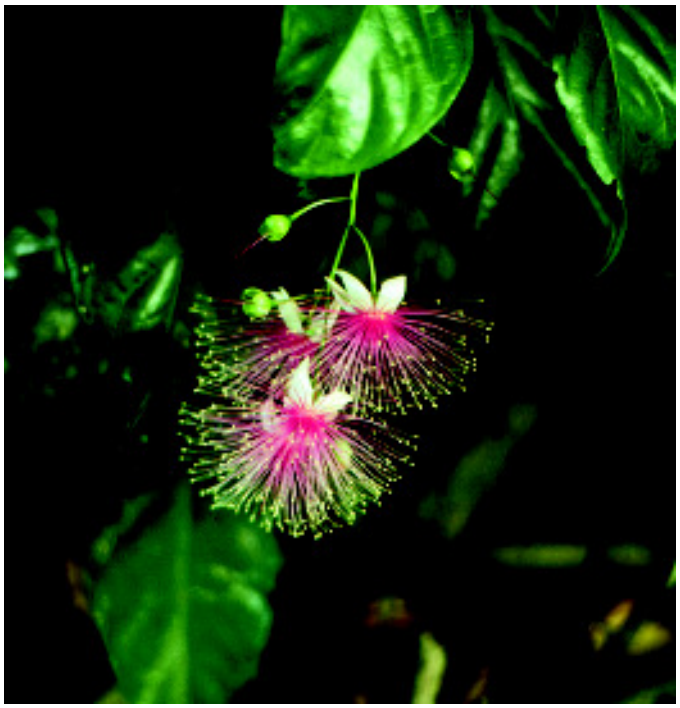
16. 2. 11. *Casuarina*

Casuarina equisetifolia is in the ***Family Casuarinacea***. Its common names include ironwood, Australian pine, WEIGHU, and GAGU. It is a fast-growing tree that may reach up to 80 feet within ten years. The bark is gray, ranging from light to dark. The wood is very tough and dark red in color.

Although *Casuarina* is commonly called a pine, it is not one. Its "needles" are actually thread-shaped, jointed, greenish 'branchlets'. Look at a branchlet carefully. Note the tiny, brownish, teeth-like organs at each branchlet joint. These are degenerate leaves.

This tree was named after a large, flightless Australian bird called "the cassowary". Cassowary feathers are flexible, thin, and drooping, like the branches of the tree. Early European visitors to Australia noted the resemblance. The tree was given a genus name similar to the bird's, which is *Casuarius*. There is a rule in biological naming. Genus names cannot be duplicated. Only members within a genus can share its name.

Casuarina is flexible and tough. When typhoons hit, the trees bend with the wind. Tips of the branches break off and there is less resistance to the wind. After a typhoon, the tree may look as if it has "mange", but it is still standing, and it will soon grow back its long needle-branchlets.



Barringtonia asiatica, Family Lecythidaceae, is a large tree with long leathery, dark green leaves and large flowers with white petals and numerous pink and white stamens.

16. 2. 12. *Barringtonia*

Barringtonia asiatica is in the ***Family Lecythidaceae***. Its common names include fish-kill tree, GHUÜL, and PUTING. This is a large tree with long leathery, dark green leaves.

The leaves grow crowded together at the ends of the tree's branches. The flowers are large with white petals and numerous pink and white stamens. The tree blooms almost continuously, but the flowers are rarely seen on the plant. This is because they open in the early morning, and soon drop off. The ground around the tree sports large numbers of these sweet smelling stamens.

The one-seeded fibrous fruit is square in one dimension and pointed like a top in another. These are about 10 centimeters in length. *Barringtonia* is native throughout the Indian Ocean and along tropical Pacific coasts. In earlier times, islanders crushed the inner seeds to prepare a poison used for stupefying fish on the shallow reefs.

Today this practice is illegal. Ironically, although the tree may be used to poison fish, if a person gets fish poisoning from eating certain types of fish, the tree may also provide an antidote. The bark of the tree is boiled into a strong tea, which is taken internally.

