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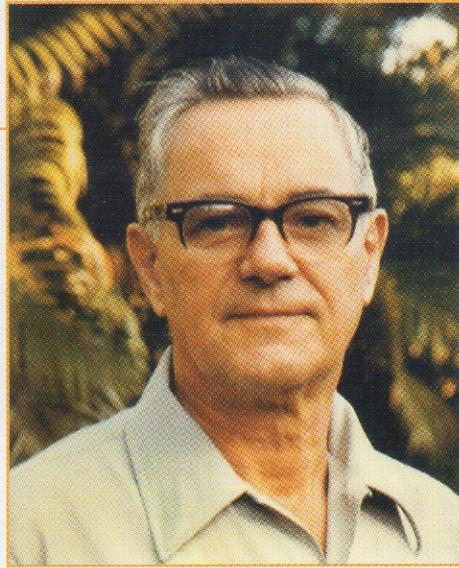
Forestry Memoirs of Frank Wadsworth

Frank H. Wadsworth

Forestry

Forestry includes knowing the forests, caring for, managing, and regenerating forests, and producing timber sustainably. My professional education gave me the following goals:

1. Forests on mountains for humanity on lowlands
2. Forest ecosystem uniqueness kept or restored
3. Forest productivity to retain or regain benefits
4. Forestry practice to earn public appreciation



Frank Howard Wadsworth

I was born November 26, 1915 in Chicago to Helen Woodman Wadsworth of Monroe, Wisconsin, an English teacher, and Robert Wadsworth of Brattleboro, Vermont, a business paper salesman, a year and a half after a brother. I grew up at 5917 North East Circle Avenue in Norwood Park, then a dry (anti-alcoholic) residential ward near the city boundary served by the Chicago and Northwestern Railway on Chicago's northwest side. In my father's vegetable garden, we produced rhubarb, strawberries, asparagus, radishes, carrots, beets, sweet corn, and enough tomatoes for the neighbors. We had bearing cherry and pear trees and I planted a blue spruce. In the summer we had an occupied wren-house and from wooded areas in the neighborhood we could hear the repeated song of the wood thrush. In the winter we fed woodpeckers.

During my first year we visited my father's parents in Calais, Maine. In two summers thereafter we went to Lutsen, Minnesota, on the shore of Lake Superior. For many summers thereafter my father drove us for two weeks to Lakewoods Resort near Cable, Wisconsin on Lake Namakagon. There we hiked in the woods and rowed on the lake, my mother reading us classics. We saw the stumps and rusted machinery left from the logging of the white pines (*Pinus strobus*), of which a few much

taller than the remaining forest were left among trees of aspen (*Populus tremuloides*) and paper birch (*Betula papyrifera*). I swam two miles across the lake. There was an ice house where ice from the lake harvested during the winter was stored in sawdust for refrigeration during the summer. The administration building had on the wall a mounted birchbark Indian canoe and a big musky fish.

Early Education

From Kindergarten to 8th grade, 1920 to 1929, was in the Norwood Park Elementary School, two blocks on foot. Liked geography. Started a stamp collection. During recesses there were street vendors with hot dogs at 5 cents and hamburgers at 15. Played baseball on the Sunday School team of the Presbyterian Church and football on a school team. In the winter I skied on a hill in the Edgebrook Forest Preserve.

From 1929 to 1933 went to Carl Schurz High School in Portage Park (bus plus street car to Milwaukee and Addison). Among the 11,000 students (then reputedly the world's largest) I practiced with one of the eight football teams. Failed botany, dropped football, repeated botany.

Boy Scout Experience

At age 13 I became a Lone Scout and in 1929 joined Scout Troop 899 and eventually became the Troop Bugler. Because my family summer vacationed, I was unable to go with the Troop to two-week Camp Owassipe near Muskegon, Michigan. Went alone on the train during a different period, assigned to a provisional troop of Scouts who didn't know each other. I didn't particularly like it. The only memorable experience was on the 14-mile hike. At noon a small fire we made to cook lunch was put out by a uniformed forester of the State Government

who then talked to us about forest conservation. Two years later, then a First Class Scout, and for the same reason I again went to camp alone and was assigned to a provisional troop. I vowed this time to participate in all activities and volunteer assistance. On the second Thursday night after taps I was awakened by an "Indian" who held out his hand. From it I received instructions. It required immediate preparation for a night hike to a distant lake. There at an isolated campsite, with two matches (one went out) told to start a fire, to meditate in silence what I had done well and not so well, and was thrown a piece of wood to carve an arrow. The next day, still in silence, was of hard work, rolling logs on a slope for future amphitheater seating. I had been chosen as a candidate for the Order of the Arrow. I later found out that only one candidate could be selected per troop, and so my companions, who knew me for only a few days, had selected me at their personal expense. This gave me self-confidence that had been lacking because of an all-A older brother, a gift of Scouting that has served me ever since.

Career selection

In March 1929 with fellow Scout Donald Duncan and his biology-teacher father who, due to the depression had been laid off his job, we drove to Anderson pond and saw lesser yellowlegs and heard the repeated explosive songs of the red-winged blackbird. After that, through high school years, Don and I used early Saturday mornings to hike three miles (5 km) to explore birdlife in the prairies and Forest Preserves along the Desplaines River. Horned larks during the winter, the plaintive calls of northward-bound white-throated sparrows in the early spring, and later the woods filled with warblers, the mating flights of the woodcock, song sparrows and meadowlarks through

the summer, and in late summer afternoons from open prairies distant vesper sparrows. In selecting a career consistent with what we had learned at home, in school, in Scouting, that was likely to be nationally beneficial and outdoors, Don and I came up with forestry.

Advanced Education

In 1934 I took pre-forestry surveying from the Lewis Institute on the West Side of Chicago. In 1935 Don and I went as room-mates to the School of Forestry and Conservation of the University of Michigan in Ann Arbor (tuition for out-of-state, \$62.50 per semester). There the summer camp, Filibert Roth, in the Upper Peninsula of Michigan taught us how to identify trees, learn northern forest birds, inventory forests, use axes and saws, blast stumps, and fight forest fires. One night we heard a barred owl across the lake. Morris Morgan and I went across in a canoe, stood up and turned the canoe over and returned wet.

