The Hawaiian Forest

To understand Hawai‘i, we have to understand the forest. The forest is not only a place where trees grow. It is a living system made of land, rain, mist, sunlight, wind, soil, plants, birds, insects, and people. In Hawai‘i, the forest is also connected to wai, fresh water. Without healthy forests, the island’s fresh water is weakened. Without fresh water, life on the island cannot continue.

One important tree in the Hawaiian forest is koa. Koa is known for canoes, paddles, bowls, furniture, and beautiful wood. But before koa becomes wood, it is a living tree. Before it becomes a wa‘a, it grows in the wao, the upland forest. Koa is part of the forest’s life, part of the water cycle, and part of Hawaiian knowledge.

Another important canoe tree is wiliwili. While koa is often connected with the wetter upland forest, wiliwili belongs mostly to the dry lowland forest. Koa helps us understand strength, large canoe hulls, and the upland forest. Wiliwili helps us understand lightness, flotation, the ama, and the dryland forest. Together, these trees show that Hawaiian canoe building came from knowledge of the whole island, from mauka to makai.

The Forest as a Living System

A native Hawaiian forest is made of many different plants. Tall trees form the canopy, the upper layer of the forest. Smaller trees and shrubs grow beneath them. Ferns, vines, mosses, fungi, insects, birds, and soil organisms all live together in the same system.

This diversity matters. A forest with many kinds of plants is stronger than a forest with only one kind of plant. Different plants do different work. Some trees reach high into the sky. Some plants cover the ground. Some hold soil in place. Some catch mist. Some provide food or shelter for birds and insects. Some return nutrients to the soil.

The health of the forest depends on these relationships. No single plant does everything. The forest is strong because many living things work together.

How Scientists Classify Hawaiian Vegetation Zones

Modern scientists classify Hawaiian forests and plant communities by looking at rainfall, elevation, temperature, soil, wind, exposure, and the kinds of plants that grow there. They often use terms such as coastal vegetation, lowland dry forest, mesic forest, montane wet forest, bog, subalpine shrubland, and alpine vegetation.

These scientific categories help people study where plants grow and why they grow there. A dry forest is different from a wet forest because it receives less rain and has plants adapted to drought. A mesic forest is between dry and wet. A montane wet forest is usually higher, cooler, and wetter. Bogs form where water collects and soils stay wet. Subalpine and alpine zones occur high on the mountains, where cold, wind, and thin soil shape the plant life.

Scientists also study how forests have changed. Some areas that were once native dry forests are now grasslands, pasture lands, or forests dominated by introduced plants. Many lowland and dryland forests were damaged because they were easier for people and animals to reach. Wet upland forests were often more remote, but they too have been damaged by grazing animals, invasive plants, disease, and human use.

Scientific classification helps us see patterns. It helps us understand that Hawai‘i is not one single environment. Hawai‘i contains many different forest zones, from dry coastal forests to wet mountain forests and high alpine areas.

Hawaiian Ways of Naming the Land and Forest

Long before modern scientists classified Hawaiian forests, Hawaiians had their own ways of naming and understanding the land. These Hawaiian names were not only descriptions of plants. They also described human use, sacredness, access, moisture, cultivation, and relationship.

Wao is a general word for an inland or forested region. Different wao described different kinds of land and forest.

David Malo described the wao kanaka as the region below the wao akua. This was the area where people could cultivate and gather useful plants. It was closer to where people lived and worked. Malo also described higher forest regions where the land became less connected to daily human activity and more connected to the realm of akua.

Samuel Kamakau gave a more detailed description of the land from mountain peak to sea. Moving from mauka to makai, he described high mountain regions, then places where small trees begin to grow, then taller forest regions, then wao ma‘ukele, the wet forest, then wao akua, then wao kanaka, then the ‘ama‘u fern belt, the ‘apa‘a grasslands, the kula lands, and finally the kahakai and shoreline.

This traditional system does not match modern science word-for-word. It was not trying to be the same thing. Modern scientists often classify by rainfall, elevation, and plant community. Hawaiian classifications also include how people lived with the land, where they cultivated, where they gathered, where they traveled, where they showed caution, and where they understood the presence of akua.