16. 3. ROCKY INTERTIDAL HABITATS

16. 3. 1. Tide Pools – Introduction

Tide pools are unique habitats within the rocky shore ecosystem. Tide pools are the small pools of water in areas of rocky coastlines found above sea level when the tide is out.

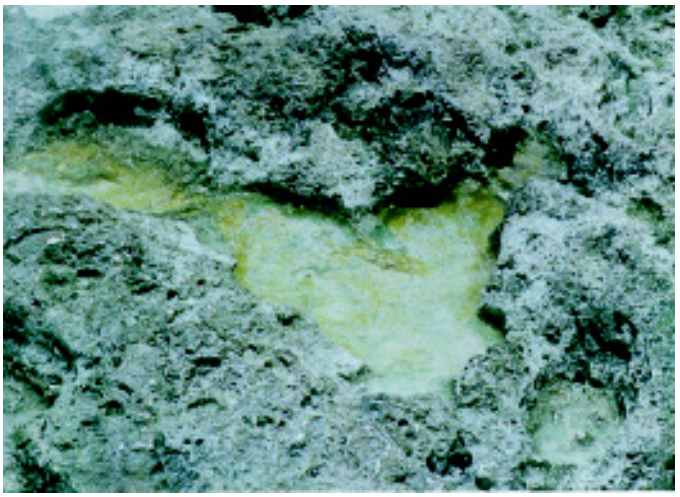
16. 3. 2. Tide Pool Environmental Conditions

The water in tide pools often becomes very hot. It also has a great range of **salinity**.

Tide pools become very saline when the daytime sun heats the water, causing freshwater molecules within it to evaporate. The salt molecules are left behind. The pool becomes saltier with each evaporating water molecule until the tide returns.

Tide pools can also become very low in salt content. This is because, during storms, fresh rainwater collects in these pools.

The organisms that live in tide pools need to have special adaptations for living under these changing conditions. If they are able to survive, however, tide pools offer protection from many reef predators, such as sharks and large groupers.



Tide pools become very saline when the daytime sun heats the water, causing freshwater molecules within it to evaporate.

Several small fish species are commonly found inside tide pools. There are also many **mollusks**, **echinoderms** and **sea anemones** found here as well. Many forms of algae live in tide pools that are not found elsewhere, isolated from herbivorous reef fish.

16. 3. 3. Snails and Coastal Bioerosion

Several forms of snails inhabit our intertidal area, both within tidepools and on rocks and cliff faces. These graze on the fleshy and filamentous **endolithic** (inside of rock) **algae** growing here. Each snail must stop eating and hold firm to a rock surface when the tide comes up and waves are crashing. When fully submerged during the highest tides, they graze and graze.

These snails are chiefly responsible for the **bioerosional 'notches'** or 'nips' of this zone. They have sharp grinding teeth on a tongue-like mouth part called a **radula**. They use it to regularly scrape off coralline algae.

16. 3. 4. *Chitons*

Chitons are one of the oldest form of snails. Evolving from segmented worms, they still show their ancestral segmentations as eight plates on their outside surfaces.

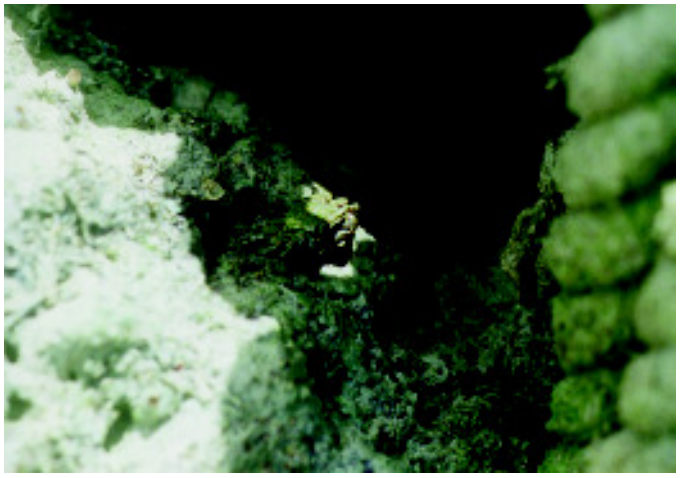
16. 3. 5. Periwinkles

Periwinkles have pointed turban-like tops and usually gather in large groups. They tend to be dark colored in grays and blacks, and several species have stripes on their shells.