Four of us decided on a canoe trip after camp and before the fall semester. Two bought a canoe at the head of Lake Superior, started with the 9-mile (15km) Grand Portage, considered as nothing by Voyageurs crossing the entire continent. Then the two paddled to Gunflint Lake, Minnesota where Bob Gensch and I had hitch-hiked. From there we paddled to International Falls on the Canadian Border. Camped on the shore of a lake one evening we heard a tall Norway pine giving its ultimate value by supporting on its very tip a hermit thrush, maintaining us captive, singing his/her heart out from sundown to dark.

On the way across big Lake Kabetogama the waves were so high that we were shipping

water. We came upon another canoe with an Indian who advised us to hug the windward shore where the trip becomes longer, but the fetch is so short that there are no big waves. We felt chagrined for being so dumb. Well before we reached International Falls we could smell the paper mill there. We sold the canoe and hitch-hiked back to the University. It took time



The steep crowns of the spruce along the Yukon

because we were competing with many girl student hitch-hikers with the same objective.

In the summer of 1936 a University of Michigan professor of forest pathology planning to collect tree fungi in Alaska took two of us students, Morris Morgan and I, with him. He assigned to me a task of describing the regeneration and succession of trees on recent sandbars in the Yukon river and on the shore across from the confluence of the Koyukuk from the Arctic. For days to get there we cruised in a stern-wheeler from Nenana down the Yukon with uncommunicative Athabaskan passengers. We stopped frequently to load stacked cordwood for the boilers from forests that grew to only about a thousand feet above the river. On one clear day, far to the south, we saw snow-clad Mount McKinley.

Camped on the Koyukuk shore of the Yukon, across the river from the sandbar study area, we crossed the Yukon each day in a rowboat borrowed from a trader, Verneti. Using head nets and cotton gloves, the rower's wrists were still swollen with mosquito bites by the end of the voyage, so we took turns. At the pueblo of Koyokuk the professor had played the Verneti piano and invited them for a dinner. Their boat arrived with 15 and all the food, including ice cream from the permafrost beneath their house. The tree succession from the bars in the river to the shoreline forest went from willows (*Salix alaxensis*) on the sandbars to big-tooth aspen (*Populus balsamifera*) to spruce (*Picea glauca*) and birch (*Betula alaskensis*) on the shore, the oldest with 175 annual rings.

Back in Ann Arbor at the University I learned in the library about Alaska and wrote up the study. I took the forestry curriculum courses on tree biology; forest hydrology; forest ecology; forest regeneration; forest pests and diseases; the sustainability of forest production; the harvesting, processing, and utilization of forest products; the development of forest recreation, and the administrative management of forests, all with the tenet to preserve soil productivity. Don and I saw birds in the University Arboretum. I joined the Society of Voyageurs, with a cabin on a lake and canoes for weekends. My education had been so broad that I saw no logic in the separation in the government of the Forest Service, the Fish and Wildlife Service, and the National Park Service.

In 1937 I received a Bachelor of Science (BSF) degree in forest management. With advanced credits from Lewis Institute and a thesis on the Alaska assignment, I obtained at the same time also a Master's Degree in Forestry (MF).

My education was resumed after I had been

in Puerto Rico about five years. My forest management professor Donald Matthews of the University of Michigan, came to the island on a consultancy. I took him to the National Forest. Although his tropical experience had been in the Philippines, by mere observation he could point to trees that were shade tolerant, fast growers, and those that sprout. Since the National Forest in Puerto Rico had been proclaimed to supply timber (and water), he urged me to get data on volume and growth of the Forest to support sustained timber yield management and come back to Michigan for a PhD degree. This I completed in 1949 with a thesis cited herein. Using inventory and growth data we collected I had determined the sustainable timber yield for 47 topographically bounded accessible compartments in tabonuco type forest.

Employment prior to Puerto Rico

Out of school at Michigan, I worked for the Evergreen Lumber Company on Chicago's South Side. There, with a crew, I unloaded freight cars bringing beautiful Douglas fir lumber and plywood from the Pacific Northwest. Some of the timbers, 32 feet (10m) long, had to be unloaded by an opening on the end of the cars. Too far from the home of my parents on the Northwest Side I rented a room. Nights I spent studying for Civil Service exams for a professional Forest Service job. There were few government jobs during the depression but the Commission kept giving exams, without which one lost eligibility. I had to take three successive exams to stay active, and my marks were getting poorer. According to the curve, I might not have passed another. To relate with the crew in the lumber yard I had taken to a corn cob pipe. One night, studying late with repeated loads in the pipe smoking, at about 11 PM I got out of bed to turn off the light, and dizzy, fell to the floor. I stopped smoking.

In 1938, as a result of a contact on the indirect 1936 trip through the West to Alaska I was taken on temporarily as an Assistant Field Assistant (\$1,620 per year) under Gustav Adolph Pearson, a Nebraska-trained forester who was Director of the Forest Service's Southwestern Forest and Range Experiment Station, with summer quarters in Fort Valley, nine miles (15km) northwest of Flagstaff, Arizona.

Mr. Pearson, who met me at the Santa Fe in Flagstaff, in Forest Service uniform and hat, was an impressive federal employee. Travelling to Fort Valley he counselled me that "Uncle Sam is the world's best employer and don't take advantage of him". On the way Mr. Pearson described why the open parks we saw were treeless (seasonal lack of soil water) and the stratification of the forest vegetation up the visible, snow-clad San Francisco Peaks.

The ponderosa pine forest beside the road was mostly of one tree species. Mr. Pearson strongly disliked Forest Service permitting cattle grazing where there are young trees because of interference with pine forest regeneration after logging. Basques with chuck-wagons brought hundreds of sheep through the forest twice a year from the desert to upland range. He said that where the Forest Service gets 2 cents of grazing fee per head, per year, timber could produce 14 cents.

I was put in bachelor's quarters. One of the first things I learned was not to leave for work before the morning milk was delivered to the

porch and got into the ice box. Exposed, the almost daily summer lightning and thunder soured it. I was given a beat-up 1931 Ford roadster with the license "Forest Service 128". I had not driven a car but dared not tell them, so I just went ahead. Mr. Pearson authorized only one trip from Fort Valley to town per week for supplies and wanted us to park official vehicles away from theaters and to get back before dark. There was a good Mexican restaurant in town, the El Charro.



Ponderosa forest and San Francisco Peaks in Arizona

In the Wing Mountain forest and elsewhere near Fort Valley, using tapes, I measured 30-year diameter growth of ponderosa pines in 160-acre (60 ha) plots Mr. Pearson had started in 1909. The purpose in the relatively slow-growing forests of the dry southwest was to discover the locations and trees of most rapid growth to accelerate future forest productivity. Provided with a 22 rifle to kill porcupines that girdle trees, one day I found a gathering and shot 22 and almost got a raise in pay.