Both systems are useful. Science helps students understand climate, elevation, rainfall, and ecology. Hawaiian knowledge helps students understand relationship, responsibility, and place.

The Ahupua‘a and the Mountain-to-Sea System

The ahupua‘a is a traditional Hawaiian land division that often reaches from the mountain to the sea. This system connects the upland forest, the agricultural lands, the streams, the coast, and the ocean.

In a simplified way, we can think of several connected zones. The wao nahele is the inland forest. The wao kanaka is the region used by people for living, farming, gathering, and work. The kahawai is the stream system that carries fresh water. The kahakai is the coastal zone. The kai is the ocean.

These zones are not separate pieces. They are connected. What happens mauka affects what happens makai. If the upland forest is damaged, less water may enter the ground. Streams may weaken. Soil may wash down. Fishponds, reefs, and nearshore waters may be affected.

This is why the Hawaiian forest cannot be understood only as a forest. It is part of the island's water system, food system, cultural system, and canoe-building system.

A Hawaiian Way to Understand the Forest

In Hawaiian knowledge, the forest can be understood through relationships between earth, sky, water, plants, wind, rain, and people. One way to understand these relationships is through the concepts of Kāne, Kū, Laka, and Lono.

These names should not be understood only as names of gods in a simple way. In this reading, they are used as Hawaiian ways of describing natural forces and relationships in the forest.

Kāne is connected with sunlight, water, and life. Plants need sunlight and fresh water to grow. Without sunlight, plants cannot make food. Without wai, plants cannot live. Kāne helps us understand the life-giving forces that make the forest possible.

Kū is connected with upright growth and the forest rising from the land. A tree grows upward from the earth toward the sky. The tall forest canopy shows this vertical strength. Koa, ʻōhiʻa, and other tall forest trees are examples of the forest rising upward.

Laka is connected with the quiet rising of moisture. When water moves through plants and returns to the air through leaves and phyllodes, that process is called transpiration. In this Hawaiian way of seeing, Laka helps us understand the rising mist and moisture that begins in trees, soil, and living things.

Lono is connected with wind, clouds, weather, rain, and sound. Wind moves across the islands. It carries clouds and moisture. It returns water to the land as rain, mist, and storm. Lono helps us understand water moving through the air and returning to the earth.

Together, these concepts describe a cycle. Kāne gives sunlight and life-giving water. Kū is the forest rising upward from the land. Laka is moisture rising quietly from trees, soil, and living things. Lono is wind and weather carrying water and returning it as rain.

This is another way to understand the water cycle. It is not separate from science. It is a Hawaiian way of organizing careful observation of the natural world.

Forest, Rain, Mist, and Wai

In Hawaiʻi, the forest helps protect fresh water. Rain does not simply fall on bare ground. It first touches leaves, branches, trunks, mosses, ferns, and forest litter. The forest slows the rain down.

When rain falls on an open, damaged slope, it can hit the ground hard, wash soil away, and rush quickly downhill. But in a healthy forest, leaves and branches soften the rain. The forest floor acts like a sponge. Water can soak into the ground instead of running away.

That water may become part of underground water storage. It may feed springs, streams, wetlands, fishponds, farms, and eventually the ocean. In this way, the upland forest helps people living below. The water that people drink, grow food with, and depend on begins in the relationship between sky, forest, and land.

Transpiration: Water Moving Through Plants

Plants also return water to the air. Their roots take up water from the soil. That water moves through the plant and is released through leaves or leaf-like structures. This process is called transpiration.

Transpiration is one way the forest breathes water back into the atmosphere. Water moves from the ground, into the plant, and back into the air as moisture. That moisture becomes part of mist, clouds, rain, and the larger water cycle.

From a Hawaiian perspective, this movement can be understood through Laka. Laka is the quiet rising of moisture from trees, soil, ponds, people, forest, and sea. That moisture rises, meets the movement of wind and cloud, and becomes part of the continuing exchange of water between earth and sky.

Wai is not separate from the forest. Wai and forest depend on each other. The forest receives water, holds water, shares water, and returns water.

Koa in the Native Forest

Koa is one of the important trees of the Hawaiian forest. It is endemic to Hawai‘i, which means it belongs naturally to Hawai‘i and is not naturally found anywhere else in the world.