Periwinkles have pointed turban-like tops and usually gather in large groups. They tend to be dark colored in grays and blacks, and several species have stripes on their shells.

Like many other snails, periwinkles have a small "trapdoor" called an **operculum**. They can use this to seal themselves in so they do not dry out. When the waves are up, they glue their operculums with mucus secretions to the rocks. These secretions allow them to hold on strong.

Pulling a limpet from a rock is very difficult since they have a low profile and a strong muscular foot.



Grapsid crabs are often seen skirting along the upper-intertidal zone of our rocky shorelines. Except when they are molting, their coloration is the same as the rocks over which they crawl.

Slate pencil urchin spines were once used as pencils.

16. 3. 6. Nerites

Nerites are snails with rounded spiral-shaped shells. Local species are either all white, or grey and white striped. They are a little larger than periwinkles, and do not gather nearly as much in groups.

Empty shells from both periwinkles and nerites are often adopted as homes by small, shallow-water hermit crabs.

16. 3. 7. Limpets

These cone-shaped snails live in the **surge zone** (cliff sides at wave height) along the roughest coastlines. In Hawaii, some limpets are known as "Opihi." They are considered a delicacy and can fetch a high market price. Collecting them is very dangerous. It is not unusual to hear that people are killed by being washed out to sea as they try to collect these prized seafood animals.

In the Marianas, on the other hand, it is unusual for someone to attempt to collect them. This is because here they are not valued as highly as the more easily-collected octopus and reef fish.

Pulling a limpet from a rock is very difficult since they have a low profile and a strong muscular foot. To get one, it must be caught unawares using a pry tool.

Some forms of limpets can survive for very long periods in the high and dry upper tidal regions. There they get wet only on the highest monthly tides. They must then eat enough algae, before the water goes out, to nourish them until the next high, high tide.

16. 3. 8. Grapsid Crabs

Grapsid crabs are often seen skirting along the upper-intertidal zone of our rocky shorelines. Their flattened bodies and long legs give them a low center of gravity. Their broad base allows them to meet the force of the waves. The flatness of the body allows the crabs to hide in narrow crevices.

Spines on the tips of their legs help in grasping the rocks. Except when they are molting, their coloration is the same as the rocks over which they crawl. We usually see them only after they move.

Molted skeletons from grapsid crabs are reddish in color. These are often found when one visits their intertidal habitat.

16. 3. 9. Armored Sea Urchins

Our two armored urchins include the slate pencil urchin and the shingle urchin. Slate pencil urchin spines are often found along the beach.

As their name implies, slate pencil urchin spines were once used as pencils. This was long ago, when school children used to write on slate tablets, instead of on paper.

Shingle urchins are not usually seen, unless the tide is very low. These are very flat animals. Even the spines on the shingle urchin are all broad and flat. Their flatness allows them to live in the very strong surge zones of our eastern seacoasts.

16. 3. 10. Special Predators of the Intertidal Zone

The octopus and the moray eel are specially adapted to tide pool life. Both of these predators are able to crawl out of one pool and move over to another.

Don't be surprised if you see one slithering along the rocks. It will soon plop into another pool as it hunts.

Octopi are known locally to even "walk" up out of the water at local beaches to grab a young ghost crab unawares. Sunbathers beware!

16. 3. 11. Special Intertidal Zone "Walking" Fish

Two families of fish, the gobies and the blennies, are specially adapted to tidal, rocky coast living. These fish use their forward fins to "walk" over the rock surface.

They seek the algae growing in and outside of the tide pools. Because of their facial features, members of these fish families are referred to locally as "monkey fish."

The octopus and the moray eel are specially adapted to tide pool life. Both of these predators are able to crawl out of one pool and move over to another.

16. 4. OUR SEABIRDS AND SEABIRD ROOKERIES

16. 4. 1. Introduction

A seabird in flight is a beautiful sight to watch. Seabirds spend most of their lives far out in the open sea.