Mr. Pearson had just been sent a new

statistician to reassess mathematically the conclusiveness of his research findings, many already published. Mr. Pearson did not take kindly to this, and one day I overheard him, in exasperation, saying to the statistician, "I don't care if it is significant, is it important?" Despite this, the two families joined in warm friendship on Sundays at Fort Valley for dinner. This was a dichotomy of behavior new to me, one I'm glad I learned.

Mr. Pearson, his son in the Air Force and his daughter in the University in Tucson, took a liking to me, had me for pancakes Sunday mornings and included me in his and Mrs. Pearson's Sunday picnic drives to the Grand Canyon and the Indian country of Arizona. She, a daughter of a famous Arizonan Judge Perkins, knew the entire state. She was brought up a Baptist and struggled to get her husband into church, only to see him turn off his hearing aid.

After about a year, from the Civil Service register I was appointed as a semi-professional Shelterbelt Assistant (at an increase to \$1,800 per year) in Ewing, Nebraska (Population 522). Not to accept it would have taken me off the Register for a later fully professional job. The Station had just sold Forest Service 128 in town. The government got \$55 for it and I went immediately and bought it for \$75, got a state license, a personal driver's license, and had the engine rebored with oversized piston rings. It took me through a bad storm to Nebraska.

In Nebraska the only trees in the landscape were along the rivers, except for cottonwoods (*Populus deltoides*) from roadside plantations from the Timber Culture Act, 50 years earlier. Dying, they were a favorite haunt of red-headed woodpeckers. I roomed with a farm family who operated a creamery. After hours

their main sport was riding the running-boards of my car through the plains hunting jack rabbits and finding ponds for filling washtubs with edible bullfrogs. When the snow left I supervised planting of mixed five- and seven-row tree shelterbelts on farm boundaries to protect exposed homesteads and crops from the north and west. Farms were already committed, and planting stock came in burlap sacks from State nurseries. On good days we planted up to 200 trees per planter. From Ewing I drove some weekends across Iowa to Chicago to see my parents. One weekend I gave the Ford to my hosts in Nebraska and went by train to Michigan to pick up a new Chevrolet and return to Nebraska.

Six months later I received a Civil Service appointment as a fully professional Research Forester at Fort Valley. Eager to get back, I started out in the evening. While still in Nebraska, before entering Colorado, I fell asleep and went off the road. Fortunately, there was a wide shoulder. At the next stop I tried my first cup of coffee. It kept me awake.

Leaving Colorado and approaching Salt Lake City in the Uinta Mountains of Utah on a sharp turn there was a badly wounded barred owl that apparently had been eating a rabbit kill on the road. I pulled over, stopped, and threw a coat over the owl. As I picked it up, its talons closed on my hand and drew blood. I was expecting to reach Salt Lake City after midnight and had to find a taxidermist for the owl and a doctor for my hand because of the risk of Rocky Mountain fever. This took me two hours before I could turn south and leave town for Arizona. I arrived at Fort Valley late in the afternoon, before they expected me.

This time the Civilian Conservation Corps (CCC) program had reached Flagstaff. We had

two crews, one of nearby Mexican-American enrollees and the other from the middle of Philadelphia. We thinned, pruned, and removed mistletoe, and beetle-attacked trees from young pine stands to favor the trees left. Their beginning use of axes was pitiful. The enrollee vocabulary in English was concentrated and unprintable, and I suspected the same of the Spanish, some of which I have not heard in Latin America.

My cabin-mate was Dr. Elbert Little, a University of Chicago botanist. His main research project was locating where in the huge Navajo Reservation the piñon pines (*Pinus cembroides*) were flowering profusely, indicating heavy nut crops a year later for the Navajos who harvest them for a "pine nut" market in New York. He was also studying the alpine flora above timberline on the nearby San Francisco Peaks. One Sunday I joined "Doc". We drove to the upper end of the road at "Spruce Cabin" and walked up through lodgepole pine and spruce forest to 11,500 feet (3,500 m). On our way down with a load of specimens the mountain kept getting wider and there was no trail where we had come up.

We didn't find the pickup before dark. We built a fire, sleeping alternatively on the ground close to it. To my surprise, at that high elevation daylight comes sooner. By 3:30 AM it was beginning to get light. About 7 AM we found the pickup and made it back to Fort Valley, to the amusement of our waiting CCC enrollees.

In 1941 Mr. Pearson's daughter, Margaret, a University of Arizona "Dominecker Hen", and I were married. Her father informed me that under the anti-nepotism rules of the federal government, I would have to accept the next available transfer.

In the second week of our married life, on a

Saturday afternoon we went into the woods for a walk. Upon our return our cabin was entirely gone, burned to the ground. The fire had aroused some people, and they got a few things out, but we went to town to get tooth brushes. The fire had started in the wood pile behind the house where I had accumulated a big pile of pitchy pine knots. No cause was ever assigned to the fire, and we moved to another cabin. We had lost our wedding gifts, but there was some efficiency in starting from scratch.

Two sons of a Secretary of the Station appeared and asked where in the house had been Peggy's ring. Their mother had sent them because month's earlier one had accidentally shot the other in a remote location and I had got him out to a doctor. She thinks I saved him. They brought a window screen, sifted the ashes, and found the diamond, which we had remounted.

At Fort Valley, at 7,000 feet (2,130 m) elevation, we stayed until it started snowing. Cabins for the staff were in a circle around a central record building. One evening I finished late recording measurements and in the dark was walking through snowflakes to the cabin and heard a mewling. I stopped and a young deer came up to me. It had a broken hip but could walk using one rear leg. It followed me to the cabin, entered the door and lay down in front of the fireplace. Peggy in preparation for supper peeled an apple.

The deer, that by then had the name "Cutie," heard that and went to her and begged for it. We found out that a family down the road from Fort Valley had found her as a fawn and the man, a doctor, had raised her. Whenever they left in a car she ran after them and in the cloud of dust was hit by an oncoming car. In Arizona the Forest Service was highly regarded and they thought we would know what to do.