Koa is also one of Hawai‘i’s large canopy trees. In some places, it can grow tall and straight. In other places, it may grow shorter, broader, or more twisted. Its form depends on rainfall, soil, elevation, sunlight, wind, and the surrounding forest.

Koa helps the forest in several ways. Its roots help hold soil. Its leaves and phyllodes fall to the ground and become part of the forest floor. Its branches provide habitat for birds, insects, mosses, and other life. Koa is also a nitrogen-fixing tree. That means it can work with tiny organisms in the soil to help bring nitrogen into the forest system. Nitrogen is an important nutrient that plants need to grow.

In this way, koa does not only take from the forest. It also helps feed the forest.

Koa can also be understood through the same Hawaiian cycle. It grows upward through Kū. It lives by the sunlight and water of Kāne. It releases moisture through Laka. It receives returning rain and mist through Lono.

Where Koa Grows on the Mountain

Koa does not grow the same way everywhere. It can grow across a wide range of elevations, from lower areas up into high mountain forests. But the best koa for large canoe logs was usually found in the higher upland forests.

In general, koa grows best in the middle and upper forest zones, where there is enough rainfall, deeper soil, cooler air, and competition from other tall trees. In these places, koa trees often grow upward toward the light. When trees grow close together in a forest, they may produce taller, straighter trunks. These tall, straight trunks were especially important for canoe builders.

In lower or more open areas, koa may grow shorter, more spreading, or more twisted. These trees are still important to the forest, but they may not produce the long, straight log needed for a canoe hull.

From a Hawaiian land perspective, koa appears in several wao, or forest zones. It can grow in the wao kanaka, the lower forest zone used by people, but there it is often smaller. It is found in the wao maʻūkele, the wet forest, and in the wao akua, the large-tree forest. The wao akua is especially important because this is where koa can be most abundant and in better condition.

For canoe builders, this meant that the search for a good koa tree often required traveling far mauka. Prime canoe-quality koa forests were often found around 4,000 to 6,000 feet in elevation. These forests could be five, ten, fifteen, or even more miles from the shore. A canoe began high in the mountain forest long before it ever touched the ocean.

This helps us understand a key idea: the waʻa connects mountain and sea. The canoe may sail on the ocean, but its first life begins in the upland forest.

Where Koa Came From

Scientists believe that the ancestor of koa reached Hawaiʻi long ago through natural long-distance dispersal. A seed may have been carried by a bird, by wind, or by ocean movement. Once in Hawaiʻi, that ancestor slowly changed over time and became the koa known today.

This means koa has two stories. It has a deep Pacific story, because its ancestors came from somewhere beyond Hawaiʻi. It also has a Hawaiian story, because the koa tree we know today developed here, in relationship with Hawaiian mountains, soils, rains, forests, and winds.

Koa became Hawaiian through time.

The Life Cycle of Koa

Koa begins with a seed. A mature koa tree produces flowers, then seed pods. Inside the pods are hard-coated seeds. These seeds can remain in the soil and wait for the right conditions.

Koa seeds often need disturbance before they sprout. The hard seed coat must be scratched, cracked, or weakened so water can enter. In nature, this may happen through heat, abrasion, movement in the soil, or other disturbance. Once water enters the seed, the seed can begin to grow.

First, a root grows downward into the soil. Then a shoot grows upward toward the light. A young koa seedling has small compound leaves made of many little leaflets. As the tree matures, those juvenile leaves are replaced by curved, flattened leaf-like structures called phyllodes.

These phyllodes help the mature tree gather sunlight and survive in different forest conditions. As the tree grows larger, it can become part of the forest canopy. A mature koa tree can flower, produce pods, drop seeds, and begin the cycle again.

Koa, Water, and Soil

Because koa is part of the forest canopy, it also participates in the movement of water. It receives rain and mist on its leaves, phyllodes, bark, and branches. It draws water from the soil. It releases moisture back to the air through transpiration.

Koa also helps the ground beneath it. Fallen koa leaves and phyllodes become part of the forest floor. As they break down, they return nutrients to the soil. Because koa can help bring nitrogen into the forest system, it supports the growth of other plants.

A healthy koa forest is not just a collection of trees. It is a water-catching, soil-building, life-supporting system.