In contrast with such modern navigational devices as satellite GPS units, radar, and sonar fish finders, nature has provided an aid that fishermen have relied upon for centuries to locate tuna and other schooling "blue water" fish. This aid is our seabirds.

Seabirds not only lead the fisherman to schools of fish. When the day's fishing is over, they also guide him back to land. It may well be that seabirds guided Ferdinand Magellan to his "discovery" of the Marianas.

Like fishermen, seabirds must catch fish to survive, and they are highly efficient at locating their food. Seabirds feed mostly on small "bait fish" and squid which have been chased to the ocean surface by tuna and other large predatory fish. The bait fish, unwilling to swim downward where hungry tuna are waiting, make easy prey for the birds.

Patrolling seabirds spot the commotion of fish breaking the water, and quickly home in on the feast. In no time, a large, swirling, black, brown, and white flock of seabirds gathers. The birds plunge together into the water, as the bait fish rise, fleeing the tuna.

Seabirds catch fish by different techniques. Each species specializes in a particular method of fishing. The large boobies (so named because they are often naive and fearless of humans) plunge from great heights. The momentum of their dives carries them as much as several meters underwater.

Tropicbirds, although smaller, also make these deep dives. Shearwaters make shallower dives, but continue "flying" underwater by using their wings as oars. White terns, noddies, and sooty terns stay in the air and dip briefly into the water to pluck fish near the surface.

A seabird in flight is a beautiful sight to watch. Seabirds spend most of their lives far out in the open sea.

Both the commercial fisherman and the sport fisherman find that seabirds are essential.

The sport fisherman who is out to capture a trophy is always on the lookout for tropicbirds.

The masters of this technique are the long-winged frigatebirds which deftly snatch flying fish in midair. Frigates also use their flying skills to chase down other birds and steal their catch.

Studies of seabirds' diets showed that although seabirds consume an enormous variety of small fish and squid, only a few prey species make up the bulk of their diets. Flying fish, scads, halfbeaks, juvenile goatfish, and squid are the favorite food of seabirds.

Frigatebirds, boobies, and tropicbirds especially seek flying fish to eat. Seabirds only rarely take young tuna, mahimahi, and other open ocean fish. Also, seabirds must avoid being eaten by the large fish, particularly in the confusion of a feeding school.

Although seabirds do compete with large fish for the bait fish, these birds consume just a small fraction of the bait fish schools.

Both the commercial fisherman and the sport fisherman find that seabirds are essential. They may depend entirely on seabirds when they head out to sea. Seabirds lead them to the fish.

On a typical day of fishing, a tuna fisherman leaves the dock and heads out to the open sea. Because tuna are always on the move, the fisherman cannot just go straight to one area where fish were caught before, and expect to find them there again. So, the first thing to do is find a seabird or a flock of birds, then follow it to the fish.

A true fisherman knows seabirds well. By looking at the birds feeding on a school of fish, they can identify the type of fish in that school. Different species of seabirds are often associated with different species of fish.

For example, for a mahimahi school, white terns are the majority of the birds following and feeding on the baitfish preferred by this species. At a tuna school, the majority are the black noddies, sooty terns, and brown boobies.

White terns are also found at tuna schools, but not as commonly as at mahimahi schools. At schools of larger fish (weighing over 10 pounds), such as yellowfin tuna and skipjack tuna, boobies often make up the majority of the flock.

The sport fisherman who is out to capture a trophy is always on the lookout for tropicbirds. The tropicbird has been named the "marlin bird" by sport fishermen, for it is often present when a big marlin strike occurs. They have also been associated with large sailfish.

The frigate birds not only aid the fishermen in locating fish, they also give warning to the general public whenever a storm or typhoon approaches. The only time frigate birds appear at Saipan and Tinian is just before or after a bad storm. On Rota they are more common, especially near the Seabird Sanctuary. Older folks call this bird "PALUMAN PAKYO."

The colony of frigatebirds nearest to Saipan is at Farallon de Medinilla, which is often used as a military bombing target. Recently CNMI resource management personnel worked with the U.S.

Department of Defense to relocate bomb targeting away from the portion of this island where these birds are known to nest.

Hopefully, someday, when the world is a safer place and defense training is either no longer an issue or can be done without environmental damage, this CNMI island can get a respite and be rehabilitated.