Cutie in Fort Valley Experiment Station, Arizona

The next day the staff tried to bind up Cutie but the break was so high that nothing would hold. During the next four weeks the hip miraculously bound by itself and we saw her make the four-legged jumps typical of western deer. But then she ate some nylon hose off a clothes line. With prewar scarcity this was serious, and Cutie would have to go. With her so tame, we couldn't leave her where we were in the Kaibab National Forest where hunting was permitted, so she was taken deep into Grand Canyon National Park.

Arrival at Puerto Rico

After a honeymoon over to the Pacific Coast and up to Banff in Canada and about six months

waiting in Fort Valley and Tucson, the winter quarters, an opening was announced in the Forest Service's Tropical Forest Experiment Station in Puerto Rico. The Forest Ecologist of the Station, Leslie Holdridge, had accepted an assignment in Haiti's mountain pine forests. We drove to Mobile, Alabama and embarked with the vehicle on the S.S. Maiden Creek, a freighter with wartime military surveillance. After four days, while I read Tugwell's "Stricken land", we saw El Morro and entered San Juan harbor on January 27, 1942. At shipside we were met by Station Director Arthur Bevan and Station Administrative Assistant Ralph Shull, both in tropical white linen suits.



Entry to Puerto Rico, January 27, 1942

The Shulls put us up for two weeks until we found a third story apartment on Ponce de Leon street in Rio Piedras where the last day's train crossed and whistled at 11 PM.

The Puerto Rico forest situation upon arrival, 1942

To a forester much of the island appeared modified. About 1/3 was mountainous



The water source, Dos Bocas reservoir

watersheds above reservoirs for irrigation, human consumption, or power. Subsistence agriculture exposed the soil throughout the

Tobacco was growing on steep slopes, and sugarcane in interior valleys and on the coastal



Dense rural population, Ciénaga Alta

plains, including drained mangroves.

This had left the island essentially deforested. Soil erosion apparently was rife, including watersheds with rivers running red with sediment into reservoirs for water supply. With seventy percent of the population reportedly rural, many were living on mountains exposed to hurricanes in wooden or palm sheath houses without sanitary sewage disposal. With introduced mongoose the native bird population must also have been devastated.



Tobacco culture on sand directly above Caonillas reservoir

mountains. Commercial tomato production on sandy slopes near Jayuya was even endorsed by the USDA Soil Conservation Service.

Forests remained only where agriculture was practically impossible, on extreme slopes, climates too dry, and on brackish soils. Even the rocky limestone hills were under cultivation for food crops. Coffee, produced in the western uplands, was shaded, not by forests, but by trees of one or two species subject to pruning. Even in the



Deforested central Puerto Rico



Tabaco cultivation in a watershed



Agriculture caused sediment in a river

public forest reserves there were hundreds of families living and farming. Notwithstanding all this, local woods were supporting the fifth industry, manufacturing furniture, in more than 200 furniture factories, employing more than 2,600 workers full time.

There was an Extension Forester, Carlos Bates, in the federally supported Agricultural Extension Service of the University, promoting tree planting on farms. This left me wondering how much of Puerto Rico, with such intensive farming, should be or could be forested. Because it was known that forest could best hold the soil on mountainous slopes, the US New Deal had brought funds for land acquisition for public forests and for nurseries and a huge reforestation program for private lands and newly acquired lands in the public forests. With tree species unknown to forestry in the United States much of the species selection, propagation, and planting was trial and error. The Tropical Forest Experiment Station, with Leslie Holdridge from the National Forest technically in charge, had come in 1939 to reduce planting failures.

The Experiment Station

The Tropical Forest Experiment Station 5-acre (2ha) headquarters area, given 50 years of free use from the College of Agricultural and Mechanical Arts of the University of Puerto Rico, was located on beautiful grounds of the Agricultural Experiment Station of the University in Rio Piedras.

A headquarters building, under construction, was on a hill and oriented perpendicular to an almost constant prevailing daytime easterly breeze. The rest of the hill behind the building was being leveled for access. A basement was required but nobody knew what for.

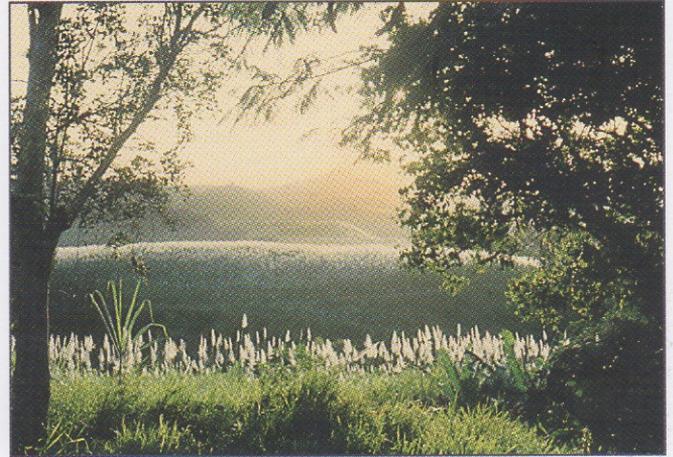
It was humid. Only the first of two floors was usable. The outer walls were being made with a unique undulating surface by weaving the board forms in and out. The windows were being made in an unfinished second floor room that was to become the library. Completed windows were of local wood with shutters that admitted the breeze except when it was pouring rain at an angle (and refreshingly cooler). Each finished office had a big fan mounted on a wall up in one corner, and paper weights were on everything. On the concrete front walk I watched a craftsman fashioning concrete ornaments to go above the front door.

The main one was a big fat eagle sitting on a map of Puerto Rico. Beside it were to be shields with inappropriate oak leaves. The building was not completed until 1943. The Experiment Station across the street in front had borrowed the Forest Station plans and was completing their building first.

The Station in addition to use of the public forests, had two Experimental Forests. One, a 9-acre (3.7 ha) wooded hillside within the grounds of the Agricultural Experiment Station, was termed the Río Piedras woodlot. The other, the St. Just Experimental Forest on the outskirts of Río Piedras, had 27 acres (10.9 ha) of sloping land.

