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THE GUARDIAN KNIGHTS



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The Guardian Knights

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Message from the Head of Center for Book Affairs

Hello, creative and book-loving children of Indonesia! These cool and exciting books are specially made for you. They're not just fun and enjoyable to read—they also expand your knowledge, spark your imagination, and shape your character. You'll be introduced to the rich and diverse cultures of Indonesia, too. Each book is beautifully illustrated with unique and captivating artwork that's a treat for the eyes.

Dear kids, a truly great book is one that touches your heart and stirs your spirit—just like the one you're holding now.

Happy reading!

Head of Center for Book Affairs!

Supriyatno
NIP. 196804051988121001





Foreword

Hi, Earth's Friends!

Have you ever met mangroves—the Guardian Knights? This book invites you to journey with mountain streams into the mangrove forests. You'll explore their maze of roots and meet their inhabitants, and feel their mighty power as they guard the land from harm. Along the way, you'll also discover their tender side, as they nurture birds and other wildlife.

Through this book, you will discover a new world between continents and oceans. It's a world that promises life for both animals and humans. Come on, enjoy the adventure!

Emil and Nisa

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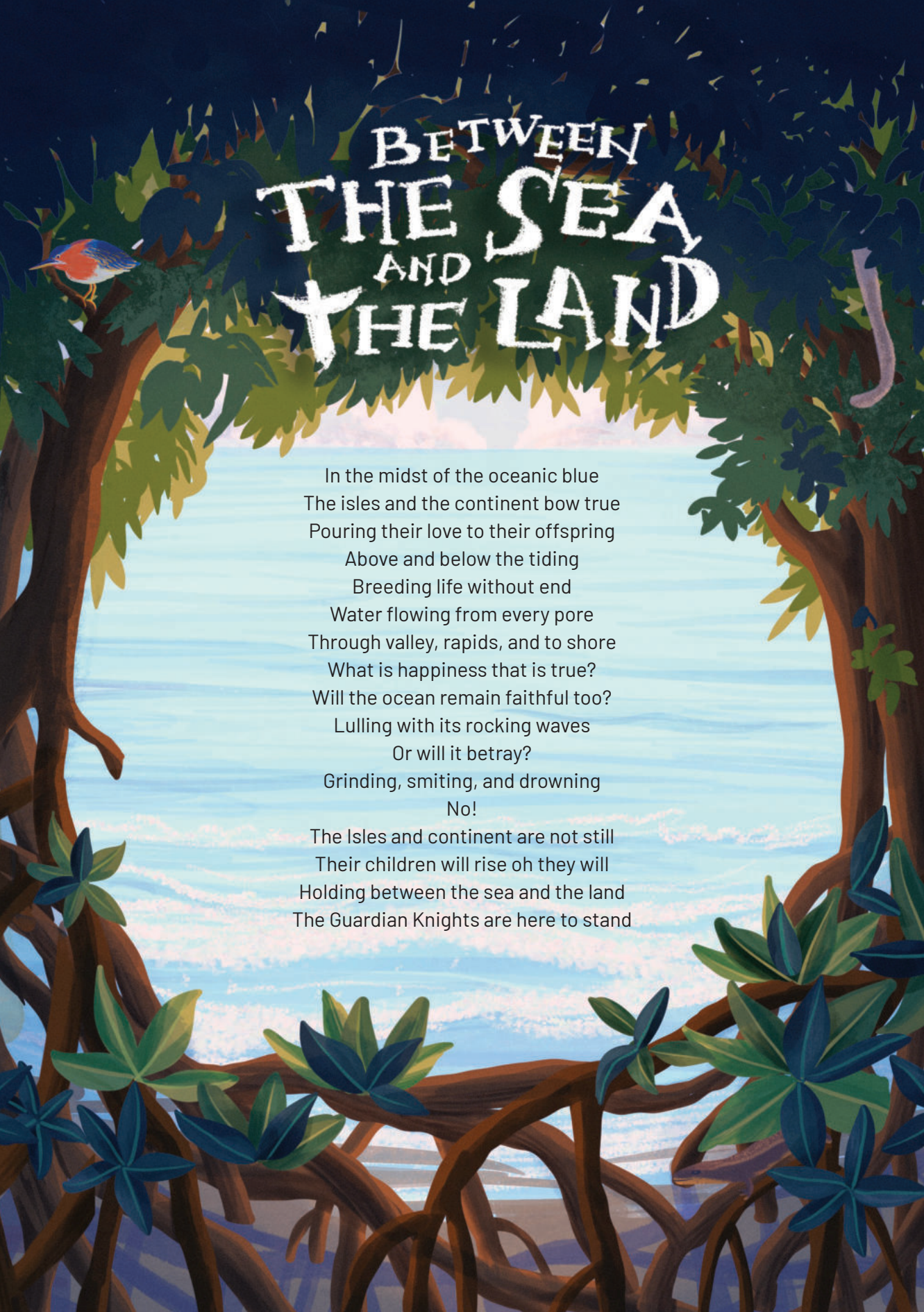
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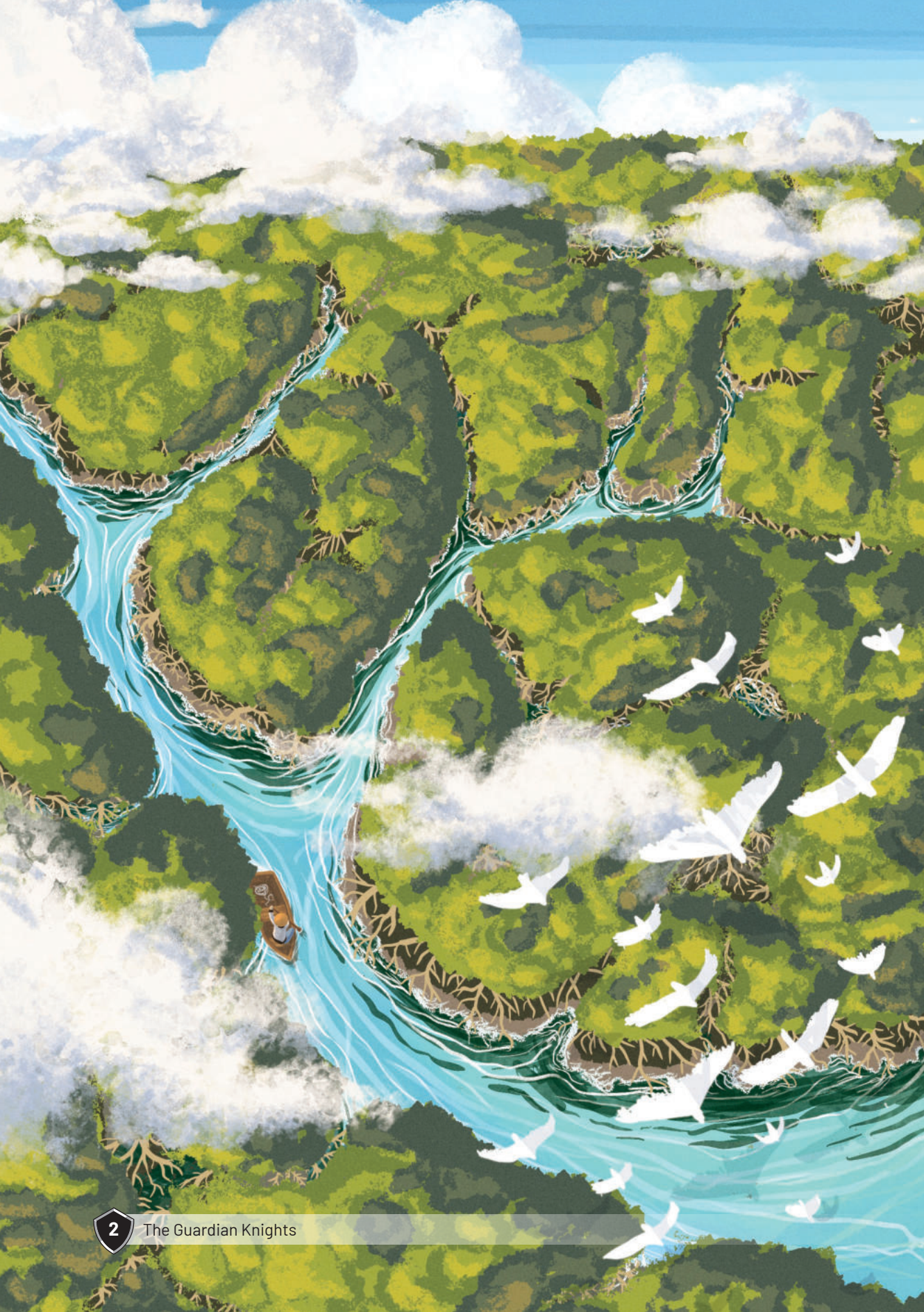
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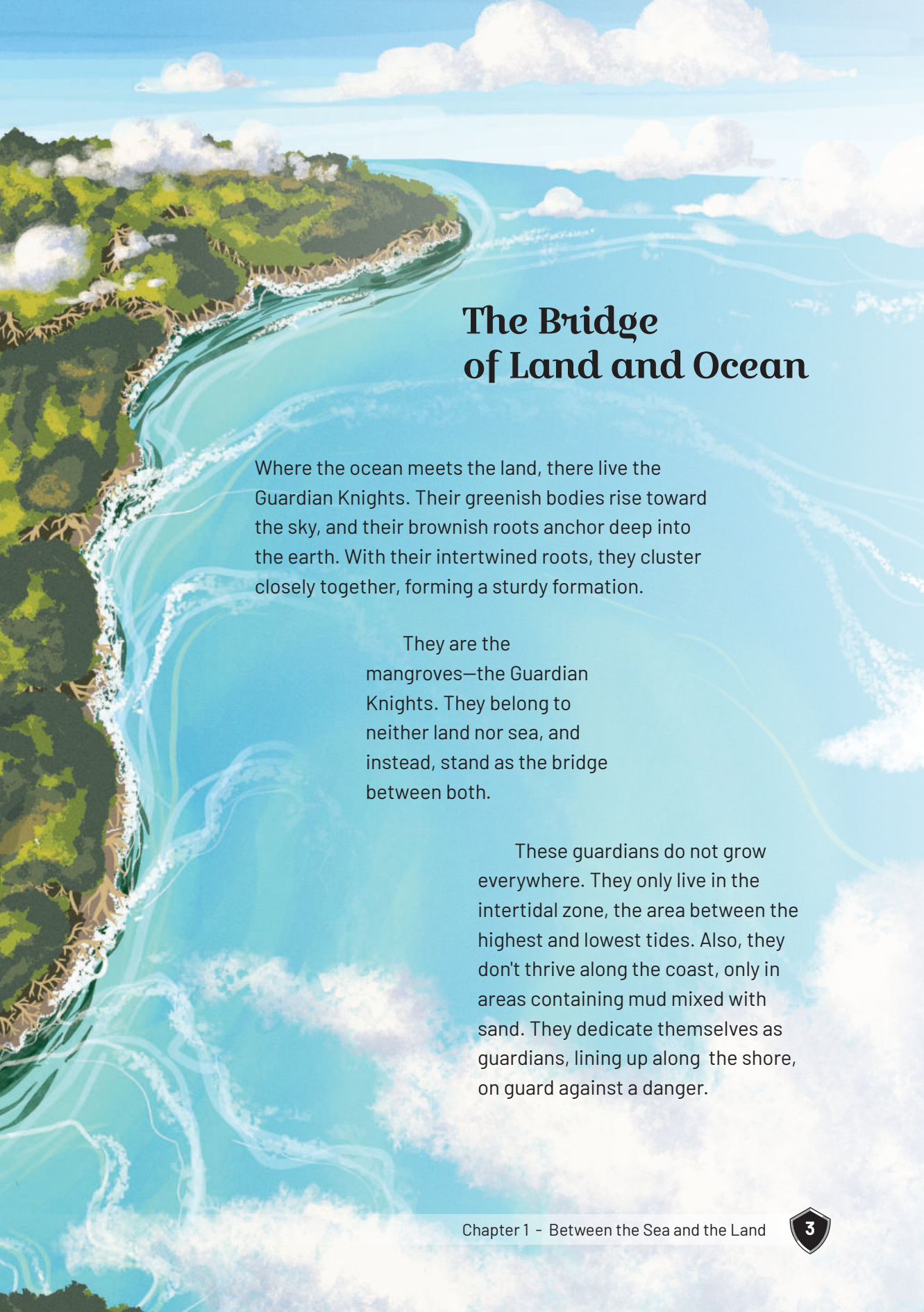
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In the midst of the oceanic blue
The isles and the continent bow true
Pouring their love to their offspring
Above and below the tiding
Breeding life without end
Water flowing from every pore
Through valley, rapids, and to shore
What is happiness that is true?
Will the ocean remain faithful too?
Lulling with its rocking waves
Or will it betray?
Grinding, smiting, and drowning
No!
The Isles and continent are not still
Their children will rise oh they will
Holding between the sea and the land
The Guardian Knights are here to stand





The Bridge of Land and Ocean

Where the ocean meets the land, there live the Guardian Knights. Their greenish bodies rise toward the sky, and their brownish roots anchor deep into the earth. With their intertwined roots, they cluster closely together, forming a sturdy formation.

They are the mangroves—the Guardian Knights. They belong to neither land nor sea, and instead, stand as the bridge between both.

These guardians do not grow everywhere. They only live in the intertidal zone, the area between the highest and lowest tides. Also, they don't thrive along the coast, only in areas containing mud mixed with sand. They dedicate themselves as guardians, lining up along the shore, on guard against a danger.

A Disturber of Stillness

The serene morning shatters into sudden chaos. Startled, birds abandon their meal and flee in alarm. They fly away, escaping from the shore.

Abruptly, the earth trembles. From beneath the calm sea, an earthquake emerged. Its tremors shake the island. The ocean hisses and foams. The water suddenly recedes for kilometers, reaching far into the heart of the sea.

The ocean turns into a desert. Fish flail, glistening under the blazing sun. Coral rises up, as if enchanted by the blue sky. Other sea creatures tremble, writhing in search of shelter.

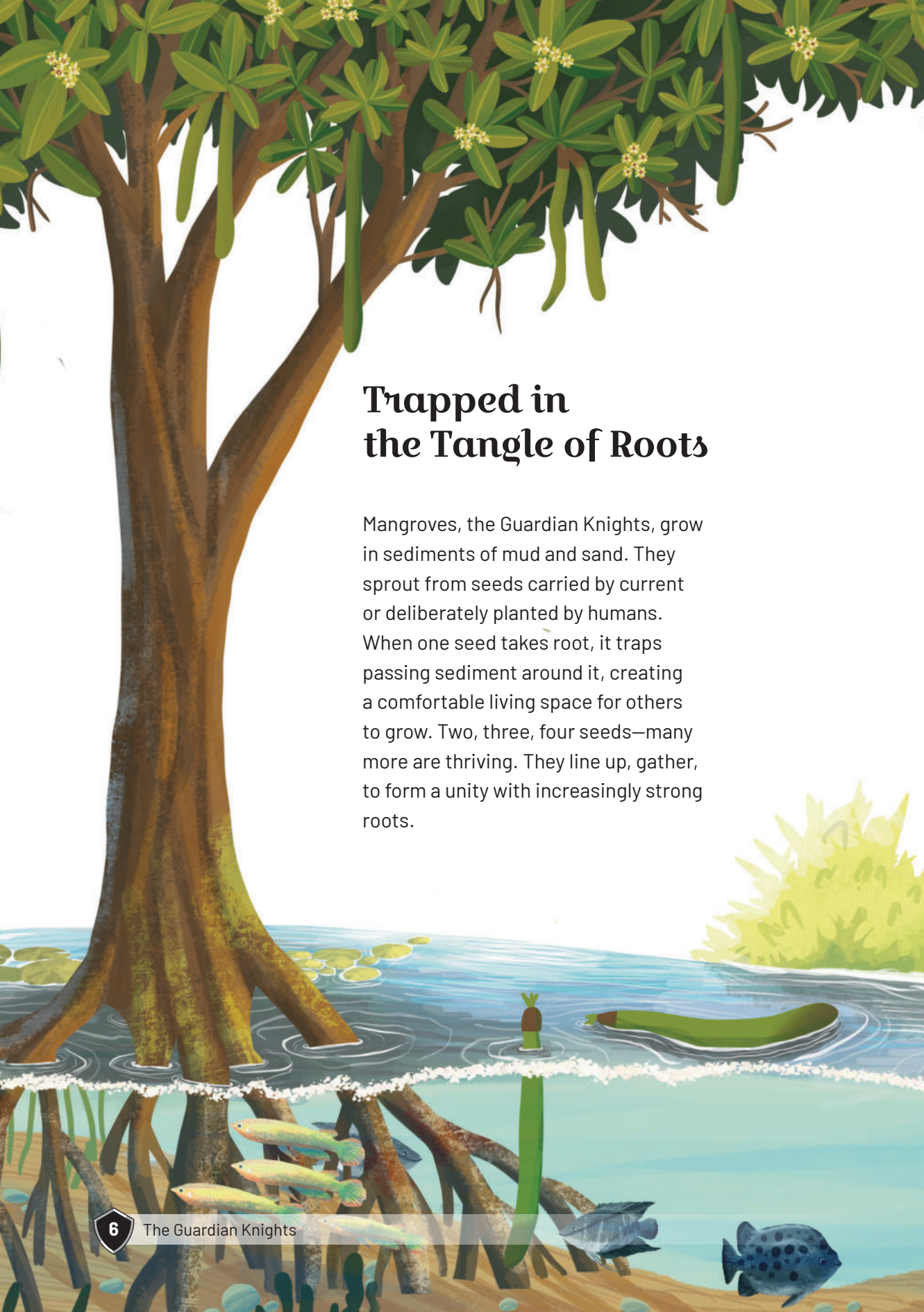
The air smells of salt. A roar echoes from the ocean. The seawater that had once receded now returns. But it is no longer calm and warm. Now it surges and rises into towering waves. The closer they get, the higher they grow, reaching tens of meters. They are ready to crash and destroy everything in their path.