Seabirds, especially those of the open ocean, have contributed hours of flying time to the evolution of our life-sustaining islands. For centuries, they have been carrying nutrients of the sea back to land.

As mentioned in earlier chapters, they assisted the first plants on our islands to arrive here, establish soil, and then grow into the forests we know today. These first plants provided shelter, habitat and sustenance for other arrivers and for those endemic species which evolved here.

Seabirds thrive by the thousands on our uninhabited islands. Those of long ago left a legacy of **guano**, turned into phosphate rock. Some islanders, such as our Nauruan neighbors (present population about 10,000), and their Australian business partners, have become relatively wealthy by mining and selling 'island land' which seabirds built and enriched long ago.

Unfortunately the mining on Nauru has left a truly barren landscape. Populations of terns, frigate birds and other seabirds have dropped dramatically. Some species of Nauru's nest supporting trees cannot survive the high heat that results from the mining. A major rehabilitation effort is planned however, to be implemented once the mining gives out.

Seabirds cannot tolerate the continued presence of people in large numbers, nor the added pressure on their nesting grounds. Even worse are the pests people unintentionally introduce, the rats, cats, and feral dogs. There are fewer and fewer "away from it all" homes for seabirds.

A fact not known, or not heeded by many, is that seabirds are protected by law. (See our Chapter 38 on Federal Laws and International Treaties).

The frigate birds not only aid the fishermen in locating fish, they also give warning to the general public whenever a storm or typhoon approaches.

Seabirds thrive by the thousands on our uninhabited islands.

16. 4. 2. Seabird Anatomy

A bird's body is highly adapted for flying. It has forelimbs that function as wings, and many species have hollow bones. These keep their weight light.

In addition, each bird's body is highly streamlined, which reduces resistance while flying through the air. The bird breast bone is similar in shape to a keel of a boat. Muscles are attached to the breast bone, and supply the wings with power.

In birds that spend long time periods in flight–such as true seabirds–the breast muscles are very well-developed. Many birds have modified beaks or bills, so that they can easily pick small prey out of the ocean.

Birds have a four-chambered heart which is more powerful than that of a reptile or even a mammal of the same size. Mammals also have a four chambered heart. This feature allows birds to circulate oxygen through their bodies at a high rate. Birds have a well-developed brain and nervous system. Their vision is excellent, often times far superior to that of human beings.

White terns are often found in Casuarina and other trees along our shorelines.

16. 4. 3. Terns

Gygis alba is the most common tern in the CNMI. You probably noticed that we adopted this bird for our book's cover. In English it is called a fairy tern or a white tern. In Chamorro it is CHUNGE' and in Carolinian it is GEEGHI or GHIYEGHI. These graceful white terns are often found in *Casuarina* and other trees along our shorelines. They may also be found "nesting" inland at cliffline forests and at our savannas.

White terns do not actually make nests. Instead, they lay their eggs in the forks of trees such as *Pandanus*, or in depressions on branches, especially those of breadfruit trees.

It is a marvel that the young hatch without falling out of the tree! The parent bird goes fishing, and can often be seen flying inland with fish held crosswise in its beak. The young can eat live fish one after another, sometimes shaking all over after swallowing a particularly big, still wiggling fish!

The fairy tern is one of the CNMI's most familiar seabirds. It can be seen hovering over the reef, diving down to eat small fish or squid. As mentioned, fishermen like this small, friendly tern because it often leads them to schools of tuna and mahimahi.

White terns do not actually make nests. Instead, they lay their eggs in the forks of trees such as Pandanus, or in depressions on branches, especially those of breadfruit trees.

Fairy terns keep the same mate for their entire lives. Take a look up in the sky once in a while. You may well see a mated pair gliding, swooping, and barrel rolling, seemingly just for the joy of it.

To keep their eggs safe from most predators, fairy terns lay a single egg on a bare branch. The female sits on the egg, while the male hunts for fish. The male feeds the female until the egg hatches.

The tiny fuzzy chick has big feet to grab the branch tightly. Its feathers are spotted with different colored browns to match the branches. After hatching, both parents bring small fish in their bills to help the chick grow quickly.