Koa and the Waʻa

For Hawaiian canoe builders, koa was one of the most important woods. The hull of a traditional Hawaiian canoe was often made from a single large koa log. That required a tree that was large, straight, sound, and strong enough to become a waʻa.

But a canoe builder was not simply looking for a big tree. He was reading the tree. He studied the trunk, bark, branches, grain, weight, color, and soundness. He looked at how the tree grew. He looked at how it leaned. He considered where it would fall and whether the log could be hauled out of the forest.

A tree that could not be removed should not be cut. Cutting such a tree would waste the life of the tree and the work of the forest.

Selecting a Canoe Tree

Traditional canoe builders used careful observation. A healthy, balanced canopy could suggest a sound trunk. Smooth, even bark could suggest fewer flaws. A large branch crotch high in the tree could be a warning sign, especially if ferns or other plants were growing there, because that might mean rot inside the trunk.

Builders could strike the base of the tree and listen. A hollow sound might mean the tree was rotten inside. A solid sound suggested the tree was sound.

The ʻelepaio bird also had an important role in tradition. If the ʻelepaio pecked at the tree, the tree might have insects or rot. If the bird ignored the tree, that could be taken as a good sign. This shows how Hawaiian canoe knowledge joined spiritual understanding with practical environmental observation.

The Different Kinds of Koa Wood

Traditional Hawaiian canoe builders understood that not all koa wood was the same. Modern wood scientists agree. Koa can vary greatly in color, figure, density, strength, shrinkage, durability, and workability.

Color means the appearance of the wood. Koa can be blonde, reddish brown, brown, dark brown, or very dark.

Figure means the pattern of the grain. Some koa has straight grain. Some has wavy or curly grain. Curly koa can be beautiful, but it can also be harder to work because the grain changes direction.

Density means how heavy a piece of wood is for its size. Two pieces of koa can be the same size, but one may be much heavier than the other. Koa can range from light to very heavy.

Lau Maiʻa, Koa ʻAwapuhi, and Koa ʻIʻo ʻŌhiʻa

Traditional canoe builders recognized koa by practical categories.

The lighter yellowish koa is described in Dudley's report as koa laʻaumaiʻa, or banana-colored koa. In this student document, we use the simpler term lau maiʻa. This wood was lighter and easier to handle. It could be useful for paddles, but it was usually not the best choice for a large canoe hull because it was less durable.

A middle-density koa is described in Dudley's report as koa ʻawapuhi, or ginger koa. This reddish-brown koa was often better suited for canoe hulls. It gave the builder a good balance of strength, weight, workability, and durability. A canoe hull had to be strong enough for the ocean but not so heavy that it became difficult to paddle, sail, haul, or land.

The heaviest koa was called koa ʻiʻo ʻōhiʻa, meaning koa with a hard, ʻōhiʻa-like grain. This wood could be very dark, heavy, twisted, and difficult to shape. Canoe builders usually avoided it for hulls because the finished canoe could be too heavy.

Modern wood science measures these differences with tools. Traditional canoe builders measured them through experience, observation, and generations of practice.

Who Was Dudley, and Why Does His Study Matter?

In April 2000, Nicklos S. Dudley and Jodi Yamasaki wrote a short forestry report called *A Guide to Determining Wood Properties of Acacia koa*. It was published as Forestry Report 3 by the Hawaii Agriculture Research Center.

This report matters because it helps students understand koa wood through modern wood science. Dudley and Yamasaki explain that koa wood quality is determined by several important properties: color, figure, density, strength, shrinkage, durability, and workability.

For a canoe builder, these same qualities mattered in practical ways. The builder needed to know what the wood looked like, how the grain moved, how heavy the wood was, how strong it was, how it might change as it dried, how long it would last, and how difficult it would be to shape.

The report says koa color can range from blonde to dark chocolate, with reddish brown being the most common color. It also says koa figure can be straight-grained, wavy, or curly. Curly koa may be beautiful, but it can be harder to work because the grain changes direction.

The report gives three density groups. Low-density koa is about 30 to 40 pounds per cubic foot. The example given is koa laʻaumaiʻa, or banana-colored koa. Medium-density koa is about 40 to 60 pounds per cubic foot. The example given is koa ʻawapuhi, or ginger koa. Heavy koa is about 60 to 80 pounds per cubic foot. The example given is koa ʻiʻo ʻōhiʻa, or hard ʻōhiʻa-like grain.