The National Forest

The National Forest had a long pre-European history. It presently covered some 30,000 acres (12,100 ha), nearly all in the Luquillo Mountains but with a 7,000-acre (2,800 ha) Toro Negro Purchase Unit reaching higher elevation in the Cordillera Central. In the Proclamation it was to provide timber and water. The forest itself was very mixed with trees I didn't know. Rainfall was of such intensity that even from



Sugar cane production even in the mountainous interior



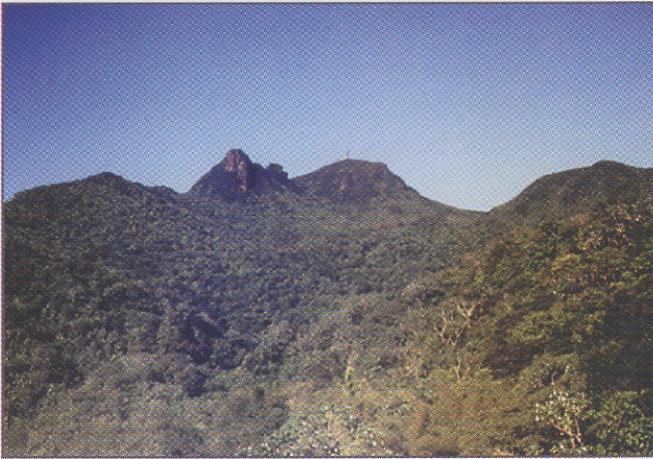
The Agricultural Experiment Station grounds in Río Piedras



The New Tropical Forest Experiment Station Building



Taino petroglyphs along Río Blanco on the Forest boundary



The Luquillo Mountains and El Yunque Peak



Primary tabonuco forest near El Verde

unmodified forests more than half of the rainwater reportedly ran off the surface. The surrounding towns of Canoanitas, Río Grande, Luquillo, Fajardo, Naguabo, and the Roosevelt Roads Naval Base were dependent on runoff water from the National Forest. The planted and timber forest was around the edges.

Bartolo Peraza, the original National Forest Guard, finishing 25 years of service in 1943, told of 3-day patrolling on horseback with firearms that was not always peaceful. He recalled the settlement in the Forest at Bisley, the Francis Reed Cabin on Río Mameyes since



Leaves of ausubo El Verde

1928, and the horse trail to El Yunque crossing Río Mameyes. Commercial gold mining was proceeding under permit from the US Department of the Interior along Río Mameyes just below what became Puente Roto.

Land acquisition was in progress. Land cost averaged about \$12 per acre (\$30/ha). A Mameyes-Río Blanco highway through the Luquillo Mountains was under construction by the Civilian Conservation Corps, having reached a central public recreation area. There were recreation trails to peaks, two natural

swimming pools, and the Forest Service's only hard-liquor restaurant, a special concession made due to the permittee's alleged lack of business profits otherwise. An attempt to introduce rainbow trout to the streams was successful but they did not reproduce.

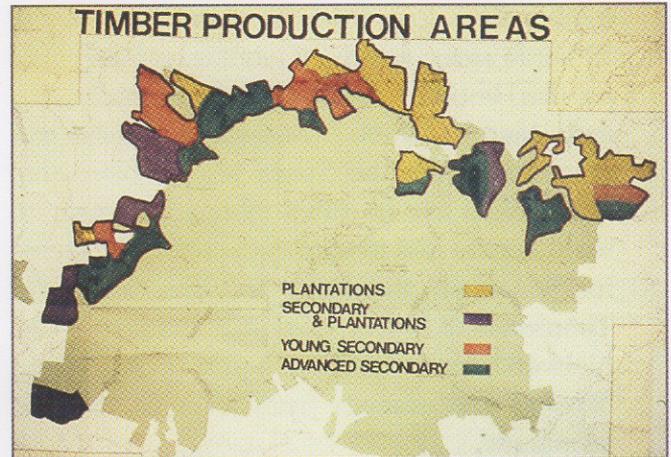
The Forest Service in buying rural land found that previous owners were unable or unwilling to remove resident families within their lands that had been their work force. It became a question of buying land with the families or not buying. The Supervisor said it was what the Forest Service had to do to meet



Falls of the Rio Espiritu Santo on the Luquillo Mountains

its share of the population density problem, and in all forests combined might eventually accommodate 2,000 families. They were living under conditions that looked miserable, homes with neither floors nor furniture. To the extent possible, each family had been assigned a parcel of land up to 12 acres (4.7 ha), and so were called parceleros. They were required to interplant trees among their crops. Because weeding of the crops benefitted the trees they were prospering, the result of a combined practice Burmese foresters call taungya.

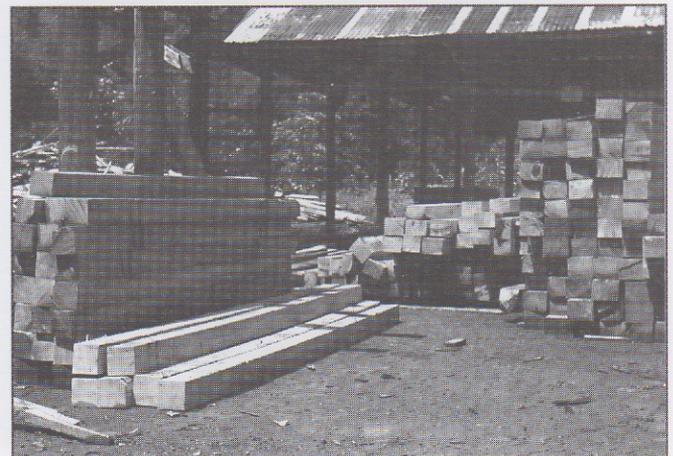
A sawmill of the Forest Service was producing



The planted area on the National Forest boundary



Parcelero in the Toro Negro Forest



Tabonuco from the Forest Service sawmill

lumber from logs from the upper Sabana and El Verde areas, mostly of tabonuco (*Dacryodes excelsa*) but also ausubo (*Manilkara bidentata*) and laurel sabino (*Magnolia splendens*). Inspectors from the States had required that the Service use its sawn tabonuco lumber to build houses and to construct concrete cisterns for water off the roofs for the parceleros. Thousands of timber sales also included poles, fuelwood for bakeries and for charcoal, and bananas and oranges from recently acquired farmlands.

For the large areas requiring reforestation, a tree nursery at El Verde had a capacity of more than a million trees annually.

Thousands of acres were being reforested in El Verde, Pizá. Cienaga Alta, Jimenez, Hicaco,

Sabana, and Del Valle plantations within the National Forest.

The year of our arrival there was a fatal accident on the National Forest entrance road where two CCC trucks loaded with enrollees collided, killing one enrollee seated up front. The Forest Supervisor asked me to make the investigation report. I had a new official speed-graphic camera, so I took lots of pictures – without removing the lens cap.