In the distance, the land waits in trembling. Dread and restlessness linger in the air. Will they survive? Or will they be ruined in the end?

At the shore, the guardians stand ready, welcoming the tsunami—the overlord. Their tangled roots intertwine to block the current from below. From above, their lush canopy catches and pulls back the waves. Slowly, the waves grow calm, their strength and height diminish. Gradually, they weaken, subside, and return to the sea as usual.



The beach is calm again. Birds return to the shore in search of food. The coral reefs settle back into the peaceful underwater world. The Knights feel relieved. Their duty has been accomplished. The wounds and damage will slowly heal.



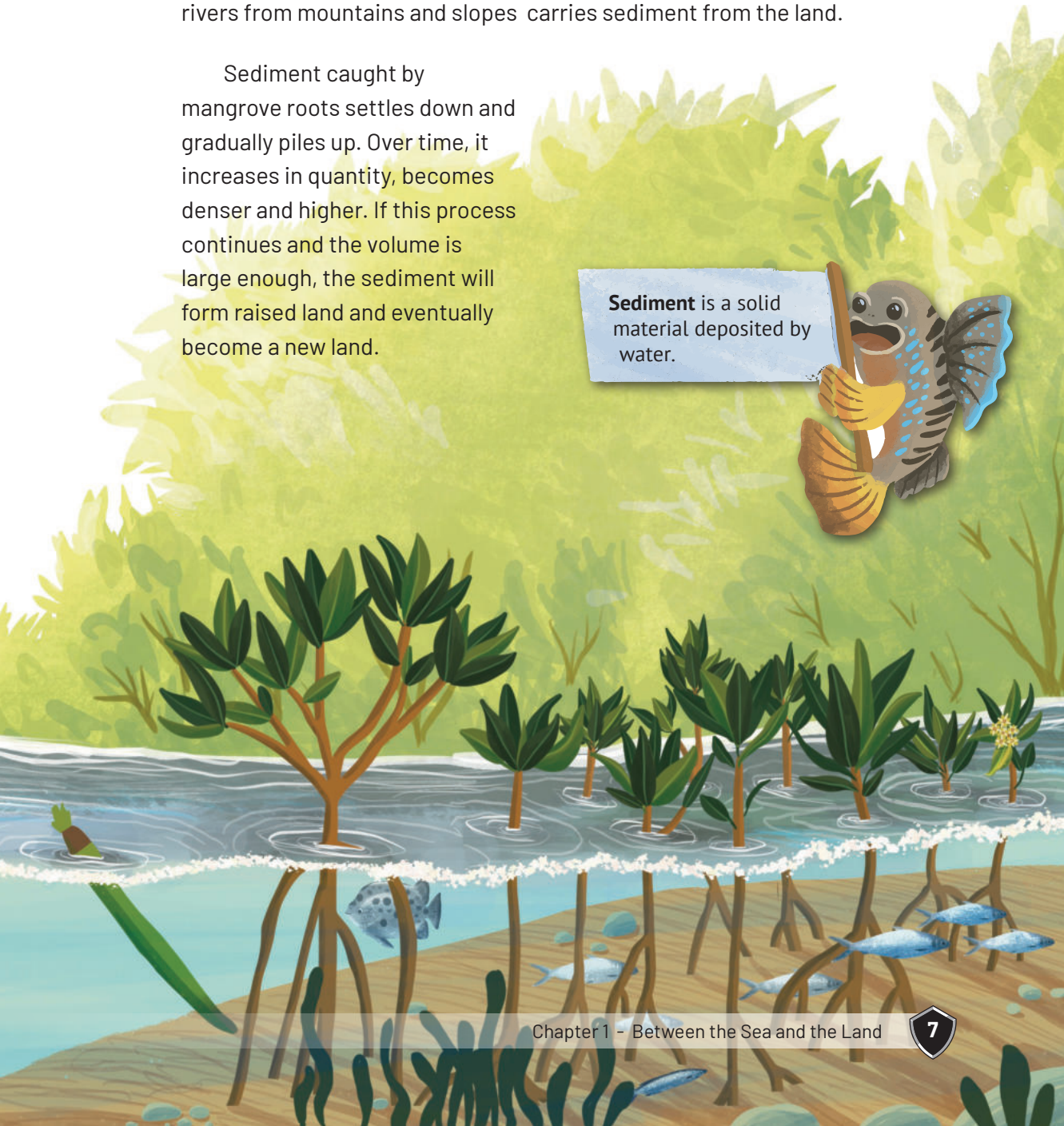
Trapped in the Tangle of Roots

Mangroves, the Guardian Knights, grow in sediments of mud and sand. They sprout from seeds carried by current or deliberately planted by humans. When one seed takes root, it traps passing sediment around it, creating a comfortable living space for others to grow. Two, three, four seeds—many more are thriving. They line up, gather, to form a unity with increasingly strong roots.

The tangle of mangrove roots capture and trap the passing sediment through them. The roots hinder the water currents carrying sediment particles, both from the sea and also from river estuaries. The slowing down allows sediment deposition to occur.

Waves striking the shore at an angle, as well as those arriving parallel to it, transport sediment from the ocean. Meanwhile, water flowing through rivers from mountains and slopes carries sediment from the land.

Sediment caught by mangrove roots settles down and gradually piles up. Over time, it increases in quantity, becomes denser and higher. If this process continues and the volume is large enough, the sediment will form raised land and eventually become a new land.



Trapped with the Sediment

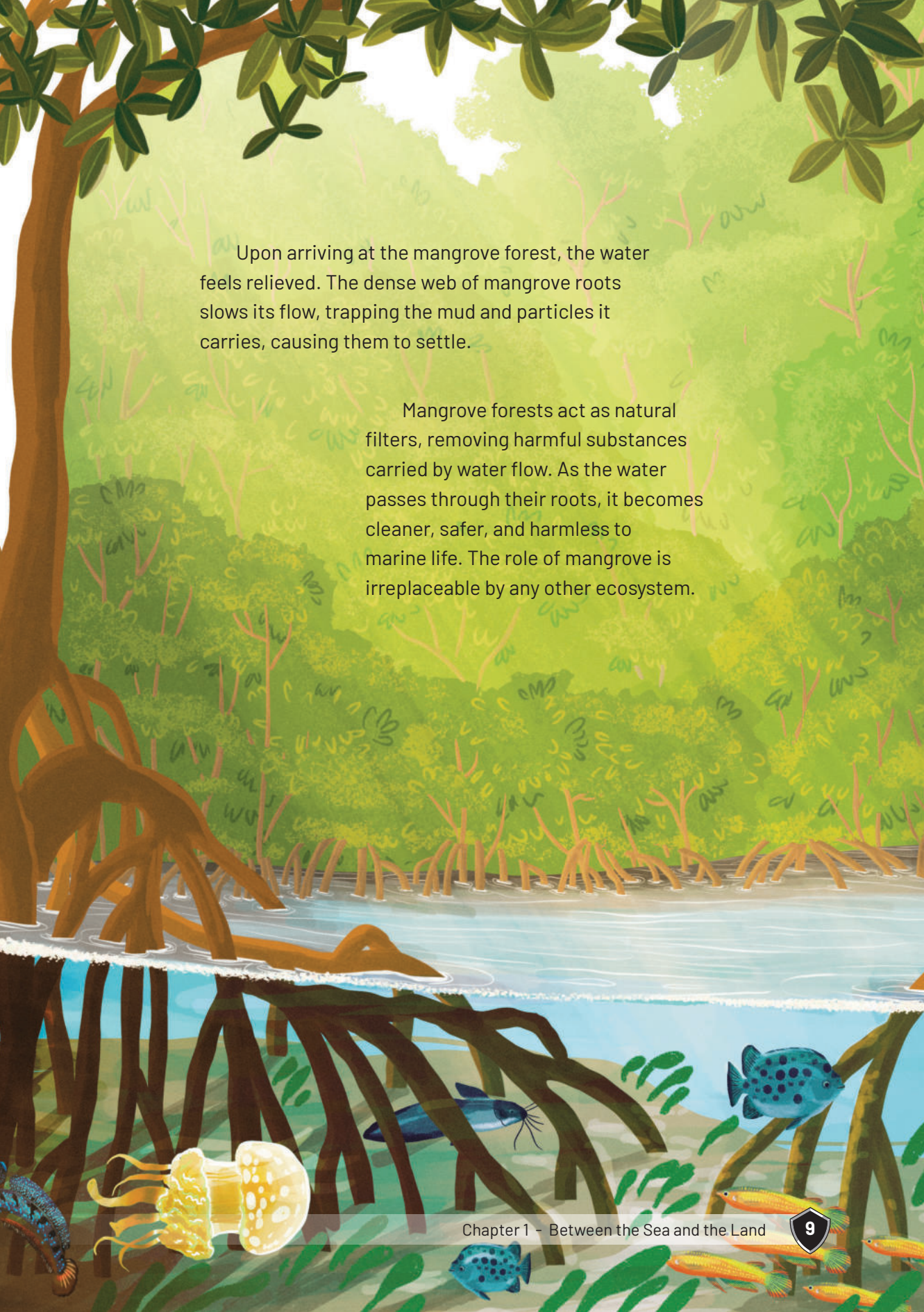
From the mountain, a spring releases clear water. Water descends to lower ground, flowing through small and large rivers to the ocean. Along the way, it carries with it everything it encounters—mud, trash, organic matter, pesticides, and other pollutants that enter the river.



Water has no power to refuse. No longer clear, it keeps flowing along the river to the ocean. It carries harmful substances that threaten the inhabitants of the sea.







Upon arriving at the mangrove forest, the water feels relieved. The dense web of mangrove roots slows its flow, trapping the mud and particles it carries, causing them to settle.

Mangrove forests act as natural filters, removing harmful substances carried by water flow. As the water passes through their roots, it becomes cleaner, safer, and harmless to marine life. The role of mangrove is irreplaceable by any other ecosystem.

The Vanished Villages

Along the coastline, villages rise and disappear. Waves and tides slowly come, eroding the land, submerging crops, and toppling trees. The seawater inches closer to the settlements, then slowly floods and drowns them.

The strength and speed of the waves cause coastal abrasion in several areas and small islands. Abrasion occurs slowly, but surely and inevitably. The shoreline gradually shifts, retreating further inland.

Areas of villages gradually shrink, then eventually sink. Residents are forced to either find new homes or adapt to a lifestyle above the water. Several areas that suffer severe erosion and are abandoned include Bedono Village in Demak Regency, Central Java; Pambang Pesisir Village in Bengkalis Regency, Riau; and the coast of Tamalate District in Makassar City, South Sulawesi.





The shift of the coastline toward the land also affects the water balance. Naturally, seawater has a higher specific gravity than freshwater, causing it to push groundwater toward the upstream. However, the surface pressure of groundwater is higher than that of seawater. As a result, a balance is established, the pressure from seawater is neutralized, and the flow moves from the land to the sea.

The shift of the coastline toward the land causes seawater to enter the ground through the land. The infiltration of seawater into groundwater is known as seawater intrusion.

Abrasion, coastline shifting, and intrusion can be prevented by mangrove forests. The Guardian Knights will catch and calm the waves and ocean currents with their intertwined roots. After frolicking for a moment in the mangrove forest, the currents and waves are sent back to the ocean. Everything is safe and sound. Abrasion, intrusion, and coastline shifting will not happen.





Blowing From the Ocean

The sun begins to shine. The densely populated land heats up more quickly than the water in the ocean. The warm air above the land surface rises. The air pressure on the land becomes lower than that on the ocean. From above the vast ocean, air blows into the lower-pressure area, heading toward the land. This wind is called a sea wind.

Strong sea winds can pose a threat to settlements on the land. It is time for the Guardian Knights to stand watch; they block and calm the wind. The dense of their canopy catches and breaks the gusts. The wind's speed and strength are reduced; it is redirected, and dispersed.

Mangrove forests, with their tall and dense trees, can reduce wind speed by up to 75–85% of its original strength. The taller, denser, and more widespread the mangrove forests, the greater the area behind them that is protected.

Not only powerful, the sea winds also carry salt particles from the ocean. The salt particles can damage agricultural crops and items made of metal. When sea winds pass through mangrove forests, their strength decreases, and the salt particles they carry fall and remain in the mangroves. The wind that reaches residential areas becomes a gentle breeze with only a trace of salt remaining.

Canopy is the branches and leaves that spread out at the top of a group of trees forming a type of roof.





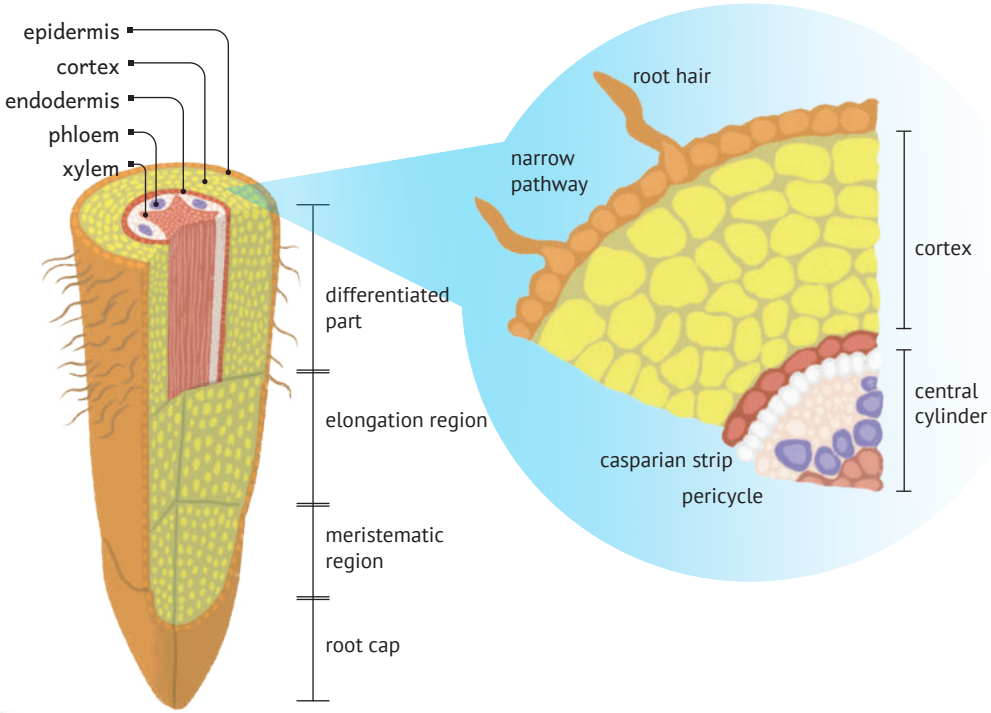

THE
BEARING
OF THE
GUARDIANS
Calm, steadfast, full of trust
Their roots like spears in earthen crust
Defying waves, enduring gust
A bastion green reaching the sky
Against the storm which just passing by
When the new day has begun
The Guardians rise to greet the sun
Adorned in fruits, blossom, and leaves
Sipping carbon, releasing fresh breeze
Enchanting one who passes and sees



The Supporters and Nutrient Absorbers

Have you ever met the Guardian Knights? Or at least see the pictures of them in books or on the Internet? What's the most interesting thing about them? That's right! It's their roots.