If the chick falls to the ground, the parents will try to feed and protect it. Storms and hungry predators make life hard for baby terns. If people come too close to the baby, the parents will fly down and try to peck them on the head.

If a fairy tern gets thirsty while fishing, it can dip down and drink seawater. Seabirds' bodies are able to get rid of extra salt that would kill most other animals. Look for these terns in the forest and near our beaches, especially around sunrise and sunset.

16. 4. 4. Noddies

Anous stolidus is a popular bird with the CNMI's fishermen. In English this is a brown noddy tern. In Carolinian its called SCHE'E'LAP

and in Chamorro it is FAHANG DANKOLO. These brown seabirds follow large fish like yellowfin tuna and mahimahi. They then feed on the same small fish and squid that the big fish are chasing.

By following brown noddy terns, fishermen can locate schools of big fish. Unlike some seabirds, noddy terns do not dive for fish. Rather, they skim along the surface of the water and snap up their prey in flight.

Many of these able-bodied fliers nest mostly on Saipan's Bird Island, and on the cliffs nearby. Many also nest on Naftan Peninsula. Sometimes you can see noddies perched on the reef or on floating logs. When they want a bath they dip their head and chest into the water. Like other seabirds, they drink seawater. They have a special salt gland that gets rid of the extra salt.

Noddy terns get their name by the male's habit of bobbing his head at a female when it is time to mate. They build nests of sticks in bushes, or on limestone cliff faces. The noddy's brown color blends in perfectly with the rocky cliffs. The female lays one egg, and sits on the egg while the male brings her food.

The noddy's brown color blends in perfectly with the rocky cliffs.

Baby noddy terns are covered with grayish down. They often eat their weight in fish every day. Parents protect their young carefully. They even attack people who come too close to the nest.

Noddy terns, and other birds nesting on Bird Island and the adjacent shoreline cliffs, are protected by CNMI Fish and Wildlife regulations. These regulations require that visitors not disturb either the noddies or their nests.

16. 4. 5. Tropicbirds

Phaethon lepturus is one of the most beautiful seabirds in the world. In English they are called white-tailed tropicbirds, in Chamorro FAGPI-APA'KA, and in Carolinian SU'GHU'BWESCH. They are white birds with striking black markings. They have long, sharply pointed wings, and two long streaming feathers in their tail. These feathers are longer than the bird's bodies.

Tropicbirds are most often seen near cliffs. Against the deep blue of the sea or sky, they fly alone or in pairs. They flap their wings constantly with occasional short glides.

Tropicbirds dive for fish and squid, and can float on the ocean's surface. They may be found far out at sea throughout much of the tropical and subtropical Pacific.

Tropicbirds hover over the water, eating flying fish. They dive with their wings half closed to catch other small fish and squid. They have bills with notches in them, almost like teeth, that help them hold their slippery prey. As mentioned earlier, fishermen follow these seabirds to locate schools of mahimahi and marlin.

Tropicbirds may fly hundreds of miles searching for food. Occasionally, they circle a ship at sea, screaming noisily, then flying away. When they are not nesting, they sometimes spend months at sea.

Phaethon lepturus is one of the most beautiful seabirds in the world.

Both parents care for the fluffy feather-covered baby tropicbird. The parents catch fish and regurgitate the food for the baby to eat.

Although graceful while flying, tropicbirds, with their short legs, can hardly walk on land. They have to crawl on their bellies to move around. Their webbed feet help them to paddle on water. Their feet also let them dig shallow nests in cracks along the CNMI's sheer cliffs.

During courtship, both the male and female will glide and circle each other high in the air. One bird will sometimes hover over its mate, gently touching the lower bird's back with its long tail feathers.

Females lay one egg, which hatches after about 40 days. Both parents care for the fluffy feather-covered baby. The parents catch fish and regurgitate the food for the baby to eat.

The red-tailed tropicbird is all white. It has black legs and feet and a trailing brilliant red tail.

16. 4. 6. Boobies

Boobies are large seabirds found around the world in tropical latitudes. There are just six species of boobies in the world. We are indeed fortunate to have three of them occur here in the Marianas.