At about 6 PM another day a farmer permittee on the Forest came to see Guard Luis Carrion at El Verde. Luis went down to the road in front of the Ranger Station and a discussion ensued. Luis's wife, watching from the porch, anticipated a fight, got Luis's revolver and killed the permittee. The Forest Supervisor



The El Verde Research Station in the National Forest

refused to authorize official legal defense since the event occurred after hours. Luis died within weeks thereafter from a fall from a hammock on a porch in Sabana, and it was found that he had compensated with a warehouse of National Forest timber in Fajardo in his name.

The Forest Supervisor

The position of the Supervisor of the Caribbean National Forest could well have been the most diverse in the entire Forest Service. He was responsible for what, by national standards, was a small National Forest, including a distant Purchase Unit and a CCC conservation program involving up to 2,000 farmers working in forest camps two weeks and then taking two weeks off to farm. In addition to road, trail, and recreation facility construction more than 4 million tropical trees had been propagated and planted.

The Supervisor also administered, under the Puerto Rican Secretary of Agriculture, the Insular Forest Service (which lacked locally the legally required professional forester as Director), with an area of Insular Forests about equal to that of the National Forest in seven locations, four of them brackish coastal mangroves. Included was a 140-enrollee camp on 14,000-acre (5,600 ha) Mona Island 45 miles (72 km) at sea, making trails and a landing strip, planting trees, constructing recreational cabins and searching for pirate treasure. To service Mona the Supervisor had a sea-going sloop, a power boat, and two planes.

The Supervisor administered also a third Forest Service of the Puerto Rico Reconstruction Administration, a federally supported local program for recovery from the 1932 hurricane. With the funds of this program five additional Insular Forests had been acquired, Carite, Rio Abajo, Guajataca, Guilarte, and Susua.

He also sent staffers George Gerhart and Eugene Reichart a one-armed Russian, to the Dominican Republic, Haiti, Panama, and Venezuela for mahogany (*Swietenia macrophylla and mahagoni*) tree seeds for the nurseries, all of which were also under his administration.

The current Forest Supervisor was Evan Worth Hadley. With word that a Tropical Forest Experiment Station was coming to Puerto Rico he apparently expected that it would also be given to him to administer. Assuming that he would move to the new building being constructed he provided PRRA funding for its completion and for two research buildings in the public forests, including the El Verde "rest house" believed necessary for temperate zone people not accustomed to the tropics. He transferred three of his professional staff and the National Forest herbarium to the Station.

When Tropical Station Director Arthur Bevan from the Pacific Northwest arrived there was immediate friction. José Marrero and I were examining some plantations at El Verde within the Forest one afternoon and were reported on by a Forest Guard. The Supervisor prohibited further entry of Station personnel into the Forest, the primary research area, without prior approval by the Supervisor of a letter of request from the Director stating who was going where and for what purpose.

José Marrero later found that a CCC camp had located a latrine within one of his marked research plots. Word of personal friction in Puerto Rico reached the Forest Service in the States. The Supervisor was transferred to Brazil to facilitate rubber (*Hevea sp.*) production and the Director to Costa Rica to obtain oak (*Quercus copeyensis*) for whisky casks, both for the War Effort.



In Brazil the extraction of rubber latex is big business

The Supervisor and the Director combined, 1943

The vacancies of both the Supervisor and the Director were filled in what became the Tropical Forestry Unit, with Arthur Upson, a former Director of the Southwestern Forest and Range Experiment Station. He was a hard worker and drew up huge atlases of all the forests with the details about each tract. I, a former employee of his Southwestern Station, became his staff Research Forester. A first assignment was to obtain from the Federal Agricultural Experiment Station in Mayagüez sufficient culms of bamboo to hold the soil being pushed from behind the building to the north slope. I also laid out driveways behind the building.

In personal work relations I learned immediately



Oak (Quercus) forest at high elevation in Costa Rica

to appreciate the warmth of Latinos by my two closest employees. José Marrero, an agronomist from Utuado, was possibly the most accomplished tree nurseryman and forest plantsman in the American tropics. He had learned the tree flora, soils for plantations, and with his cohort of the Insular nurseries, Jose Gilormini, had experience with the propagation of probably more than 100 tropical tree species. He was so well liked that for studies we had land, forests, and assistance from all of the State Forests. When things did not turn out the way José hoped he just laughed, assigned it to the curiosities of his Puerto Rico, and started over. He had a most considerate trait to correct my Spanish, sometime later, but firmly. It made me figure out what I must have said, awful, laughable, or even pornographic.

Ana Vega de Jimenez, the Director's Secretary who also did my paper work was able to meet requests from both of us. On one day of typing in English on onion-skin with 12 carbons of a 32-page single-spaced report she made only two typos. She also maintained the only complete complex ledger of the plantations on all of the public forests, Federal, State, and PRRA. She had intelligent answers to my many questions. After a protracted period an overdue contribution was her insistence on no more instructions from me in English.

The experiences described that follow exclude events where my relation was that of only a hierarchical "administrator" or "director". Outstanding examples are tree propagation, wood technology, and montane forestry.