Mangrove roots are unique and well-built. They have three fascinating root systems: horizontally sprawling cable roots, vertically anchoring prop roots, and roots with tiny hairs.



For the Guardian Knights, roots serve two roles. First, the roots support their bodies. Mangrove roots do not reach very deep, but their unique shape allows them to firmly anchor their bodies in relatively soft, muddy sediment. Second, they function as absorbers of nutrients and gases needed for photosynthesis and respiration.

The roots of some mangrove species also function to filter salt because they grow in saline habitats. When absorbing water, some of the salt is blocked from entering, reducing the salt content in the mangrove's stem. The roots also contain lenticels, which facilitate gas exchange, including the absorption of oxygen.

Types of Roots

Some mangrove roots grow above the surface of sediment. These roots provide a home for snails and a playground for mudskipper fish. They like climbing the roots and enjoying the warmth of the sun.

Various Types of Mangrove Roots



Aeration roots

These roots emerge to the surface from a horizontal, cable-like root system underground. They are shaped like pencils or cones and have numerous fine pores that allow oxygen to enter.

Knee roots

These roots emerge from horizontal roots that protrude above the surface, then curve downward again. Their shapes resemble a bent knee.





Prop roots

They are shaped like branched chicken feet. These brown roots protrude from the lower part of the trunk, extending toward the surface.

Plank roots

These roots are similar to prop roots, but they spread out like ribbons on the ground and twist like snakes. Their function is to help support dan stabilize the tree. The larger the trunk and the thicker the canopy, the wider and taller the plank roots become.





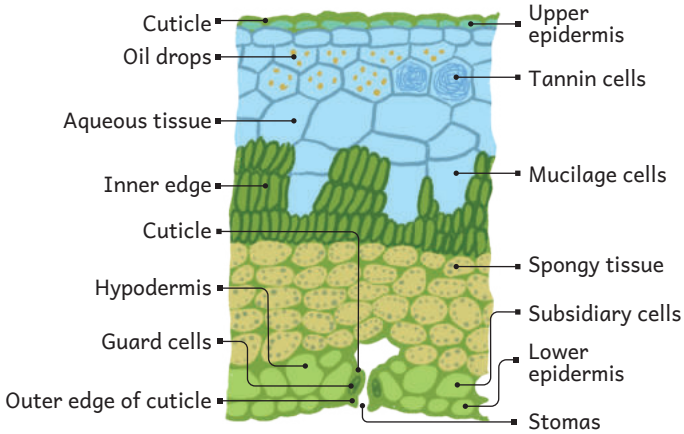
Hanging roots

These roots emerge from the trunk and grow downward, but they do not reach the sediment surface, so they appear to hang in the air. Their function is to absorb water vapor and oxygen.

Maintaining Low-Salt Water Content

Mangrove roots absorb water with a low salt content. From the roots, water is distributed throughout the plant and used for photosynthesis by the leaves. To ease the work of the roots, low-salt water must always be available and used optimally. Mangrove leaves help prevent water waste. Any remaining salt is excreted through old leaves before they fall. Fallen old leaves are replaced by new ones that grow in roughly equal numbers.

Mangrove leaves have several characteristics related to their function of slowing down or reducing evaporation. The upper surface of the mangrove leaf is coated with a waxy layer called the cuticle. There is a protective layer called the epidermis beneath the cuticle and on the underside of the leaf. The cuticle and epidermis layers act as barriers to prevent water within the leaf from evaporating easily.



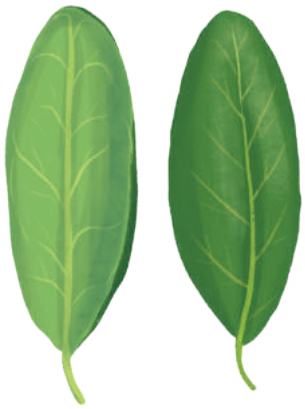
Anatomy of *Rhizophora mucronata* mangrove leaves

Various shapes of mangrove leaves



***Acanthus ilicifolius Linnaeus* (Jeruju)**

The leaves vary from pale to deep green; the shapes are zigzagged like a saw, tapered and have sharp thorns



Avicennia marina

The shapes are oblong-obovate, with pointed to rounded ends



Nypa fruticans

They grow in clumps without trunks, with pinnate leaves arranged in pairs to the tip





Ceriops zippeliana Blume

They are bright green; the shapes are elongated elliptical with rounded ends



Rhizophora mucronata

They are green with spots on the underside, their shapes are widened ellipse

Flowers, Fruit, and Seeds

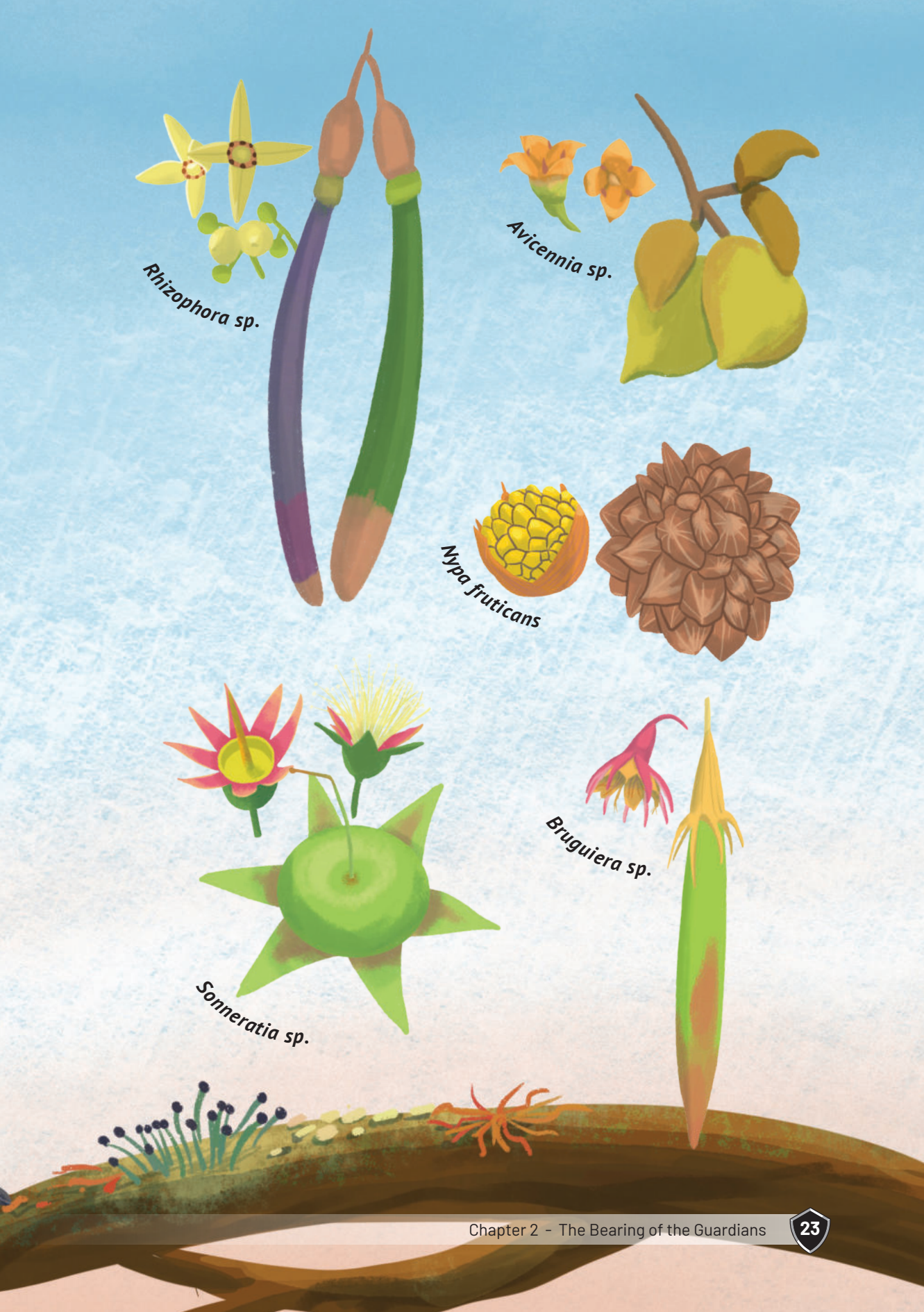
Not only strong and mighty, the Guardian Knights are also good at adorning themselves. Tiny, pretty flowers adorn their dense canopy. Some blossoms are yellow with four petals, and others resemble tiny brush-like stalks.

The beauty of mangrove flowers attracts pollinators. Bats, butterflies, bees, and birds are some of the animals that help fertilize mangroves. However, not all mangrove flowers rely on insects for pollination. For example, wind assists in the pollination of *Rhizophora sp.*

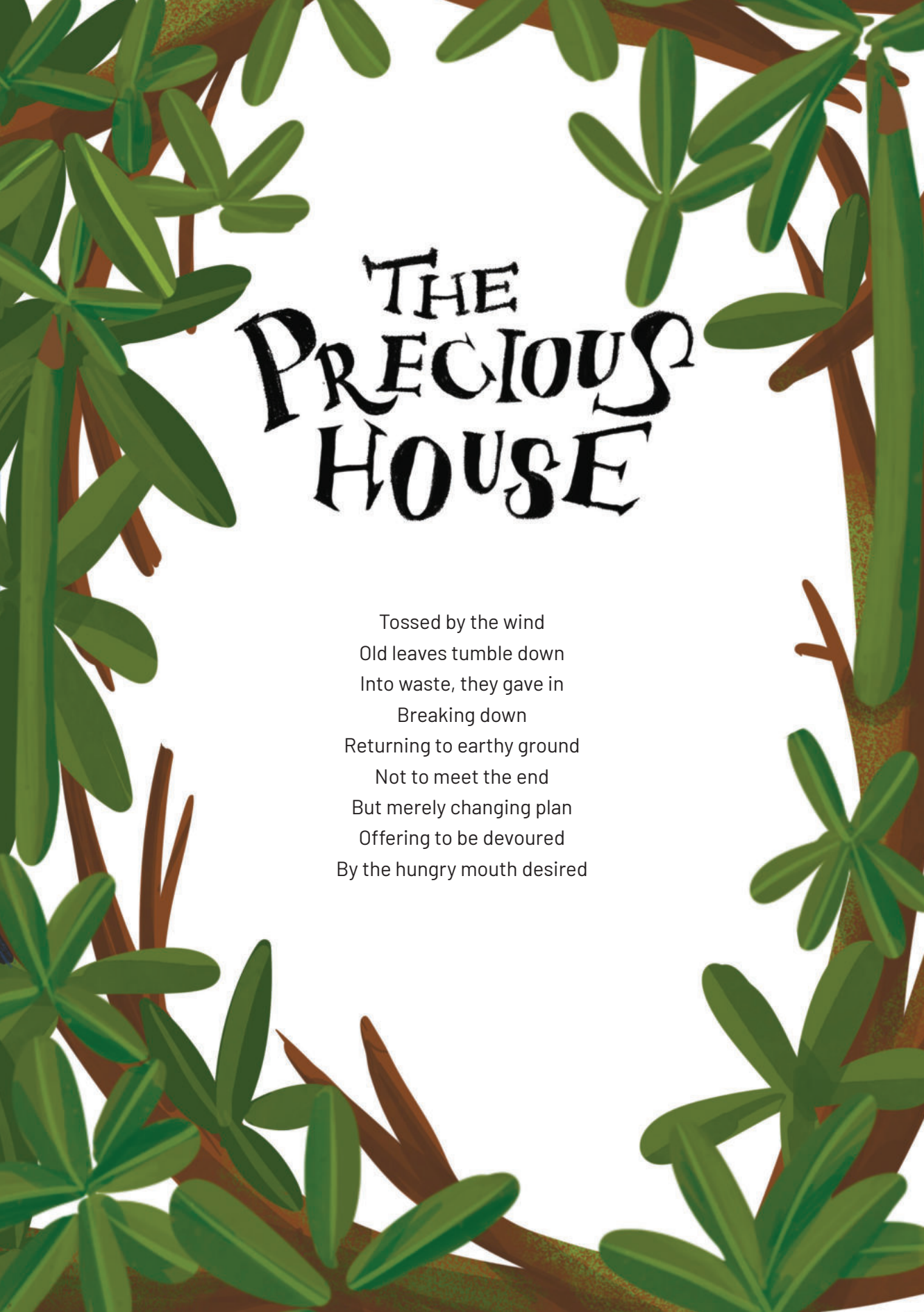
After the pollination process, the flowers gradually transform into fruits with various unique and fascinating shapes. Some are long and hang like sticks, some resemble apples with star-shaped petals, some look like bullets, and so on.

Fully mature and ripened fruits become seeds ready for dispersal. Mangrove seeds, known as propagules, can float. Carried by water, they travel to places both near and far. When they land in the right place, the propagules will grow into new plants.




Rhizophora sp.
Avicennia sp.
Nypa fruticans
Bruguiera sp.
Sonneratia sp.



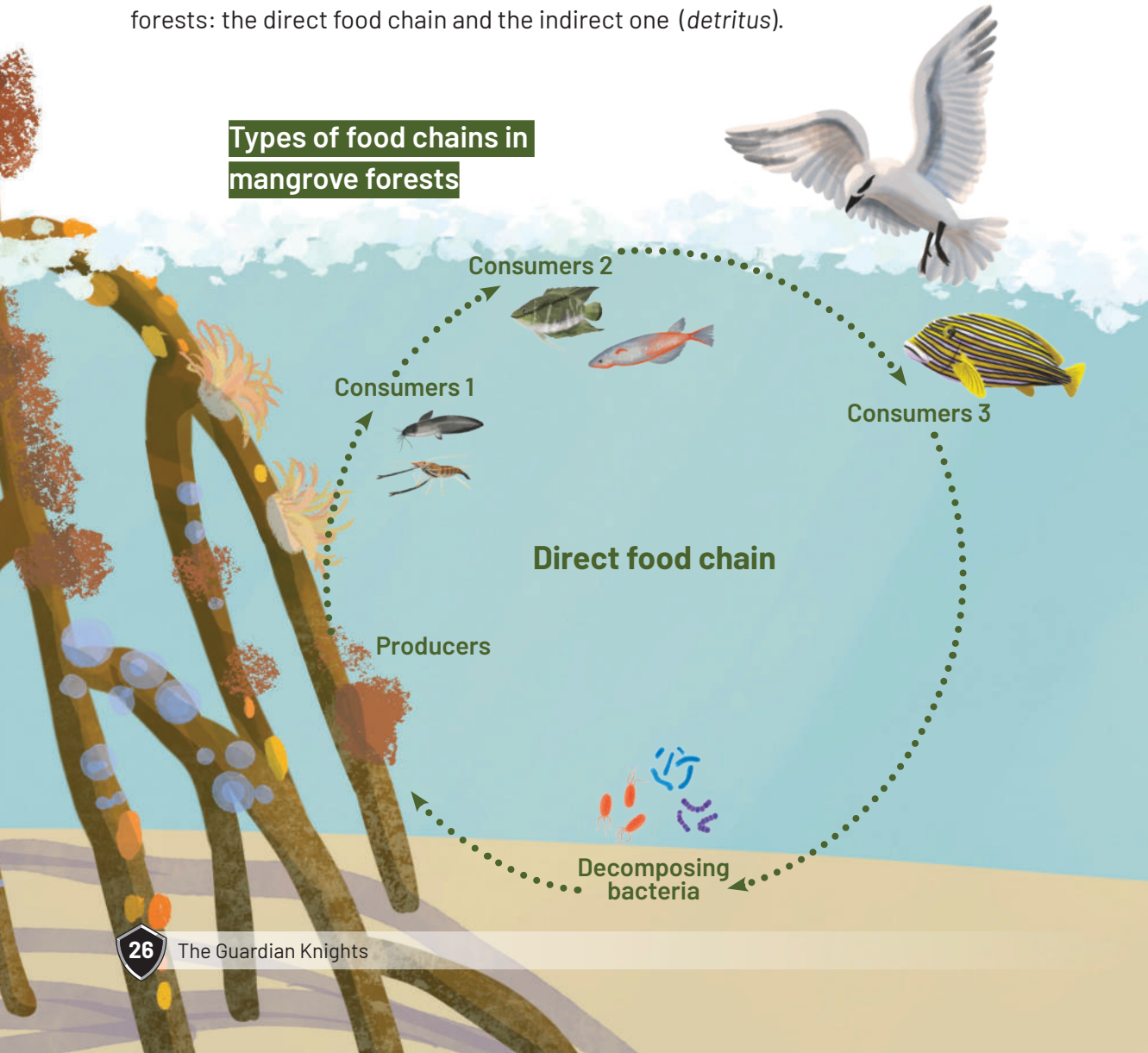


Tossed by the wind
Old leaves tumble down
Into waste, they gave in
Breaking down
Returning to earthy ground
Not to meet the end
But merely changing plan
Offering to be devoured
By the hungry mouth desired

Who is the Strongest?