This helps explain why Hawaiian canoe builders did not treat all koa the same. A light koa log, a middle-weight koa log, and a very heavy koa log could produce very different canoes. The best canoe wood needed the right balance of weight, strength, durability, and workability.

Dudley and Yamasaki's report also says koa compares closely to black walnut in mechanical strength. It says koa can take a high polish and is generally easy to work and carve. But it also warns that highly figured koa can be difficult to machine because the grain changes direction.

This modern study does not replace Hawaiian canoe-builder knowledge. Instead, it helps modern students see that the old builders were observing real wood properties. They may not have used pounds per cubic foot, but they understood density. They may not have used laboratory tools, but they understood weight, grain, color, strength, and workability through practice.

For a canoe builder, the question was never just, "Is this koa?" The better question was, "What kind of koa is this, and is it right for the waʻa?"

Wiliwili and the Dryland Forest

Koa was one of the great canoe trees of the wet upland forest. Wiliwili was one of the great canoe trees of the dry lowland forest. Together, these two trees help us see that Hawaiian canoe building did not come from only one forest zone. It came from careful knowledge of many forests, many trees, and many kinds of wood.

Wiliwili, or *Erythrina sandwicensis*, is an endemic Hawaiian tree. This means it belongs naturally to Hawai‘i and is found naturally nowhere else in the world. It is part of the pea family, the same large plant family that includes koa, but wiliwili is a very different kind of tree.

Scientists believe that the ancestor of wiliwili reached Hawai‘i long ago by natural long-distance dispersal. Its exact path is not certain. Wiliwili’s closest relatives appear to be other *Erythrina* trees, including *Erythrina tahitensis* from Tahiti and *Erythrina velutina*, which is found in tropical parts of the Americas. This means wiliwili has a deep ocean story. Its ancestors came from outside Hawai‘i, but over time the tree changed and became Hawaiian.

Wiliwili grows mostly in dry, low-elevation forests. These forests are usually found on the leeward sides of the islands, where there is less rain. Wiliwili was once one of the common native trees of dry forests at low elevations, often from about 500 to 2,000 feet on the leeward sides of the islands. It is also known from rough ‘a‘ā lava flows and dry gullies where many other trees have difficulty growing.

A dry forest is not empty or lifeless. It is a tough, specialized forest made of plants that can survive heat, wind, lava, dry soil, and long periods with little rain.

Wiliwili is well suited to this dry forest world. It is one of Hawai‘i’s few native deciduous trees. During the hot dry months, it may drop its leaves to conserve water. Later, it produces bright flowers that may be orange, red, salmon, yellow, greenish, or white. Its seed pods twist open to reveal red or orange seeds. The name wiliwili means “twisted” or “repeatedly twisted,” which likely refers to the twisting seed pods.

The dryland forest where wiliwili grows also includes other important native plants. These may include lama, uhiuhi, koai‘a, ‘a‘ali‘i, alahe‘e, ‘ilima, hala pepe, ‘iliahi, māmane, and other trees and shrubs. Each plant has its own role. Some provide shade. Some hold soil. Some offer flowers, seeds, or shelter for birds and insects. Some produce hard, heavy wood. Others, like wiliwili, produce very light wood.

This lightness made wiliwili important in Hawaiian culture. Its wood is soft, light, and buoyant. Hawaiians used it for canoe ama, fishing floats, surfboards, and other objects that needed to float. Its bright seeds and flowers were also used for lei. Wiliwili was not valued because it was strong like koa. It was valued because it was light.

For the Hawaiian canoe, this difference mattered. The hull needed strength, so koa was often chosen for the ka‘ele, or main body of the canoe. The ama had a different job. It needed to float beside the canoe and help balance it. For that purpose, wiliwili was especially useful.

Tommy Holmes, in *The Hawaiian Canoe*, helps us understand that the ama was not just a piece of wood tied to the side of the canoe. It was a carefully shaped part of the wa‘a. He Make‘e Wa‘a also explains that the most favored wood for the ama was wiliwili, although hau was often used when wiliwili was not available.