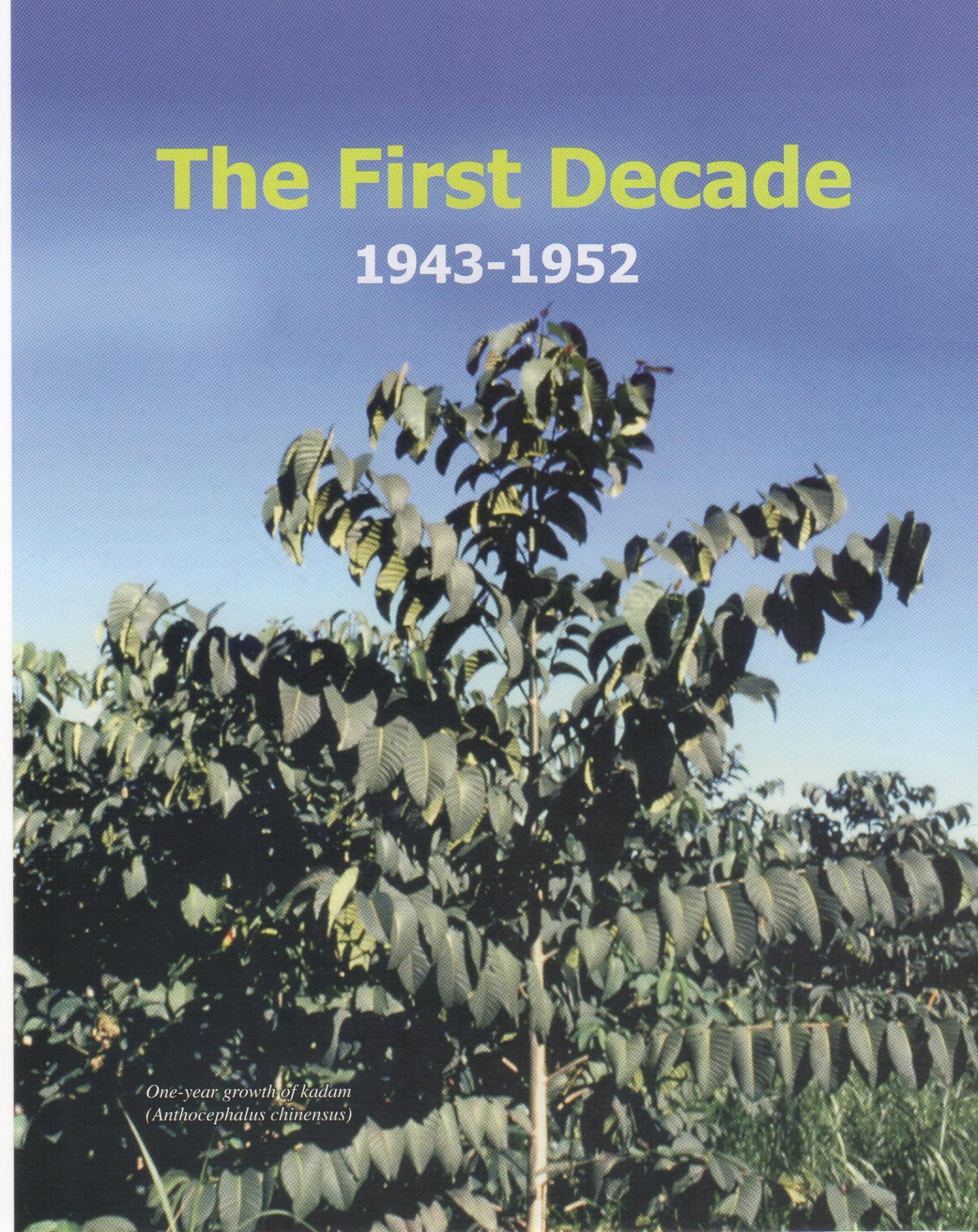
But neither is the rest necessarily what I did. In nearly all that happened related to my forestry career I was peripheral to that done more by others. So the term, "we" describing experiences in Puerto Rico includes some of the following colleagues of the Station or the National Forest who generally were closer to the action than I was. I didn't really have much to do even with the selection of most of the employees, although I did dismiss two and later selected my successor.

Ramiro Agosto Ruiz, Herster Barres, Abrahan Betancourt, R. Sidney Boone, Charles B. Briscoe, Myriam Brunet, Luis Carrion, Martin Chudnoff, Thomas Crow, Antonio Cruz Soto, Carlos Dominguez Cristobal, Zhura C. Del Valle, Carl Ehelebe, George Englerth, John Ewel, JoAnne Feheley, Angel Ferrer, Lambert Fredericksen, Carmen Garcia-Piquera, Thomas Geary, Andrew Gillespie, Jose Gilormini, Alberto Girod Giol, Jeffrey Glogiewicz, Alberto Gonzalez, Ernesto Goytia Olmedo, Luis Gregory, Lisa Hernandez, Miguel Hernandez Agosto, Lawrence Hill, Bernard Huckenpahler, Cameron Kepler, F. Bruce Lamb, Jose Lefebre, Leon Liegel, Frank Longwood, Eduardo Maldonado, Jose Marrero Torrado, Wanda Marrero, Doug Monteith, Juan Muñoz, Robert Nobles, Helen Nunci, Beatriz Ramirez, Carlos Ramirez, Gisel Reyes, Jose Reyes Mateo, Carlos Rivera, Jose Rodriguez Viruet, Luz Silva, Noel Snyder, Emilio Solis, Joseph Sposta, F. Ralph Throop, Angel Torres, Felipe Torres, Ana Vega de Jimenez, C. Robert Venator, Peter Weaver, J. Les Whitmore, James Wiley, Raul Ybarra Colorado.

The First Decade

1943-1952

*One-year growth of kadam
(Anthocephalus chinensis)*



Forest Research

The Station was assigned the assessment of 78 recent forest plantings with 35 tree species and nearly 30 million planted trees in public forests and 50 million trees distributed to private landowners during the previous 20 years. Extensive planting of 15 native tree species and 9 introduced within the National Forest had exposed those best adapted. According to Marrero four species had proved promising on sloping sites, capa blanco (*Petitia domingensis*) eucalyptus, maria (*Calophyllum calaba*), and roble (*Tabebuia heterophylla*). In protected valleys capá prieto (*Cordia alliodora*), guaraguao (*Guarea guidonia*), Honduras mahogany, and jacana (*Pouteria multiflora*) also were promising. Reforestation with Dominican mahogany (*Swietenia mahagoni*), and Spanish cedar (*Cedrela odorata*) had generally failed. Additional tests in the National Forest with which I was related, included 2 native species and 5 introduced.

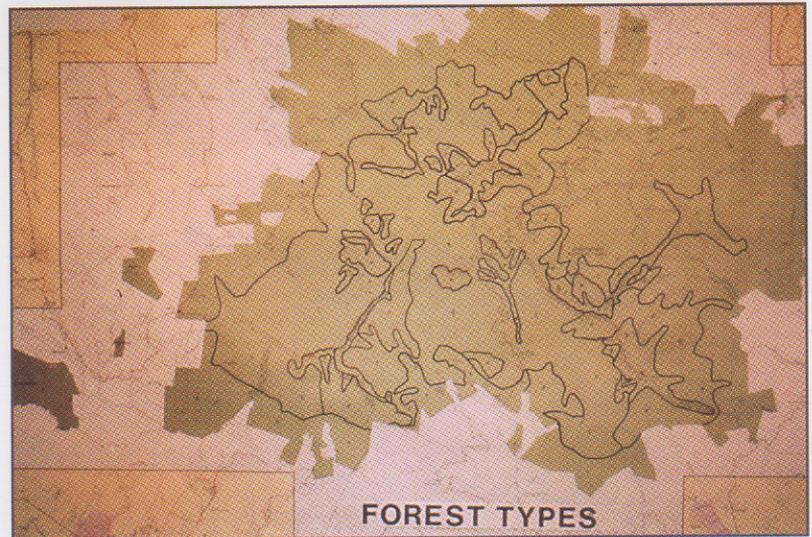
Judging by the success of plantations in the forests throughout the island we concluded that favorable weather conditions called for a mean rainfall of 6 inches (15cm) per month led and followed by months with not less than 4 inches (10cm). The data were used to define and publish favorable reforestation seasons for all of the municipalities of the island.