Among the tangled roots of mangroves, various species of fish, shrimp, mollusks, and other marine life live in the waters and substrate of the mangrove forest. The lush canopy offers a cozy haven for birds. They all live within a mangrove ecosystem. In this ecosystem, food chains and symbiotic relationships exist among its inhabitants. Additionally, various cycles and exchanges of elements take place within it.

In general, there are two types of food chains in mangrove forests: the direct food chain and the indirect one (*detritus*).

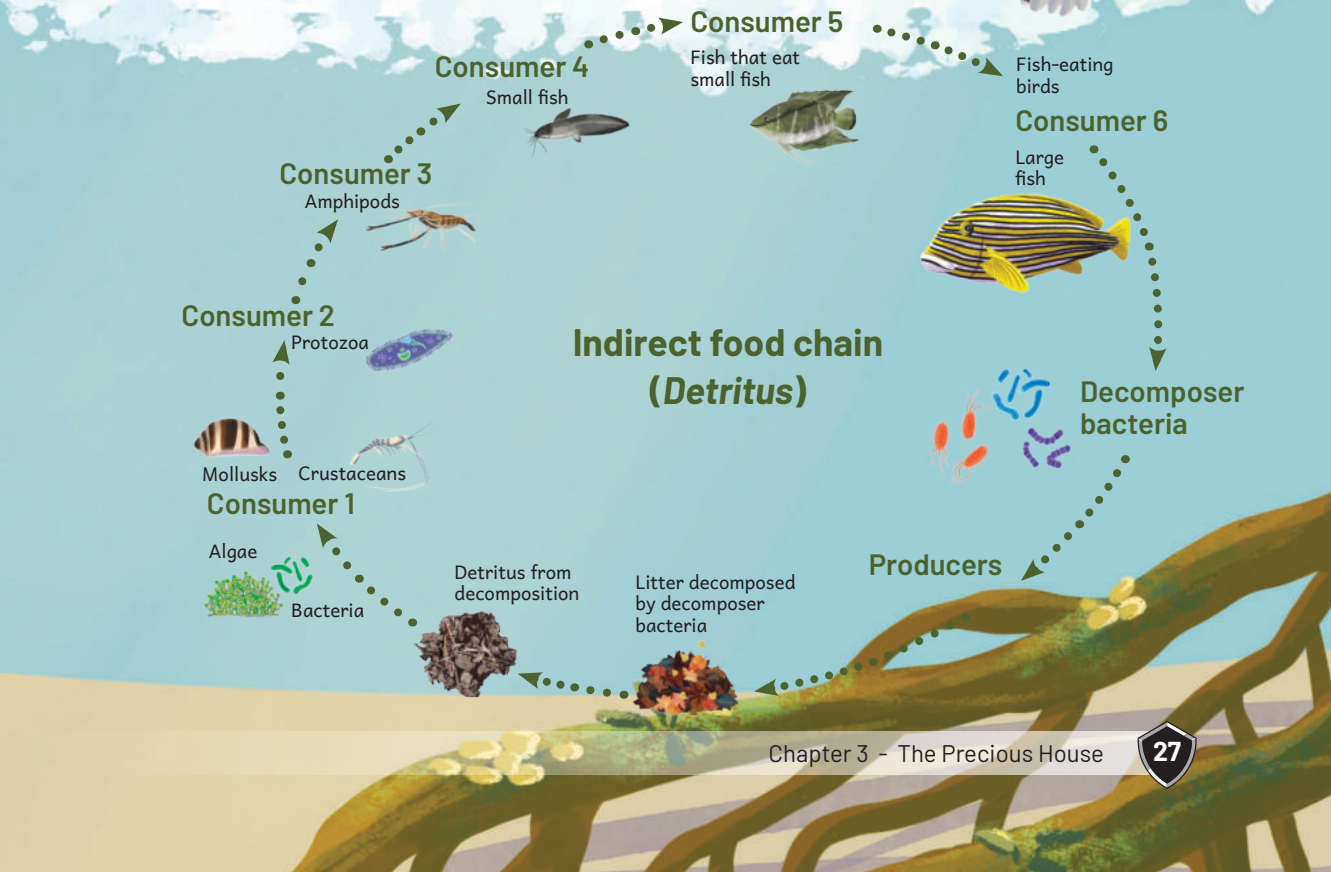


Decomposition is the process of decay.
Detritus is the result of the decomposition of dead plants and animals



Mangrove plants are a source of nutrients and organic matter. Fallen leaf litter, flowers, and twigs are decomposed by microorganisms, turning into detritus. This nutrient-rich detritus serves as a food source for aquatic animals, especially detritivores, or detritus-eating organisms.



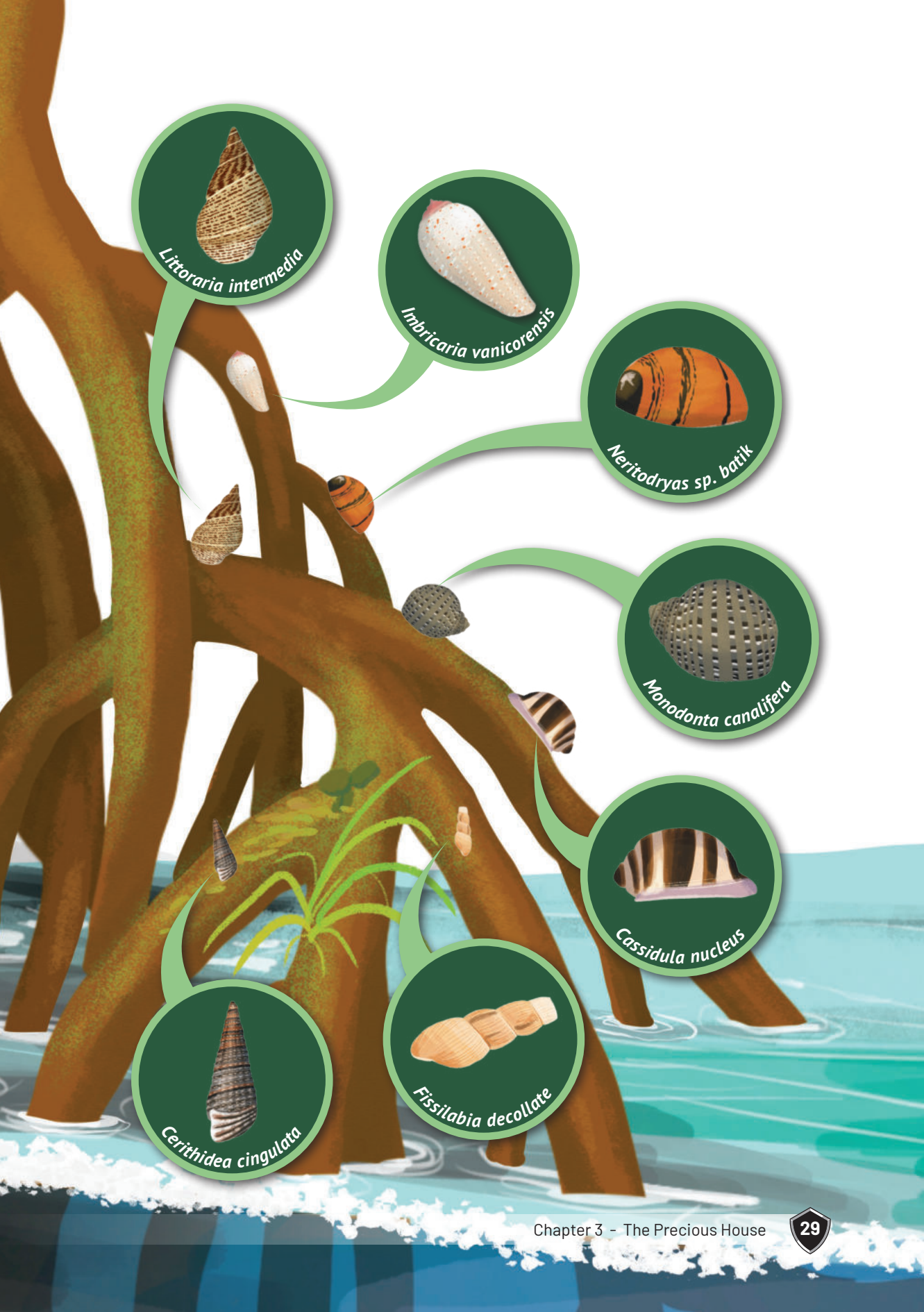


Settling and Crawling

Tiny snails crawl slowly, eating scattered detritus. They live in mangrove trees, mud surfaces, and within the sediment. In mangrove trees, mollusks inhabit the roots, trunks, leaves, and even dead woods.

Here are several types of mollusks commonly found in mangrove forests.




Littoraria intermedia
Imbricaria vanicorensis
Neritodryas sp. batik
Monodonta canalifera
Cassidula nucleus
Fissilabia decollate
Cerithidea cingulata

Armored Insects from the Sea

Their bodies are armored like warriors marching into battle. Their heads—made up of five segments—bear a pair of antennae. Each section of their segmented bodies carries a pair of legs. They are crustaceans, known as the "insects of the sea" for their vast numbers and widespread presence.

Crabs and shrimp are the most common crustaceans in mangrove forests. They play a vital role as decomposers, feeding on fallen mangrove litter and fresh leave.

Decomposers are organisms—including bacteria and fungi—that carry out the process of decomposition. What they break down includes not only dead organisms but also waste materials from living things, such as tree bark.

Here are some crabs and shrimps found in mangrove forests



Metopograpsus messor



Metopograpsus latifrons



Grapsus tenuicrustatus



Helice leachii



Metopograpsus thukuhar



Macrobrachium rosenbergii



Macrobrachium equidens



Alpheus euphrosyne



Macrobrachium dacqueti



Acetes sp.

Splash Between the Roots

Beneath the calm surface of the water, fish and shrimp splash, play, and chase each other. The unique root systems of mangroves provide shelter for small fish. The maze-like spaces offer perfect hiding places from lurking predators. In this safe haven, the fish can grow until they are large enough to survive in the open sea.

Fish interaction patterns in mangrove forest

True Resident Fish

True resident fish spend their entire lives in mangrove forests. An example is the mudskipper from the *Gobiidae* family. These fish feed on organic matter found on the surface of the water or in the sediment.



Periopthalmus sp.
Mudskipper

Temporary Resident Fish

Temporary resident fish inhabit mangrove forests only during one phase of their life cycle. Some examples include the eeltail catfish (*Ariidae* family), marble goby (*Eleotridae* family), sicklefish (*Drepanidae* family), ricefish (*Adrianichthyidae* family), and tinhead fish (*Aplocheilidae* family).



***Adrianichtyidae* family**
Ricefish



***Ariidae* family**
Eeltail catfish



***Drepanidae* family**
Sicklefish



***Aplocheilidae* family**
Tinhead



***Eleotride* family**
Marble goby

Visitor Fish

They come to mangrove forests only during high tide, with the sole purpose is looking for food. When the tide recedes, they return to the ocean. Examples include the grunt (*Haemulidae* family) and the permate fish (*Pristigasteridae* family).



***Haemulidae* family**
Grunt

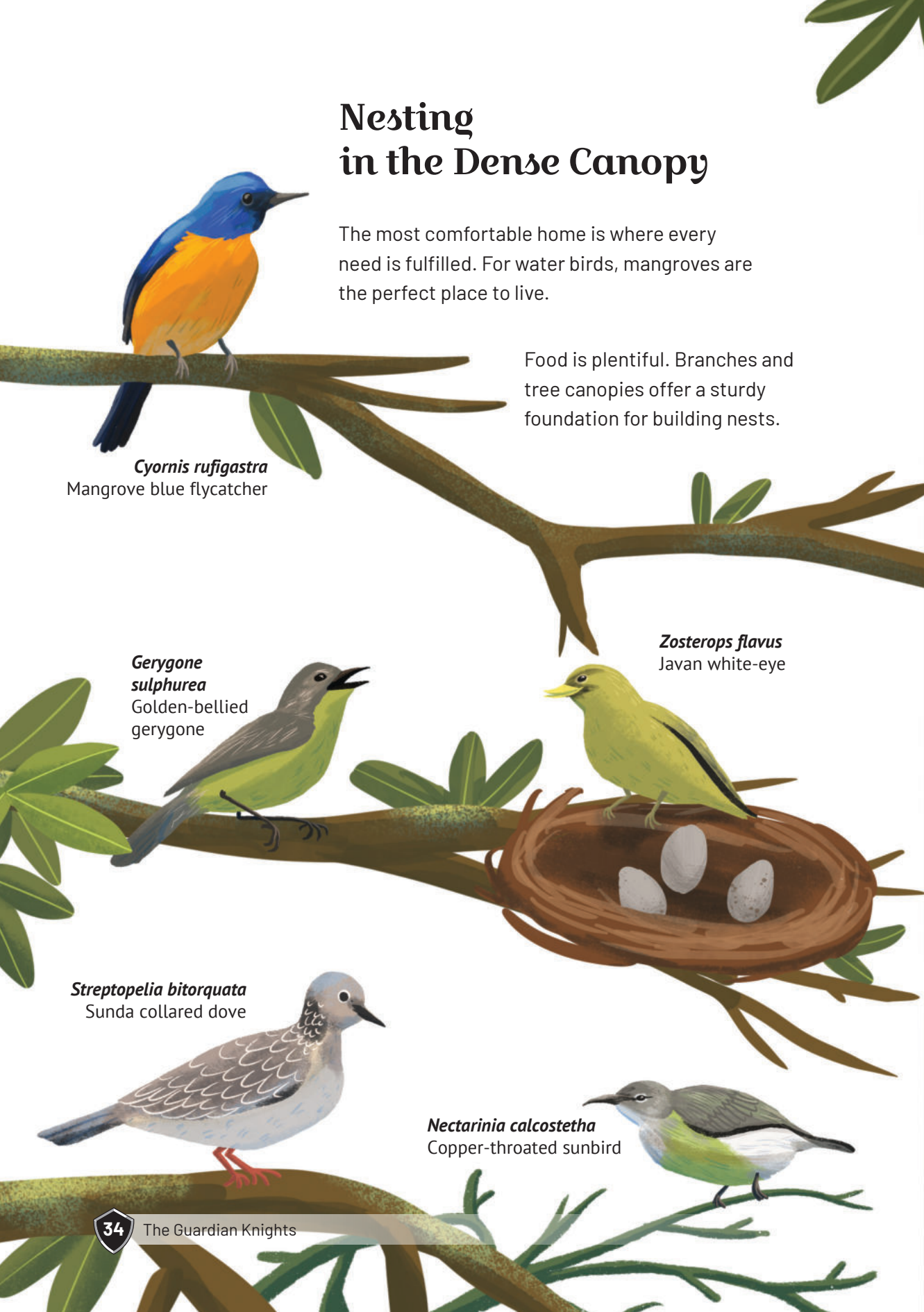


***Pristigasteridae* family**
Permate fish

Nesting in the Dense Canopy

The most comfortable home is where every need is fulfilled. For water birds, mangroves are the perfect place to live.

Food is plentiful. Branches and tree canopies offer a sturdy foundation for building nests.