The making of an ama could begin long before the tree was cut. When a young wiliwili tree was found and chosen, a skilled craftsman could care for it while it was still growing. Unwanted side branches were trimmed away. The young tree was guided and shaped so that it would grow into the curved form needed for the ama. This shows that canoe building did not always begin after a tree was harvested. Sometimes it began while the tree was still alive.

The ama itself had named parts. The front section was called the lupe. The lupe rose out of the water and was shaped like a cutwater to reduce resistance when the canoe moved through rough seas. The middle section between the two ʻiako was called the kino. The rear section was called the kanaka. The front and rear of the ama rose from the water, while the main body of the ama worked with the ʻiako to give the canoe balance.

This teaches an important lesson. Hawaiian canoe builders did not simply use whatever wood was nearby. They understood the qualities of different trees. Koa gave strength for the hull. Wiliwili gave lightness and flotation for the ama. Uhiuhi and other dryland woods gave hardness and weight for other tools or uses. Each tree had its own character, and the builder matched the tree to the job.

Wiliwili also helps us understand the dryland forest itself. These forests were once much more common in Hawaiʻi. Today they are among the most endangered forest types in the islands. Many have been damaged by development, fire, grazing animals, invasive grasses, and other introduced plants. To protect wiliwili, people must protect the dryland forest. To protect the dryland forest is to protect part of the knowledge that made the Hawaiian canoe possible.

Koa teaches us about the wet upland forest. Wiliwili teaches us about the dry lowland forest. One gave the canoe strength. The other gave it balance. Together, they show that the waʻa was born from the whole island, from mauka to makai.

How Long It Takes to Grow a Canoe Tree

A canoe-quality koa tree takes a long time to grow. A large log suitable for a canoe might need more than a century. Some sources estimate that it can take roughly 100 to 200 years to grow a koa tree large enough for a canoe hull.

This matters. A canoe is not only built during the months or years when people carve it. A canoe begins generations earlier, when the tree first begins to grow.

If people cut canoe trees faster than the forest can replace them, the practice cannot continue. To protect the waʻa, people must also protect koa and wiliwili. To protect koa and wiliwili, people must protect the forest. To protect the forest, people must protect wai.

Koa and Wiliwili as Teachers

Koa teaches science, ecology, and culture at the same time. Its seed teaches life cycle. Its roots teach soil protection. Its leaves and phyllodes teach transpiration. Its relationship with nitrogen teaches forest fertility. Its trunk teaches wood density, grain, strength, and workability. Its use in the waʻa teaches technology, observation, patience, and responsibility.

Wiliwili also teaches science, ecology, and culture. Its dryland habitat teaches drought survival. Its leaf-dropping habit teaches water conservation. Its light wood teaches buoyancy and flotation. Its use in the ama teaches balance, design, and the careful matching of material to purpose.

Koa and wiliwili also teach that Hawaiian knowledge is not separate from science. Canoe builders understood wood properties through careful observation. Forest practitioners understood water through careful observation. They understood that different forest zones produced different trees, and that different trees had different strengths.

The forest itself was the classroom.

Key Idea

The Hawaiian forest is a living system that helps create, hold, and protect wai. Modern science helps us understand this system through rainfall, elevation, moisture, plant communities, and ecological zones. Hawaiian knowledge helps us understand the same island through wao, kula, kahakai, wai, kai, cultivation, gathering, sacredness, and responsibility.

Koa is one of the great trees within that system. It grows from seed, rises into the canopy, supports soil and forest life, participates in the movement of water, and may one day become the hull of a canoe.

Wiliwili is another important tree within that larger island system. It grows in the dryland forest, survives heat and drought, produces light buoyant wood, and may one day become the ama that gives the canoe balance.

Kāne, Kū, Laka, and Lono help us see the forest as a living relationship. Kāne brings the life-giving power of sunlight and water. Kū is the upward growth of the forest. Laka is the quiet rising of moisture. Lono is wind, cloud, rain, and returning water.

To understand koa is to understand more than a tree.

To understand wiliwili is also to understand more than a tree.

Together, they help us understand the relationship between forest, fresh water, dryland, upland, culture, canoe building, and the responsibility each generation has to the next.