These are the masked booby (*Sula dactylata*), the brown booby (*Sula leucogaster*), and the red-footed booby (*Sula sula*).

The brown booby is called LU'AO in Chamorro, and O'MWO'O'BWESCH in Carolinian. It is mostly brown, with a white lower breast and belly. The red-footed booby is called AMWO in Carolinian, and LU'AO TALISAI in Chamorro.

Boobies are large seabirds found around the world in tropical latitudes.

Boobies can be distinguished from other seabirds by their large size, and wedge-shaped tails. Boobies can have a wingspan of up to five feet. They often fly higher than other seabirds.

The flight pattern of boobies is also distinctive. Many other birds fly by continuously flapping their wings. Boobies, however, alternate flapping and gliding, resulting in a flight path that sequentially rises and falls.

Boobies have large webbed feet. They eat fish, catching flying fish right out of the air, or by diving into the water. Very beautiful in flight, these birds are awkward and somewhat comical on the ground, stepping high with their webbed feet. They move much like a skin diver walking with flippers.

Boobies sometimes investigate ships. Occasionally, they hitch a ride, by perching on a mast or railing. Normally, they return to land to roost at night.

Brown boobies and masked boobies nest on sea cliffs in large colonies. Because the boobies spend part of each day feeding at sea, rodents sometimes steal their eggs from the nest. However, when a parent bird is present, it can ferociously defend its eggs.

Red-footed boobies are tree-nesting birds, and thus suffer less from egg predation. Saipan does not have a booby colony, but colonies can be found on Tinian, Rota and other CNMI islands. *Sula* are related to pelicans and tropicbirds.

Boobies may range up to 80 kilometers from their home islands. Fishermen use them to locate schools of fish.

To Caroline Island traditional navigators, they are true friends. When one sees them, they know that land is within 80 kilometers. At dusk, they can be trusted to fly straight towards shore, thus showing the prudent observer the way back to land.

16. 4. 7. Frigatebirds

Fregata minor is a large, mostly black bird with long, angled wings and a deeply forked tail. In English it is called a frigate or man-o-war bird. In Chamorro it is called PAYA'YA and in Carolinian it is ASAF. The male is black, with an inflatable red throat pouch. The female has a white breast. Immature birds may have a white head and breast.

Frigatebirds are graceful fliers and soarers, beautiful sights to see! The name "frigate" refers to fast, medium-sized but powerfully armed sailing vessels of the 18th and early 19th centuries. Frigatebirds effortlessly fly great distances, and have been reported over 6,400 kilometers from their nest sites. Remarkably, they do not land on water—their feathers are not waterproof.

They catch fish from the surface, or, belying their majestic appearance, they commonly steal fish from other fisherbirds! They swoop on terns and boobies, scaring them into dropping their catch of squid or fish. These dropped catches the frigatebirds quickly scoop up, often while they are still in midair.

Frigatebirds are widespread in our Pacific. They often appear in the art of many Pacific islanders.

Fregata minor is a large, mostly black, bird with long, angled wings and a deeply forked tail. The male is black, with an inflatable red throat pouch. The female has a white breast.

16. 4. 8. Shearwaters

Puffinus are small- to medium-sized offshore and pelagic birds. In English these are called Shearwaters. In Chamorro they are also called PAYA'YA'. In Carolinian they are called LIFO'RO. Shearwaters are usually all dark, but sometimes are dark with white underparts.