Cyornis rufigastra
Mangrove blue flycatcher

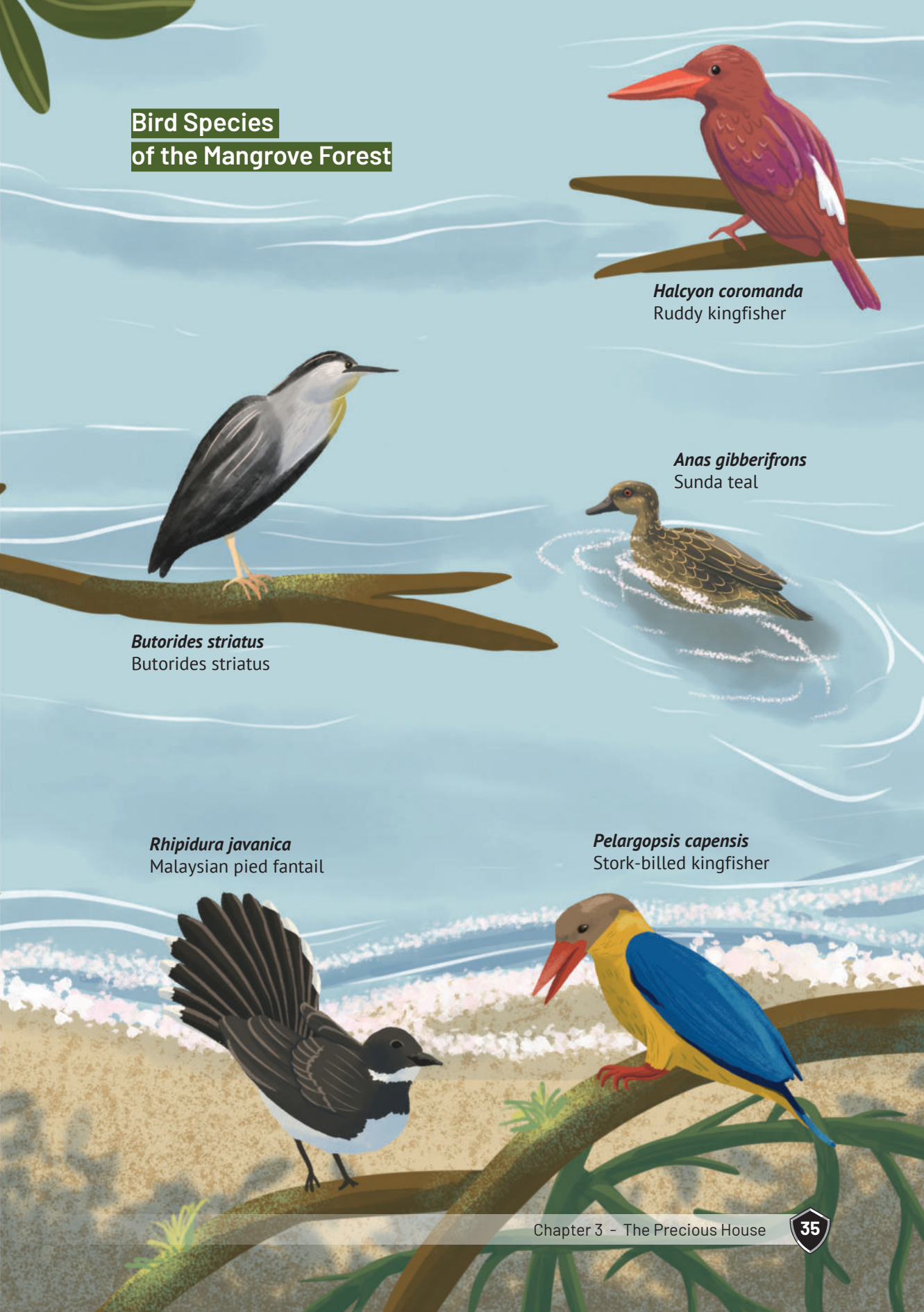
Gerygone sulphurea
Golden-bellied gerygone

Zosterops flavus
Javan white-eye

Streptopelia bitorquata
Sunda collared dove

Nectarinia calcostetha
Copper-throated sunbird

Bird Species of the Mangrove Forest



Halcyon coromanda
Ruddy kingfisher

Anas gibberifrons
Sunda teal

Butorides striatus
Butorides striatus

Rhipidura javanica
Malaysian pied fantail

Pelargopsis capensis
Stork-billed kingfisher



Chlidonias hybrida
Whiskered tern

A Resting Place for the Adventurers

Food becomes scarce while hungry mouths multiply. The birds are compelled to travel far, leaving their breeding grounds.

Migratory birds can travel thousands of kilometers across seas and continents.



Actitis hypoleucos
Common sandpiper



Tringa nebularia
Common greenshank



Xenus cinereus
Terek sandpiper



Tringa totanus
Common redshank

Each year, they journey along familiar routes toward places where food is abundant. At these destinations, they come solely to feed, not to breed. They will return to their original habitat once the weather improves. The mangrove forest is one of the favorite stopover sites for these adventurers.



Ficedula narcissina
Narcissus flycatcher



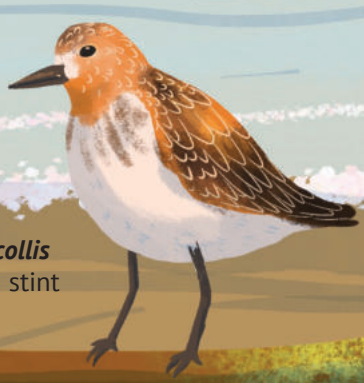
Numenius phaeopus
Eurasian whimbrel



Calidris ferruginea
Curlew sandpiper



Fregata andrewsi
Christmas frigatebird



Calidris ruficollis
Red-necked stint

Keeping Watch After Dusk

The daystar descends from its throne. The light grows dims, dusk arrives in a gentle glow. The mangrove dwellers lay their bustle to rest. They are hurrying home, curling into their cozy nests. For a moment, silence reigns, awaiting the coming of darkness.

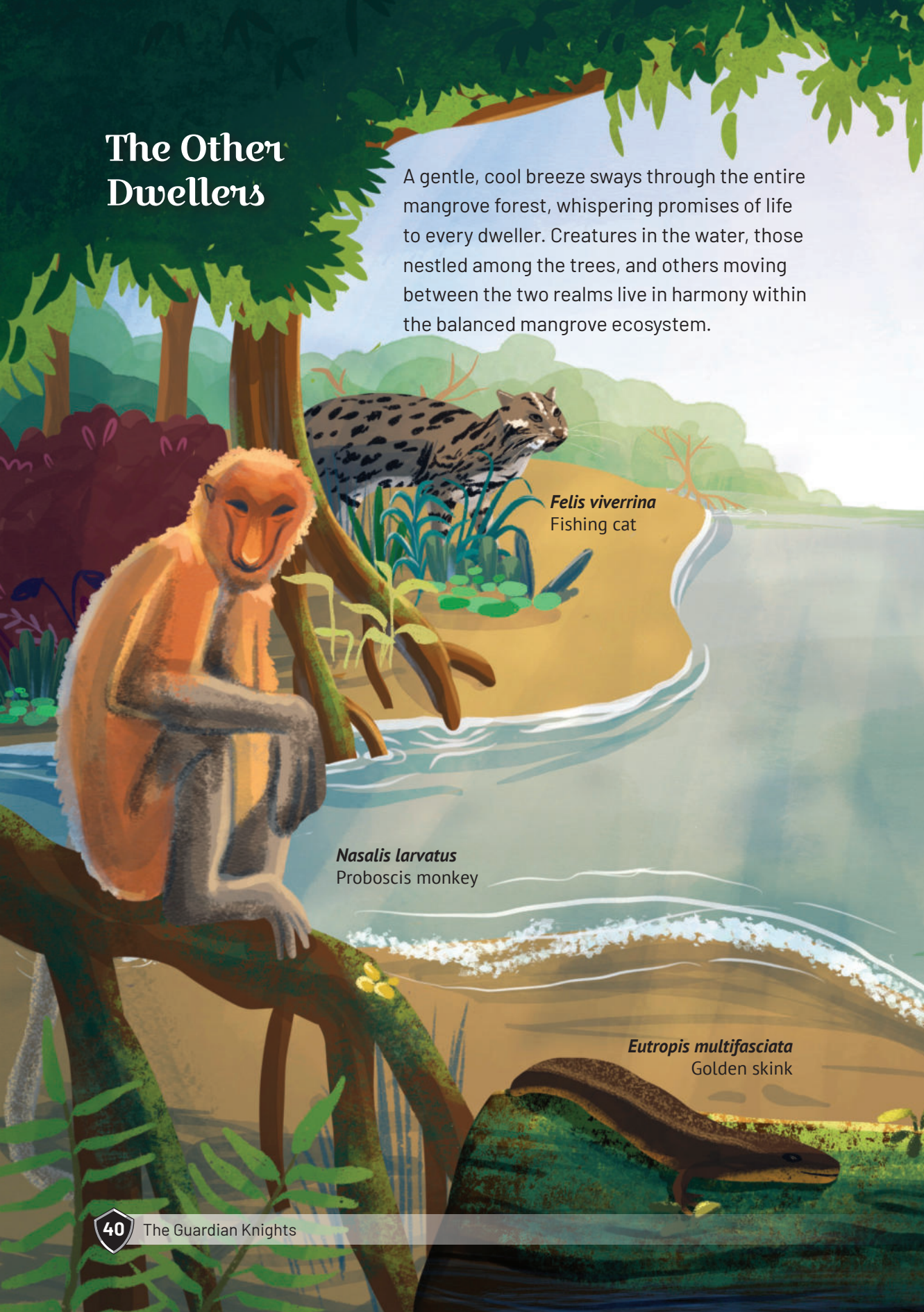
Twilight turns into night. Faint light fades into the darkness of night. Tiny lights flicker and dance in the shadows—they are fireflies, the lanterns of the night. Their presence stirs other nocturnal creatures, awakening them from slumber.




Tyto Alba
Western barn owl
Pterophus Alecto
Black flying fox
Fejervarya cancrivora
Crab-eating frog
Acrochordus granulatus
Little file snake
Crocodylus porosus
Saltwater crocodile

The Other Dwellers

A gentle, cool breeze sways through the entire mangrove forest, whispering promises of life to every dweller. Creatures in the water, those nestled among the trees, and others moving between the two realms live in harmony within the balanced mangrove ecosystem.



Felis viverrina
Fishing cat

Nasalis larvatus
Proboscis monkey

Eutropis multifasciata
Golden skink


Macaca fascicularis
Crab-eating macaque
Sus scropa
Wild boar
Phalangeridae
Bear cuscus
Varanus salvator
Monitor lizard

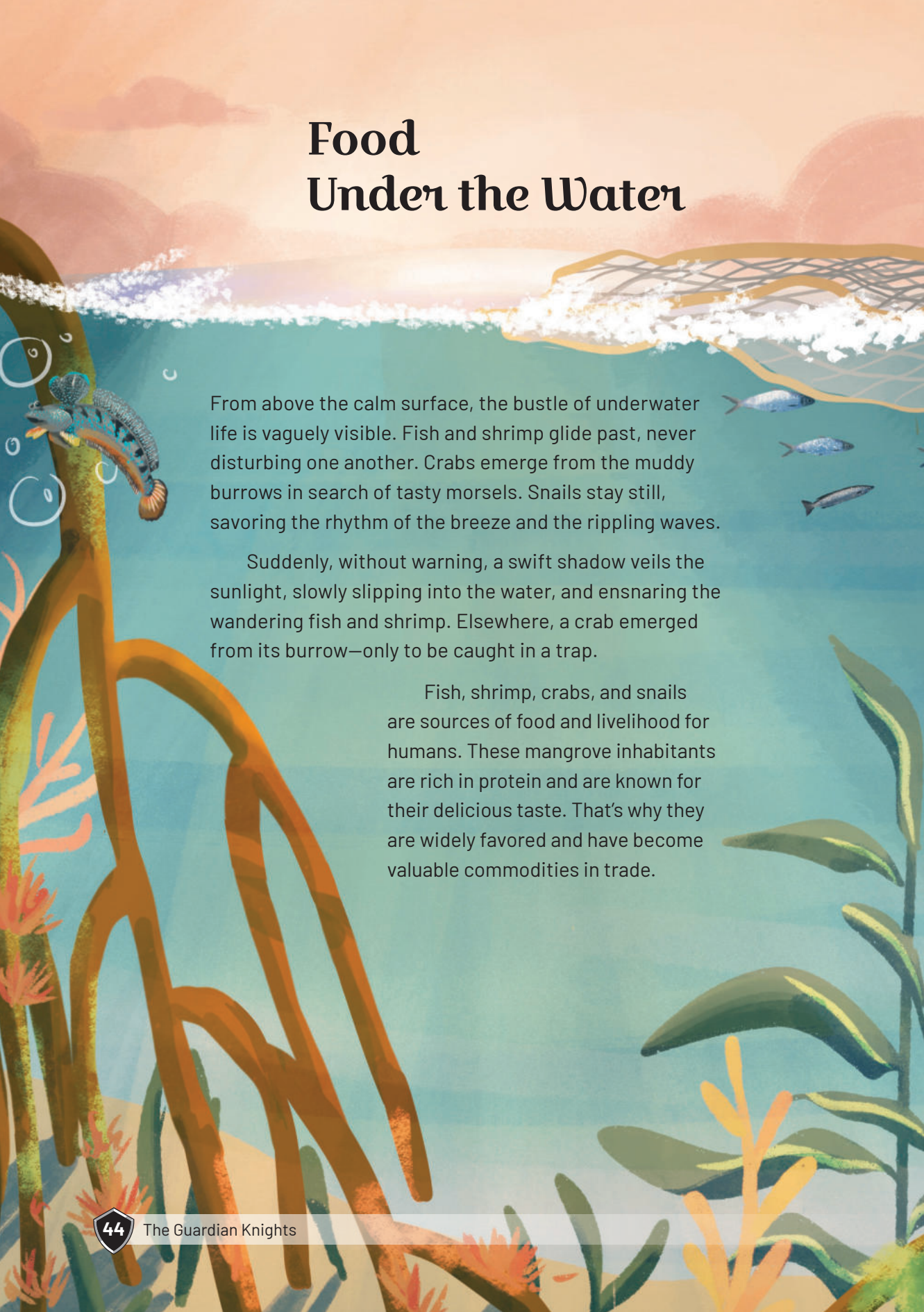


FOR BODY AND SOUL

The splash of oars guides the boat's swift glide
Slipping through roots that intertwine and hide
Nets are cast, traps laid with care
To the valiant Knight, hope is laid bare
Would it still support our welfare?



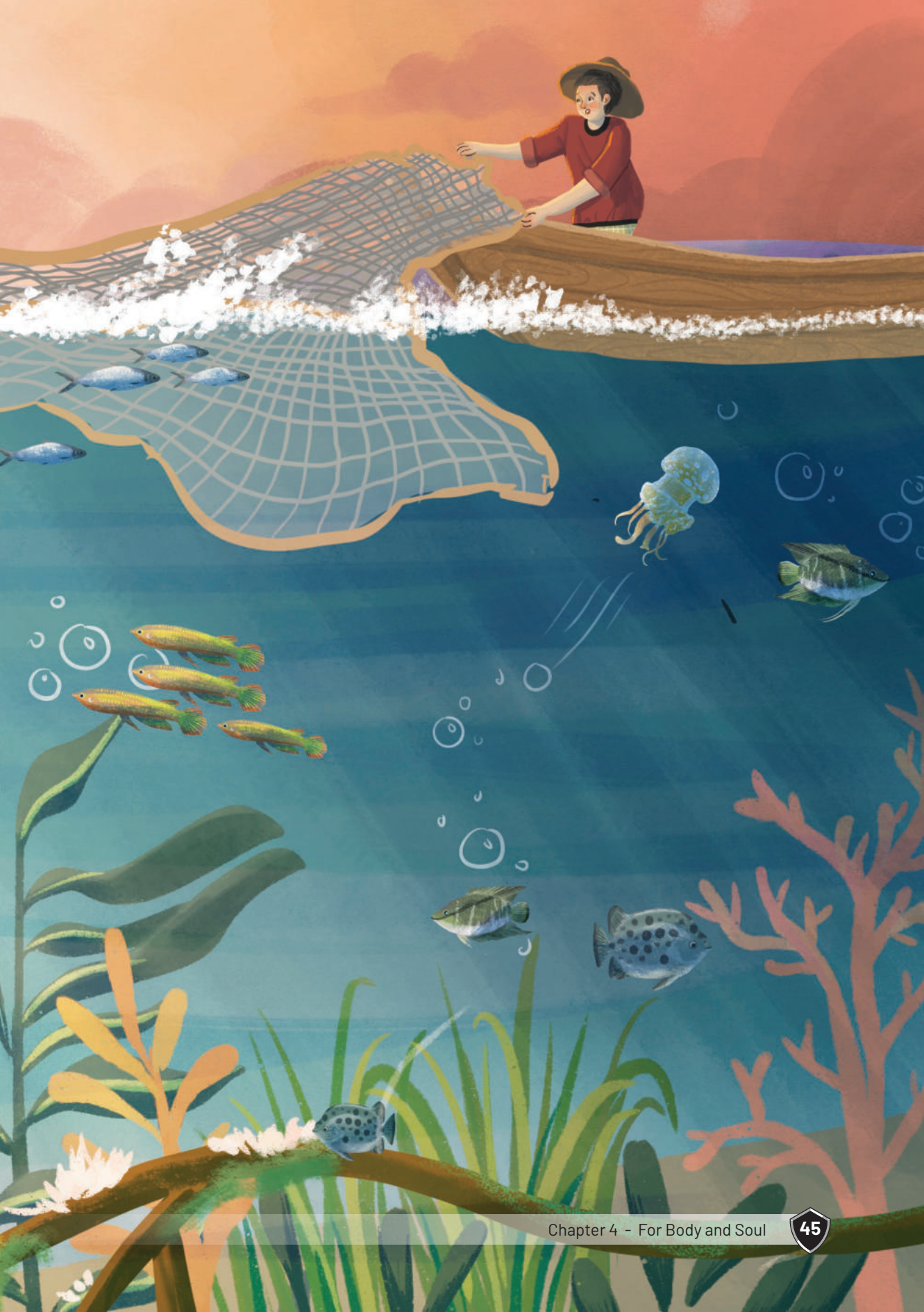
Food Under the Water



From above the calm surface, the bustle of underwater life is vaguely visible. Fish and shrimp glide past, never disturbing one another. Crabs emerge from the muddy burrows in search of tasty morsels. Snails stay still, savoring the rhythm of the breeze and the rippling waves.

Suddenly, without warning, a swift shadow veils the sunlight, slowly slipping into the water, and ensnaring the wandering fish and shrimp. Elsewhere, a crab emerged from its burrow—only to be caught in a trap.

Fish, shrimp, crabs, and snails are sources of food and livelihood for humans. These mangrove inhabitants are rich in protein and are known for their delicious taste. That's why they are widely favored and have become valuable commodities in trade.



From Harbor to Dinner Table



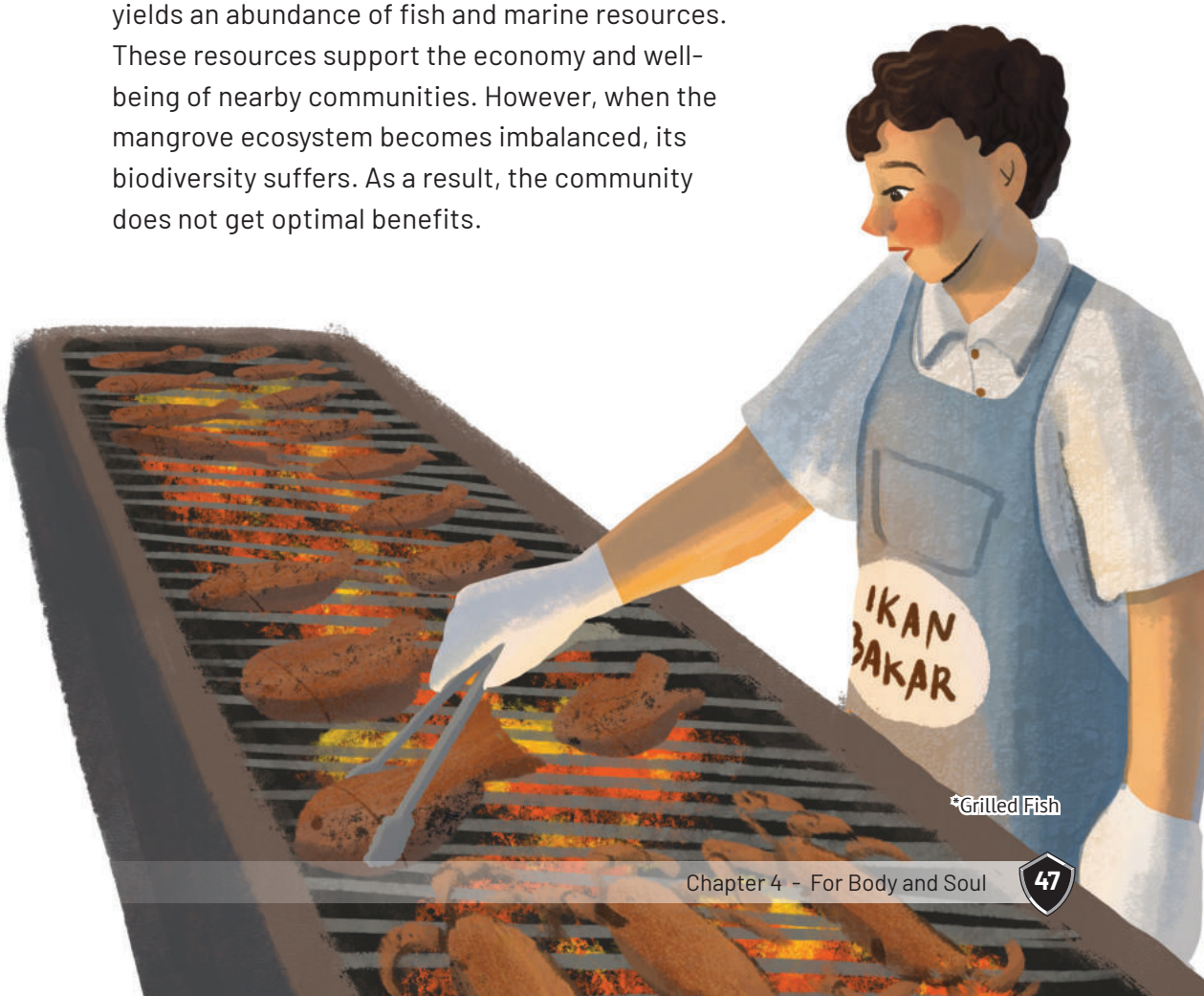
Coastal communities living near mangrove ecosystems rely on aquatic life as a source of livelihood. They catch fish, crabs, shrimp, and snails for daily meals, and sell the rest to earn income. Traders bring these catches to the city and sell them in local markets. In urban areas, many people purchase these marine products. Thus, fish, crabs, shrimp, and snails from the mangrove forests can be enjoyed and appreciated even by those who live far from the coast.



*Wholesale Market



A healthy and well-preserved mangrove forest yields an abundance of fish and marine resources. These resources support the economy and well-being of nearby communities. However, when the mangrove ecosystem becomes imbalanced, its biodiversity suffers. As a result, the community does not get optimal benefits.



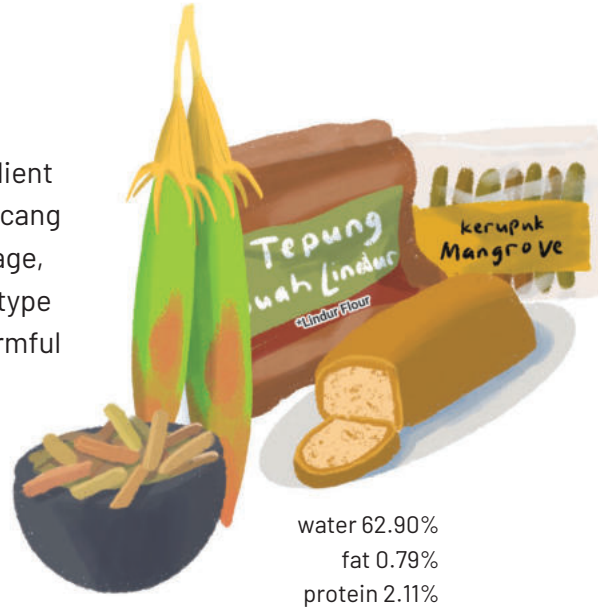
*Grilled Fish

Food on the Water

The support of the Guardian Knights for human life is boundless. The fruits, flowers, and leaves of the mangrove can be processed into a variety of highly nutritious foods.

Lindur (*Bruguiera gymnorrhiza*)

Lindur fruit contains a high level of carbohydrates, making it a promising ingredient for food production. Community groups Tancang Jaya and Ngudi Makaryo in Kartika Jaya Village, Kendal Regency, Central Java, process this type of mangrove fruit into flour. To eliminate harmful substances, the preparation involves washing, boiling, and drying. The resulting flour is then used to make crackers, sponge cakes, and mangrove stick snacks. According to research, these processed foods are rich in nutrients and antioxidants, and high in fiber. Other products made from lindur fruit include syrup and jam.



water 62.90%
fat 0.79%
protein 2.11%
ash 1.29%
carbohydrate 32.91%.

Pedada or Mangrove Apple (*Sonneratia caseolaris*)



contains vitamins A, B1, B2, and C

In Rugemuk Village, Deli Serdang, North Sumatra, the Putri Mangrove Group processes pedada fruit into dodol (a traditional sweet). Another group producing mangrove dodol is Lintang Jaya, located at Beting Beach in Pantai Bahagia Village, Bekasi. Pedada fruit is also made into syrup. The farmers group Wonorejo In Surabaya has developed a nutritious and flavorful pedada syrup. This syrup can be further processed into pedada jam.

Nipa palm (*Nypa fruticans*)

Nipa fruit contains a high level of carbohydrates and dietary fiber, making it suitable for processing into fiber-rich flour. This flour can be used to make cakes, donuts, and other processed foods.

The Tunas Harapan and Karya Bersama farmer groups in Sungai Lueng and Sukarejo Villages, Langsa City, Aceh, process nipah fruit into dodol (a traditional sweet), nipa juice, and candied nipa.

In Pallantikang Village, South Sulawesi, locals tap the sweet sap from nipa flower clusters to produce palm sugar and granulated palm sugar.



carbohydrates 51%
protein 2.27%
dietary fiber 2.5%
vitamin A 30.5 mg/100 g
sodium, calcium, magnesium, iron, and zinc

Antioxidants are compounds that can neutralize harmful substances, so that the body is protected from disease.



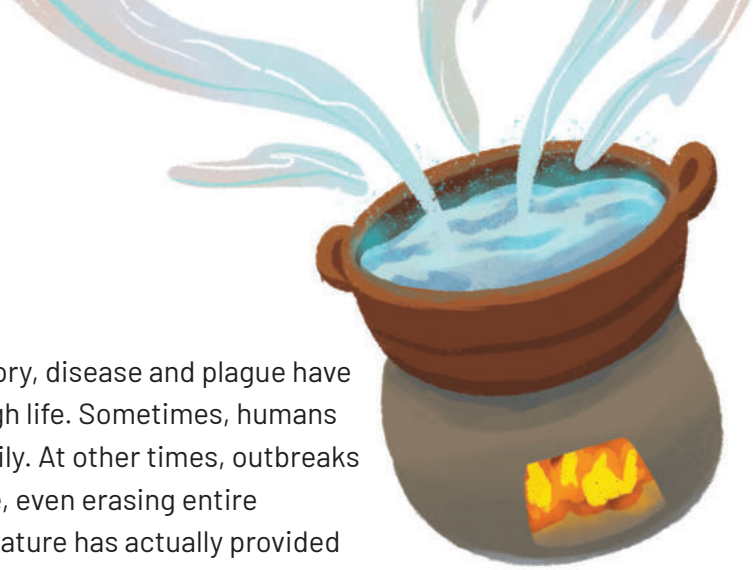
Holy Mangrove (*Acanthus ilicifolius*)

Unlike other mangrove plants whose fruits are used as food ingredients, holy mangrove is valued for its leaves. The leaves contain compounds with antibacterial properties, along with other substances beneficial to health.

The people of Labuhan Sumbawa Village in East Nusa Tenggara use holy mangrove leaves to make tea. In Sei Kupah Village, West Kalimantan Province, locals make crackers using a mixture that includes holy mangrove leaves.



Treating the Sick



Throughout human history, disease and plague have repeatedly swept through life. Sometimes, humans can overcome them easily. At other times, outbreaks are difficult to eradicate, even erasing entire civilizations. However, nature has actually provided cures for all diseases.

Mangrove forests are one of nature's sources of medicine. In Papua, five indigenous tribes—Mandender, Sough, Ambay, Inanwatan, and Mandori—have long practiced the use of mangrove plants as traditional medicine. This local wisdom continues to pass down through generations. The knowledge begins with experimenting on parts of the mangrove plant to treat specific illnesses. When recovery occurs or signs of healing appear, the experience becomes shared knowledge, preserved, and handed down from one generation to the next.



The Mandender ethnic group use the flowers of ***Bruguiera gymnorrhiza*** to cure skin and ear disease.



The Sough ethnic group use ***Rhizophora sp***. bark to treat toothache and malaria.





The Ambay ethnic group use the stems and twigs of ***Rhizophora apiculata*** to warm and massage babies, helping them to develop strong bones.



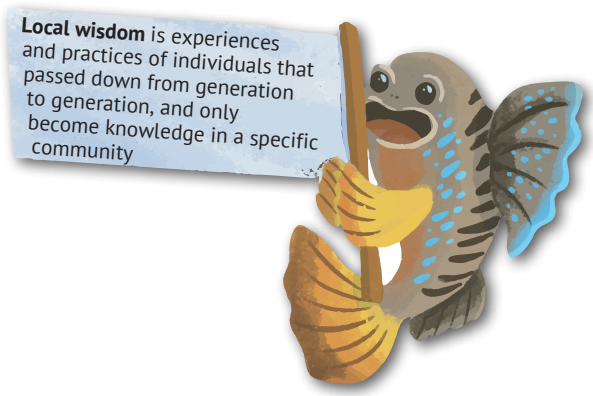
The Mandori ethnic group use ***Lumnitzera littorea*** flowers as a remedy for itching.



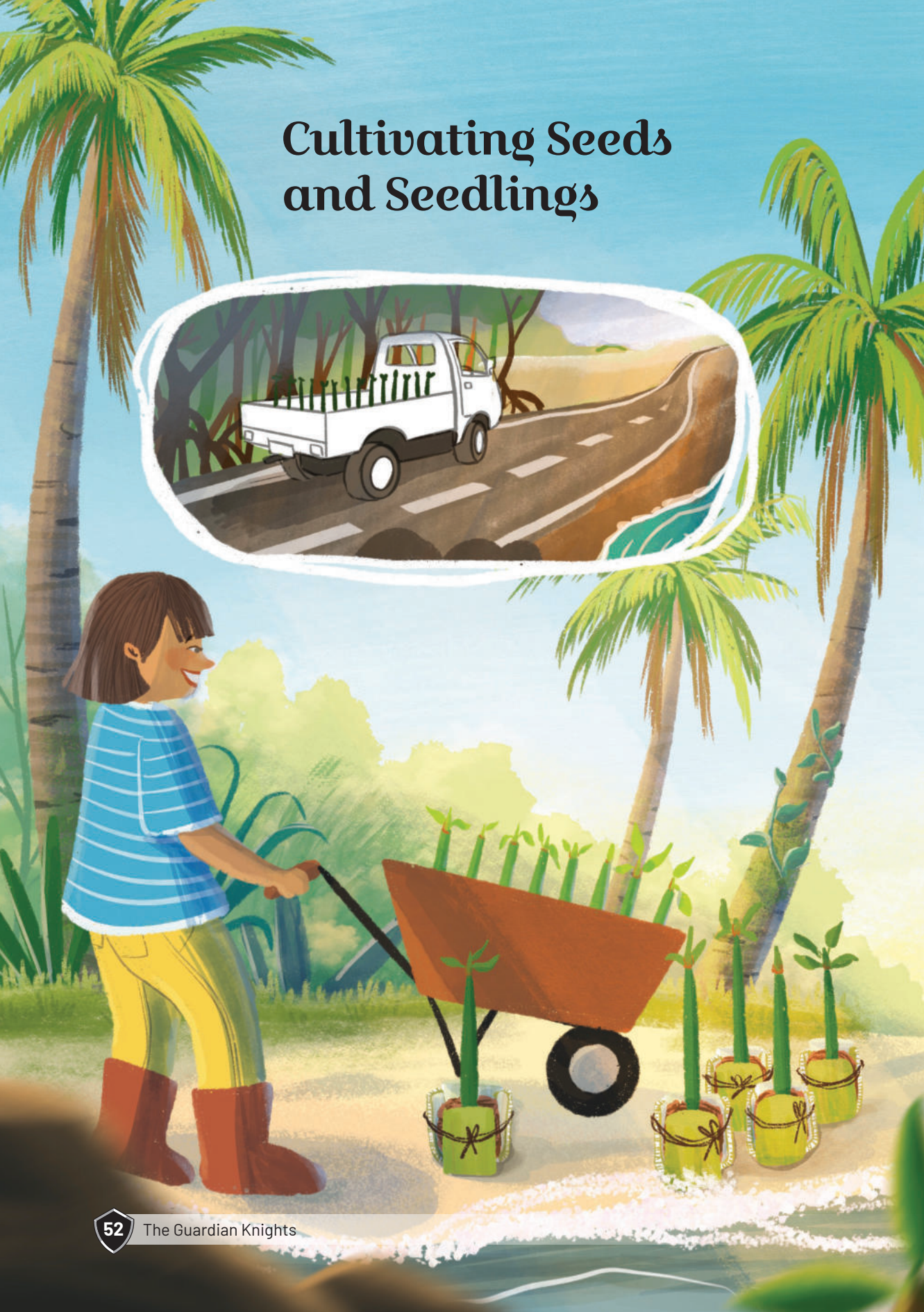
The Inanwatan ethnic group use the fruit of ***Heritiera littoralis*** as a stamina enhancer.