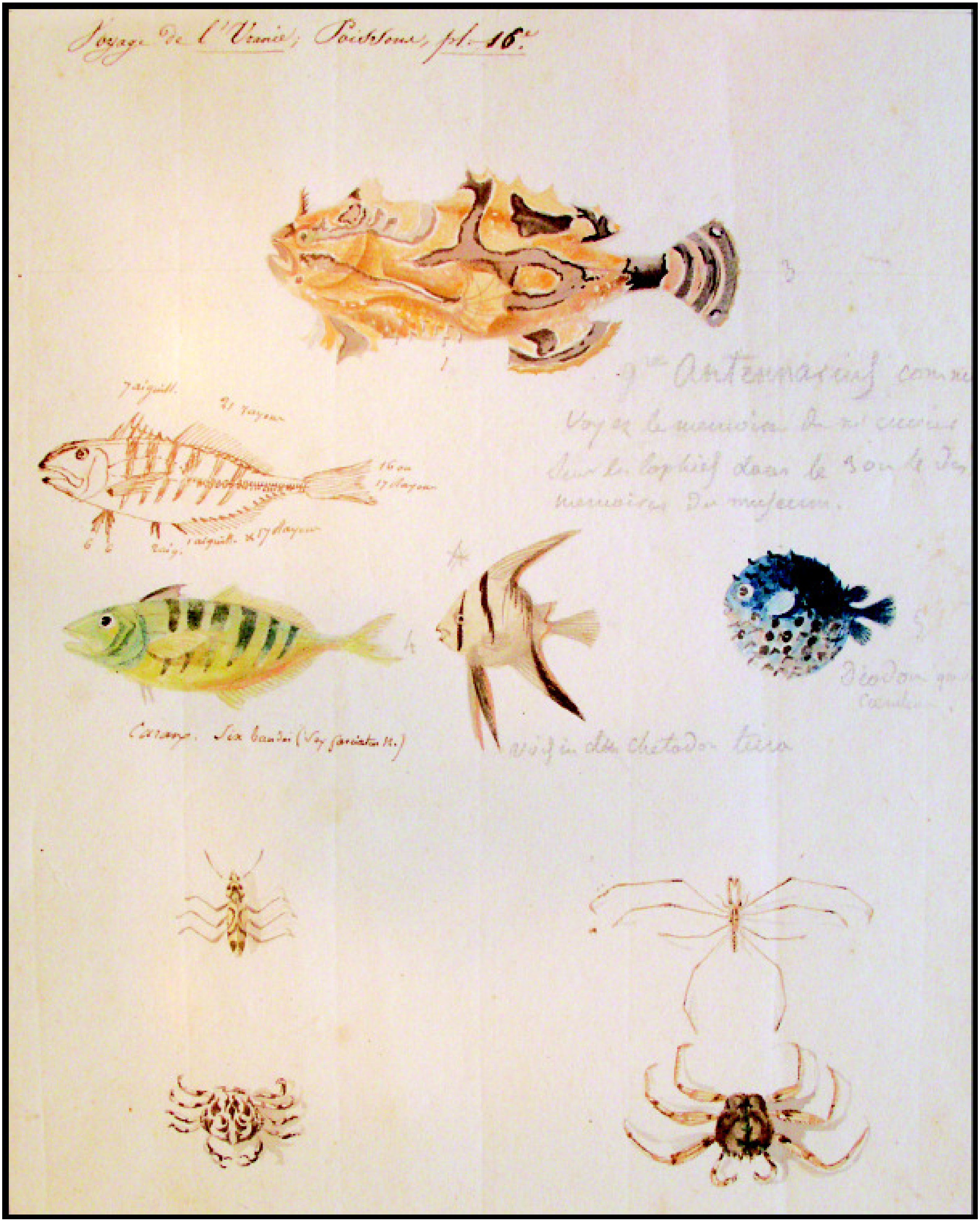
They have long narrow wings, heavy bodies, and short tails. If we could get close enough to observe, we would see they have long, slim, hooked bills with paired tubular nostrils.

Shearwaters fly with alternate short bursts of flapping and long glides. They bank low on stiff wings over the ocean's surface.

Shearwaters eat small fish and squid near the surface in shallow dives. They are often seen over schools of fish. At the time of this chapter's writing there were about four species of Shearwaters reported from our area; all of these had been thought to be stragglers. A straggler is a type of bird that is rarely seen in a particular area but it does, however, show up from time to time.

[Ed. update note: wedge-tailed shearwaters (*Puffinus pacificus chlororhynchus*) have recently adopted Managaha Island as a regular nesting site. Conservation measures are being undertaken to protect them.]

Puffinus are small- to medium-sized offshore and pelagic birds, are usually all dark, but sometimes are dark with white underparts and have long narrow wings, heavy bodies, and short tails.


Voyage de l'Uranie, Poissons, pl. 16.