The use of mangroves as traditional medicine has been passed down through generations because mangroves are easy to obtain and have no side effects. Not only in Papua, but other coastal tribes in Indonesia also possess similar local wisdom. The types of plants and the parts used for healing vary, depending on the experience passed down through generations.

These medicinal remedies play an important role in modern medicine. The wealth of local wisdom serves as a reference for pharmaceutical research in developing modern drugs. Thus, medicine derived from mangrove plants can be developed into modern drugs that benefit many people.



Cultivating Seeds and Seedlings



The mangrove buds have bloomed perfectly, gradually transforming into tiny fruits. These fruits grow larger and ripen over time. Once sprouted—known as propagules—they are ready to take root as new life, joining the ranks of the Guardian Knights.

People living near mangrove forests use propagules to grow seedlings. Ripe fruits are harvested and planted in containers. Once they adapt and develop a pair of leaves, the propagules become seedlings ready for planting.

Mangrove seedlings are planted in other suitable coastal areas to expand the mangrove forest. Some are even brought to distant shores, reaching beyond the island.



Tourism and Education

A milky stork flaps its wings, glides low, then dives downward. It plunges its beak into the water, startling its prey. When the beak rises again, a fish is caught between its jaws. The stork flies back to its nest atop a mangrove tree, where its hungry chick chirps with joy.

On the wooden bridge, a group of boys and girls stand with binoculars and notebooks in hand. They observe and carefully record the moment with care. It is a natural wonder, rich with meaning.

Mangrove forests can be developed as tourism and educational sites. Visitors not only enjoy a relaxing environment, but also gain new knowledge and understanding of the benefits and importance of the mangrove ecosystem. Several mangrove ecosystems have already been developed as ecotourism and educational sites, including:

Mangrove Wetland Essential Ecosystem Area in Pasarbanggi Tireman, Rembang Regency



Bontang Mangrove Park in Kutai National Park



Tongke-Tongke Mangrove Forest in Sinjai Regency



On the other side, some people stroll through the mangrove forest, enjoying its beauty and taking selfies. The soft breeze and delightful scenery soothe the hearts of the visitors.



Inspiring Artists

Bathed in the gentle light of morning, the mangrove—the Guardian Knight—reveals its elegance. Resilient and strong in the face of danger, it also appears graceful when welcoming people.

Several artists are captivated. The uniqueness of the mangrove becomes a wellspring of inspiration for their artworks. Their imaginations awaken, unleashing boundless creativity. Mangroves spark ideas for poetry, paintings, songs, dramas, and batik designs.

In Tegal, Central Java, a group of artists from Paguyuban Penyelamat Lingkungan Kota Tegal (Association of Tegal Eco-Warriors) actively create and exhibit mangrove-themed paintings. Nai' Maula Ramdhani, an artist from Universitas Negeri Surabaya, East Java, created a painting inspired by the mangroves of Labuhan Village, Brondong District, Lamongan Regency, and explored it further in a scientific paper.

Poets compose mangrove-themed poems that reflect their deep admiration and concern for its ecosystem. Some of these works include *Mangrove: A Forest Growing on Swamplands* by Tengsoe Tjahjono and *Mangroves and the Wooden Bridge* by Ahmad Irfan Fauzan.



Musicians create mangrove-inspired compositions to voice their concern over the destruction of mangrove ecosystems. Kadek Indra Wjaya from Institut Seni Surakarta, Central Java, produced a musical piece titled *Tangled in Musical Mangrove*, inspired by mangroves in Kedonganan, Kuta District, Badung Regency.

Mangroves also inspire the creation of other art forms, such as batik. Batik featuring mangrove motifs and natural dyes has flourished in coastal areas. The motifs depict diverse parts of the mangrove plant and the various animals that inhabit the mangrove forest. Mrs. Lulut Sri Yuliani from Kedungasem Subdistrict, Rungkut District, Surabaya, developed "*SeRu*" batik (*Seni Batik Mangrove Rungkut*—Mangrove Batik Art of Rungkut). Another batik group, 'Wjaya Kesuma' from Mangunharjo Subdistrict, Semarang, uses mangrove waste as a natural dye, blending it with other organic materials to create a variety of colors.




Canned-Fish
SARDEN
ENAK

Threatening the Guardian Knights



Devotion poured from soul entire
Sacrifice of flesh for the bonefire
Yet none sing praises in their name
When villains rise and seize acclaim
Greed and folly rule the land
The Guardian Knights face a dire demand

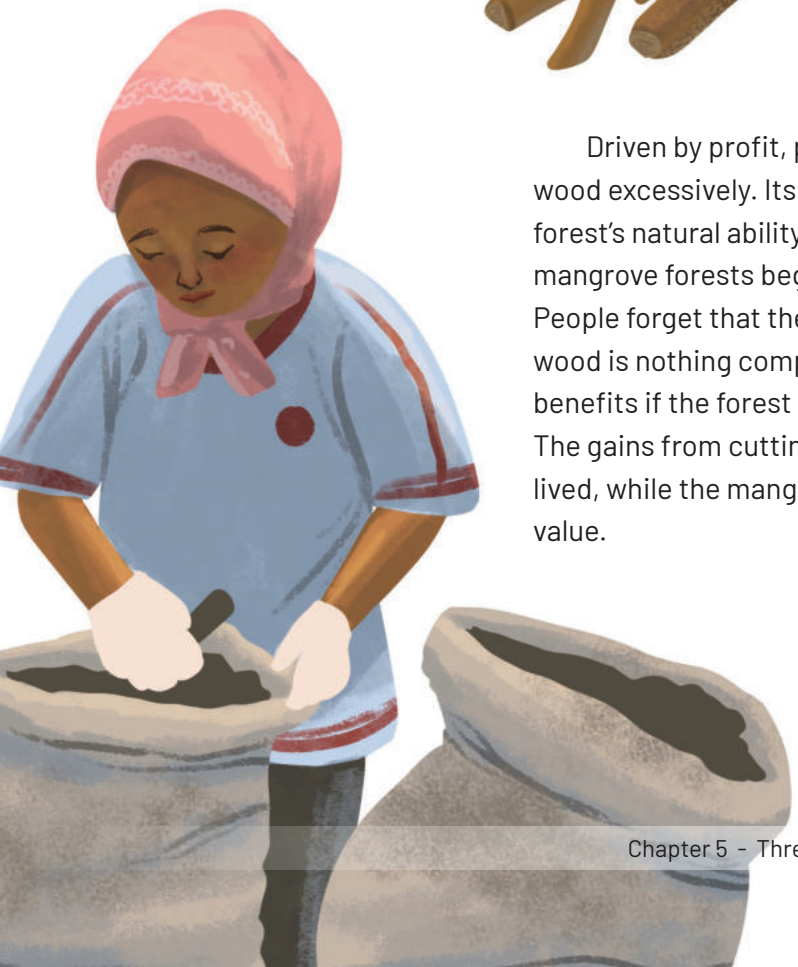


Overexploitation

Strength does not always lead to goodness; sometimes, it invites disaster. The mangrove forest has experienced this firsthand. Its tough, solid wood is often harvested for fuel and turned into charcoal. Mangrove wood provides a steady, long-lasting fire, and the charcoal derived from it is of high quality, giving it a good price. Additionally, large mangrove timber is frequently used as construction materials.







Driven by profit, people harvest mangrove wood excessively. Its use quickly outpaces the forest's natural ability to regenerate. Gradually, mangrove forests begin to shrink and deteriorate. People forget that the profit gained from mangrove wood is nothing compared to the long-term benefits if the forest is allowed to grow and thrive. The gains from cutting mangrove wood are short-lived, while the mangrove ecosystem offers lifelong value.

Trash from Land and Ocean

The sea cannot reject what the river delivers—including trash. People carelessly toss trash away, which ends up in rivers and flows downstream. The farther the water travels, the more trash it gathers. When it reaches the estuary, some of the trash enters the mangrove forest. Over time, it accumulates—piling up and scattering everywhere.



Trash is scattered, caught in roots and branches. When the waves rise high, the trash can even reach the mangrove canopy. Once trapped, it will not disappear—especially plastic waste, which takes hundreds of years to decompose. The Guardian Knight begins to suffer. Where seawater once flowed freely, washing over the roots, now the water is blocked, unable to move. Old water is trapped, while new water cannot enter because of the piles of plastic waste.



In a healthy ecosystem, mangroves receive nourishment from the ebb and flow of water. The incoming tide brings essential nutrients. Water leaves, replaced by the one, once its task is done. But that no longer happens. The Guardian Knights grow hungry. Their breath are stifled. Their growth are stunted. If this continues, the Guardian Knights will eventually perish.



The piles of plastic waste also prevent the Guardian Knights from continuing their lineage. Mangrove seedlings, ready to begin life on their own, fall—only to be trapped atop the piles of plastic. Unable to take root, they die before growing into new Guardian Knights.

It's not only the Guardian Knights who suffer—mangrove-dwelling creatures are also affected. Small fish can no longer swim or live among the Guardian Knights. Shrimp, crabs, and other animals also suffer the same fate, losing their safe home.





Industrial and Domestic Pollutants



Industry produces various products that make human life easier. The more advanced civilization becomes, the more complex human needs grow. Industrial output continues to increase. Unfortunately, industry and daily human activities leave behind waste containing harmful substances. Examples include chemicals, heavy metals, oil, and detergents. Some of this waste flows into and settles in mangrove forests.



Heavy metal waste, such as lead (Pb) and cadmium (Cd), is hazardous. In small amounts, the Guardian Knights can break it down. But when this pollutant becomes excessive and persistent, it begins to accumulate in the roots, bark, stems—even the leaves of the mangrove.



The bark and leaves of the Guardian Knights, saturated with heavy metals, eventually fall and are consumed by aquatic organisms. If the concentration of heavy metals exceeds what the organisms can tolerate, it leads to death. Even when they survive, the toxins accumulate in the bodies of top predators, like fish. If humans catch and consume those contaminated fish, the heavy metals will also accumulate in the human body. In the long term, this can harm human health and even lead to death.

accumulation is the process of gradually increasing in amount



Pest and Disease Attacks

Like other living creatures, the Guardian Knights have natural enemies, too. These enemies make the mangroves sick, often even leading to death.

Natural enemies of the mangrove are part of the mangrove ecosystem. In a healthy environment, they pose no real threat—their numbers remain low because the ecosystem is in balance. But when the ecosystem becomes unhealthy, these natural enemies multiply rapidly. Their presence disrupts mangrove growth and causes damage to the forest.

One example is the attack of bagworms *Pagodiella spp* and *Acanthopsyche spp* in the mangrove forests of Batu Ampar District, Kubu Raya Regency, West Kalimantan.



Pagodiella spp., Acanthopsyche spp.
Bagworm



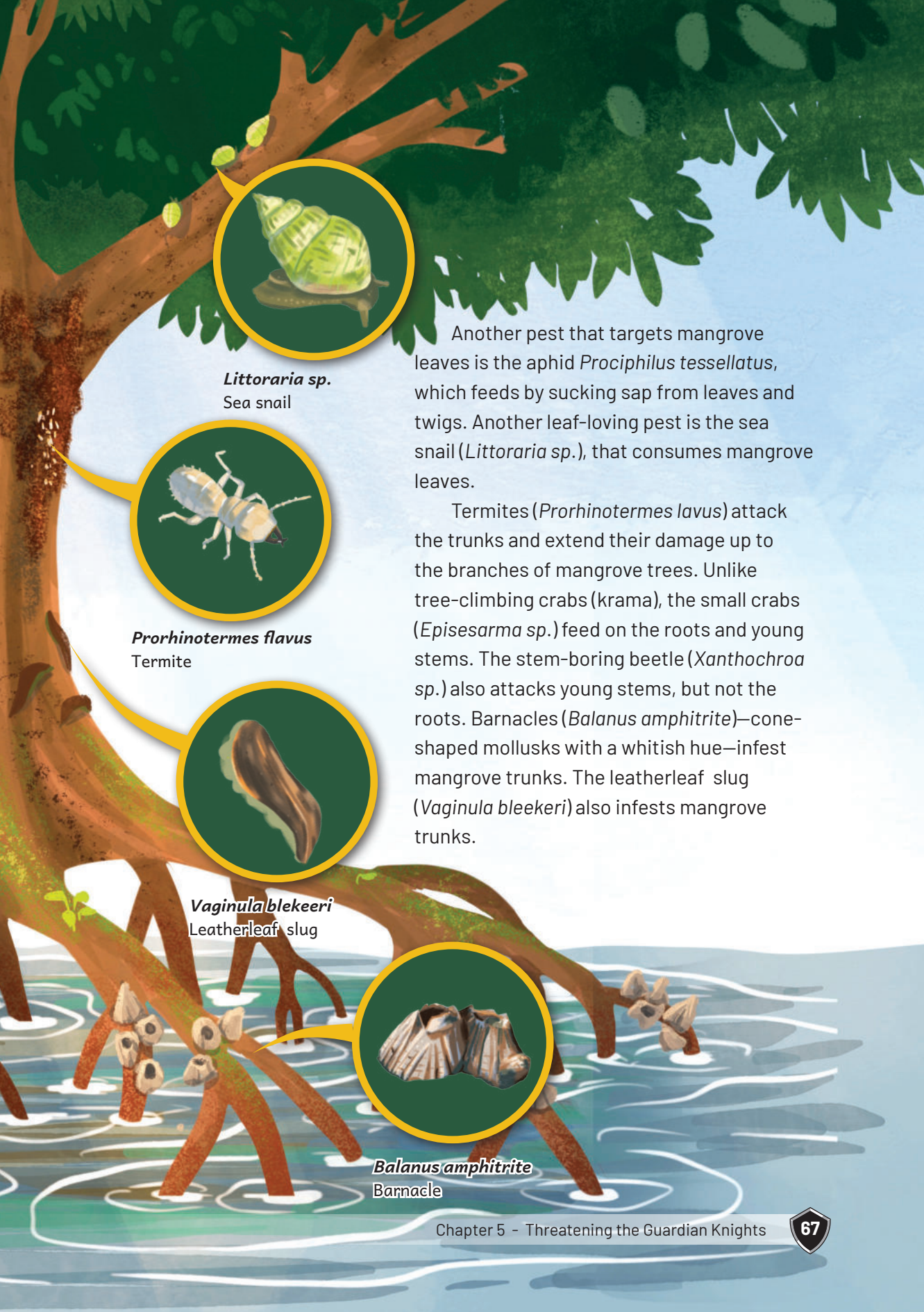
Prociphilus tessellatus
Aphid



Xanthochroa sp.
Stem-boring beetle



Episesarma spp.
Krama



Littoraria sp.
Sea snail

Prorhinotermes flavus
Termite

Vaginula blekeeri
Leatherleaf slug

Balanus amphitrite
Barnacle

Another pest that targets mangrove leaves is the aphid *Prociphilus tessellatus*, which feeds by sucking sap from leaves and twigs. Another leaf-loving pest is the sea snail (*Littoraria sp.*), that consumes mangrove leaves.

Termites (*Prorhinotermes lavus*) attack the trunks and extend their damage up to the branches of mangrove trees. Unlike tree-climbing crabs (krama), the small crabs (*Episesarma sp.*) feed on the roots and young stems. The stem-boring beetle (*Xanthochroa sp.*) also attacks young stems, but not the roots. Barnacles (*Balanus amphitrite*)—cone-shaped mollusks with a whitish hue—infest mangrove trunks. The leatherleaf slug (*Vaginula bleekeri*) also infests mangrove trunks.

The Transforming Power of Nature

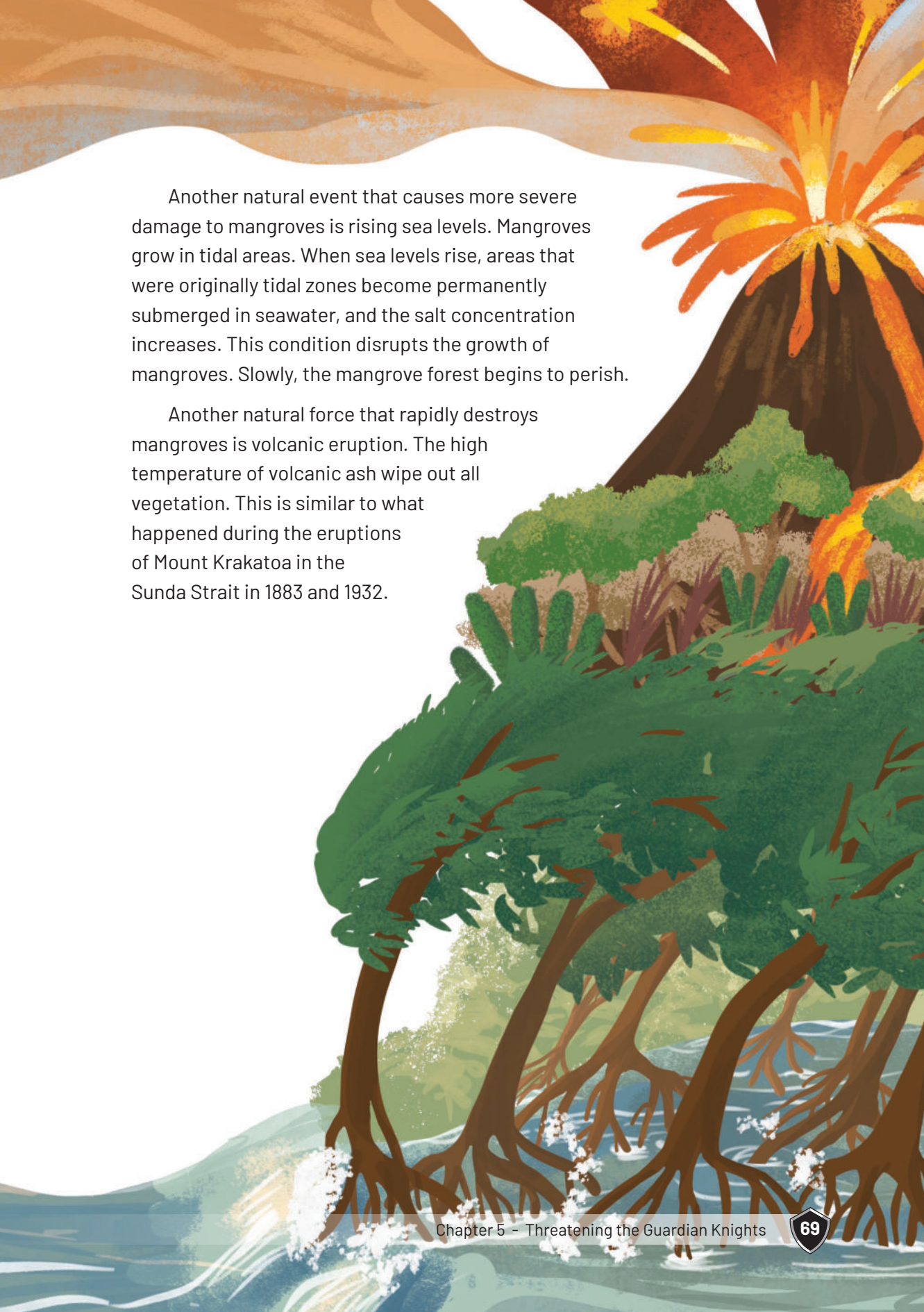
The Guardian Knights stand ever-ready, undaunted by a danger. Even when sacrifice is required, they fulfill their duty. When a tsunami strikes, the Knights stand firm—bravely blocking, absorbing, and taming its force. The settlements behind them are spared. However, the immense power of the tsunami impacts the mangrove forests. Trees are damaged and uprooted. The taller and stronger the tsunami waves, the greater their potential to devastate the mangroves.

After the waves recede, the mangrove forest is no longer the same. One example can be seen in Teluk Lot Pria Laot, on the eastern coast of Weh Island, Aceh. There were few casualties and damage to residential areas, but the mangrove forest was devastated. Most of the trees were broken, leaving behind only roots and lower trunks. This damage also led to a drastic decline in wildlife populations.

Typhoons and storms cause almost similar impacts. Mangrove forests help reduce the force of hurricanes and storms. However, the force of the storm can still break branches, twigs, and even mangrove trunks.

Another natural event that causes more severe damage to mangroves is rising sea levels. Mangroves grow in tidal areas. When sea levels rise, areas that were originally tidal zones become permanently submerged in seawater, and the salt concentration increases. This condition disrupts the growth of mangroves. Slowly, the mangrove forest begins to perish.

Another natural force that rapidly destroys mangroves is volcanic eruption. The high temperature of volcanic ash wipe out all vegetation. This is similar to what happened during the eruptions of Mount Krakatoa in the Sunda Strait in 1883 and 1932.

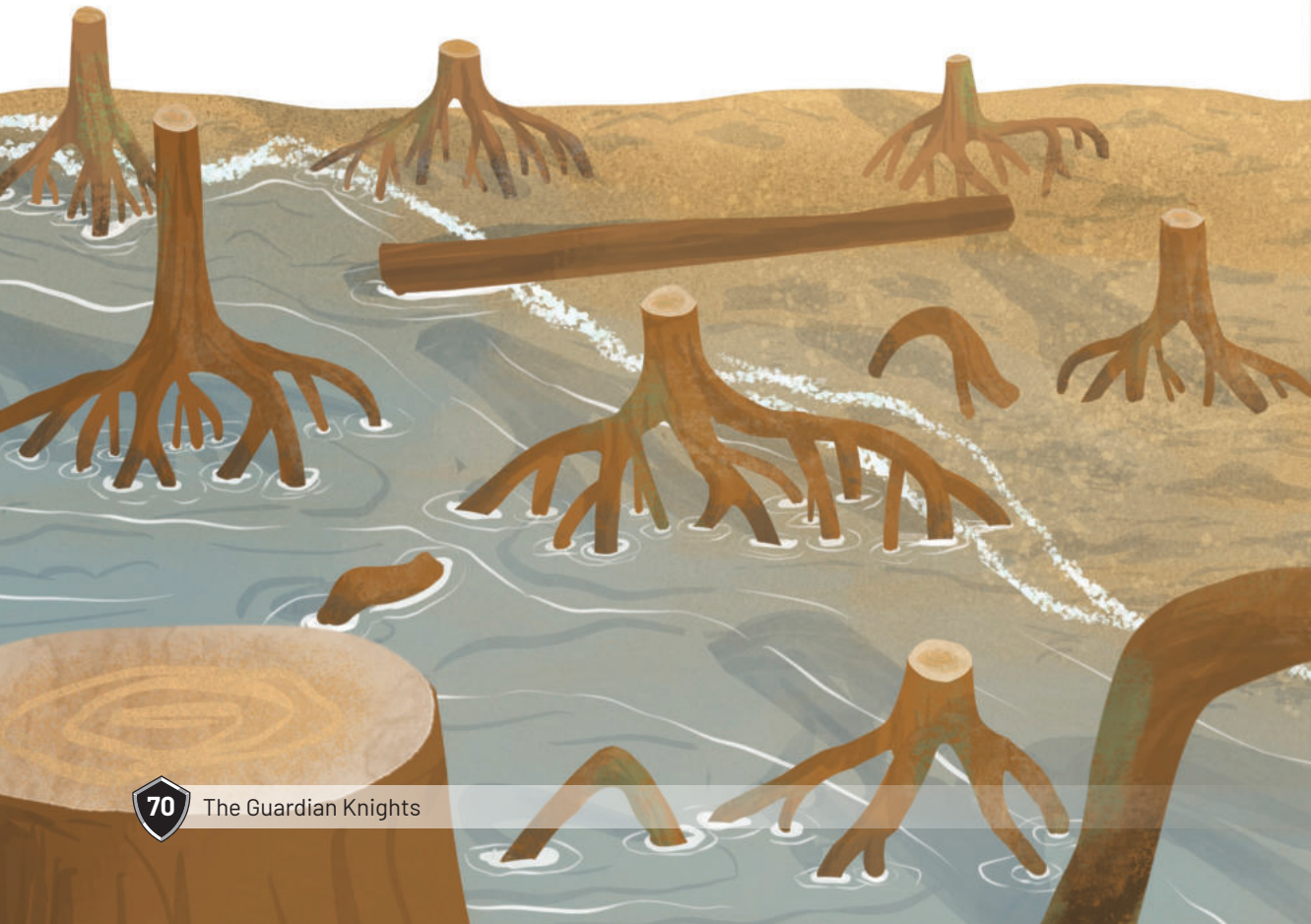


Destructive Greed

The Guardian Knights' role in supporting life is not always recognized. People often overlook the existence of mangroves and all their vital functions. In fact, mangrove ecosystems are often perceived as having no economic value.

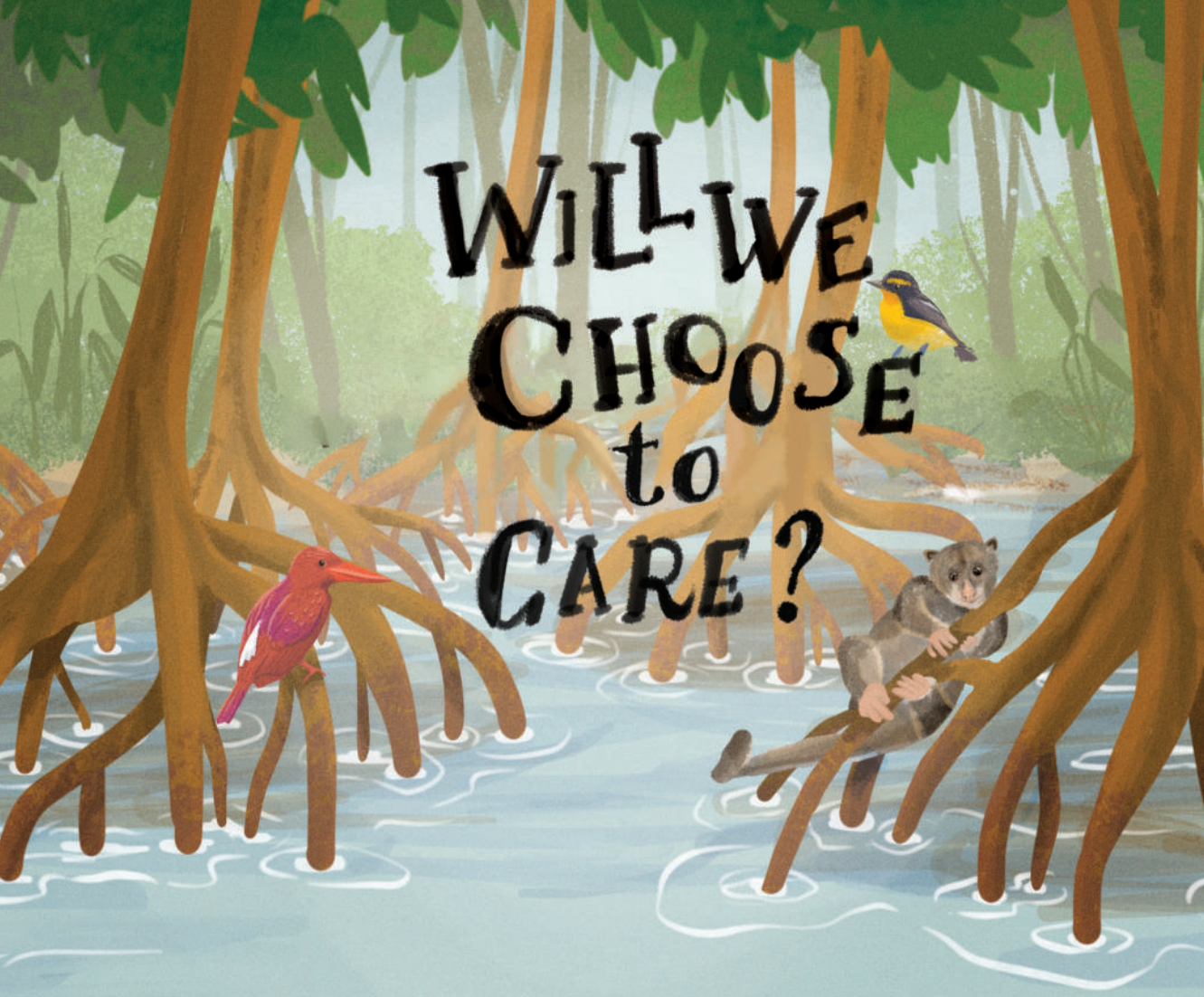
In the name of development, mangrove ecosystems are cleared away. The coastline is now lined with industrial zones, fish farms, docks, reclaimed land, and residential settlements.

Not only tree cutting, but the clearing of mangrove forests also brings further threats. Heavy machinery such as tractors, excavators, and bulldozers move relentlessly, toppling and crushing the Guardian Knights. Thousands of trucks arrive, dumping hard soil and rocks to fill and elevate the mangrove areas. As a result, the mangrove ecosystem is destroyed—both the trees and the wildlife that inhabit it. In the long term, waste pollutes the waters and the surrounding mangrove areas are also damaged.




reclamation is the process of filling in coastal areas to expand the land





Who holds the right to dwell?
Human beings?
Or beasts, plants, and all living things?
And what of soil, of water, air, and sunlight's beam?
The entire balance of the ecosystem.
Without them, humans are in despair.
Will we choose therefore to care?

Enjoy, Don't Destroy

"Take nothing but pictures, leave nothing but footprints". This ancient proverb reminds us how humans should maintain their relationship with nature, including with mangrove forests. Humans are but a small part of the ecosystem. The overall balance of the ecosystem greatly affects human life. Only when the ecosystem's sustainability is maintained can humans live comfortably. Therefore, we must maintain our concern for these Guardian Knights.

We should enjoy and admire the amazing mangrove ecosystem. In recent times, touring to enjoy the great outdoors with its beautiful scenery has become a popular trend among all ages. One example is traveling to mangrove forests. Visitors flock to mangrove areas, take photos, and then upload them on social media.

Unfortunately, most visitors remain careless. They come in large groups, making noise that disturbs the wildlife there. Sometimes they eat and drink, then throw their trash into the mangrove forest or the sea. At times, visitors even damage the mangrove forest.



As a generation that cares about the lives of the Guardian Knights, we should avoid such behavior. We should enjoy the mangrove ecosystem without destroying it. As the ancient proverb says, "Take nothing but pictures, leave nothing but footprints."

Care for Guardian Knights

Our care and love for the Guardian Knights form a strong foundation for the preservation of the mangrove ecosystem. Every action we take helps ensure the continuity of this ecosystem. Start with yourself, start with small things, and start now.





To know is to love. Understanding and learning everything about the mangrove forest is essential for cultivating a sense of care. We will discover a wealth of knowledge and wonders there. And we will come to realize even more deeply that humans are just a small part of the ecosystem.

Small actions can have a big impact when done consistently and collectively. The more people who care, the better preserved the integrity of the mangrove ecosystem will be. We have a duty to campaign, to invite others to care and participate—starting with our closest family and friends.



The time has come for us to take action and participation in rescuing the Guardian Knights. Our hands hold the power to heal and restore the damaged mangrove ecosystem. Planting and nurturing mangroves until they grow and thrive is a true expression of our care and love.


Planting mangroves today
Protecting life tomorrow

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Book Creators



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