Based on experience, we prescribed for reforestation planting the following practices:

- Select a rainy time of year.
- Select a site with at least partial vertical illumination.
- Prepare the site to minimize later weeding

- Select valuable species adapted and of rapid early growth.
- Plant known material, seeds directly, bare-root, or potted.
- Weed early and at frequent intervals.
- Apply at least one thinning for continuing growth.

We tested underplanting of trees within forests to improve composition. We learned first that even on their former sites, for growth they need overhead light, open corridors, and on dry sites the removal of close roots.



The forest types of the Luquillo Mountains

We mapped from aerial photographs the four principal forest types of the National Forest, tabonuco, colorado, palm, and dwarf. The natural boundary between the tabonuco type (below) and the colorado type (above) was at about the 73°F (23°C) isotherm. From aerial photos the palm type (*and yagrumo hembra overstory had similar reflective appearances). Their distinction for the map was corrected by observation from low-flying planes.

In the most inaccessible area of the Forest in the headwaters of the Rio Mameyes we found the least disturbed remains of the four visibly distinct forest associations: tabonuco, colorado,



Virgin rain forest in the Baño de Oro Natural Area



Dwarf forest on the Luquillo peaks

palm, and dwarf. Within an area of 1,840 acres (745 ha) there were 1,025 acres (415 ha) of tabonuco forest, 333 acres (135 ha) of colorado forest, 358 acres (145 ha) of palm forest and

123 acres (50ha) of dwarf forest. The tabonuco, colorado, and dwarf forests were distinct as to elevation: between 800 to 1,970 feet (245 to 600m); 1,640 to 3,020 feet (500 to 930m); and 2,300 to 3,400 feet (700 to 1,025m), respectively. The palm association is intermediate in elevation, 1,970 to 2,950 feet (600 to 900m), dictated not by elevation but by riparian zones and very steep slopes. In 1949 we had the entire area officially proclaimed the Baño de Oro Research Natural Area, preserved indefinitely from modification, even experimental.

We determined the volume of usable wood in the trees of the species of the tabonuco and colorado forest types as related to their dbh (trunk diameter outside bark at breast height, 4.5 feet [1.4m] above the ground) and merchantable trunk height, to make possible forest volume inventories. To assure a representative sample of the many timber species we measured 665 trees of all sizes as we came upon them in the forest.

It was in the 1943 to 1946 period that we began systematic study of tree growth under natural conditions. It required plots within which the trees were enumerated for repeat measurements. We began in the Rio Piedras woodlot. Plots in the National Forest begun at this time included El Verde, 1, 2, 3, T-cu1 and 2 in cutover tabonuco forest, TS-2, TS-3

in mature tabonuco forest, TR-1 in the Baño de Oro Research Natural Area, CS-1, 2, 3, 4, and C-cu-1 on slopes and CV-1, 2, 3, and 4 in valleys in the colorado forest, and P-1 and 2 in

the palm forest, one on a slope and the other in a riparian valley. With additional plots in the Insular Forests there were more than 15,000 numbered trees. These measurements gave the first evidence of the structure and composition of the different natural forests.

Plot El Verde 3, 1.8 acres (0.7 ha) near Sonadora Creek, was my introduction to the tropical rain forest. The plot was located to include a healthy cutover forest on varied topography in what Holdridge termed the "austamo" type, a contraction of ausubo (*Manilkara bidentata*), tabonuco (*Dacryodes excelsa*), and motillo (*Sloanea berteriana*). Overnighting in the El Verde residence with all the windows open, bats flew through the house all night. I set "canillos" (durable posts) in the corners and, with José Marrero, established the plot in the first 5 days of June, 1943, identifying, numbering, and measuring the diameters of some 940 trees. There was the three-storied structure of the forest, with columnar trunks of emergent trees of tabonuco and ausubo standing above a general canopy, producing an irregular upper surface of the forest, and motillo trees with the high root buttresses of the tropics. Pole-sized tabonucos were growing almost beside the big ones, apparently supported by a spongy root mat common for the two. Above me, against the sunlight could be seen tiny droplets of water falling from transpiring leaves. Apparently at home completely suppressed beneath the canopy was what became a favorite tree, guayabacón (*Myrcia leptoclada*) with a dense crown of small leaves and smooth bark, a potential ornamental.

I was only learning the topographic preferences

of tree species when, seated beside me on a log lurching in the forest, Dr. Howard Odum, the renowned ecologist, pointed to a tree seedling on the forest floor and listed all the circumstances that had to be favorable for it to be there, only there, and those to be expected ahead of it. Another visitor, the British Colyear Dawkins, stationed in Uganda, came through looking for healthy yagrumos (*Cecropia schreberiana*) in closed forest. I took him to all that were tagged and was surprised when he pointed out that all of them had thin crowns and were failing. He



The forest selected for El Verde Sample Plot 3

concluded that they came in at the time of the San Ciprian hurricane, 11 years earlier, closed gaps, and were finishing their role. This and later growth data led me to conclude that the mere presence of a full overstory of trees after 11 years indicated that the forest had survived the hurricane. It was quiet, except for the soft swishing of the nearby stream and incessant calls of distant pigeons. And yet the extremely diverse family of species was all living in harmony, each presumably both contributing

and receiving from the system. To confirm the "tropical" of El Verde I later learned that some of the tree species there cross the Amazon and are growing as far south as Paraguay. I became attached to El Verde 3 and to renew friendships participated personally in many of its remeasurements.

In the Saint Just Experimental Forest we tested plantations of different species and progressively opened a natural thicket of



Kitchen fuelwood from the Cambalache Forest

returning forest. (*The shift of growth to the released young trees was immediate and spectacular. We concluded that such early treatment might shorten the rotation to tree maturity by a decade or more).

To extend forest research to extensive limestone hills along the north coast, in 1944, after the 500-acre law split the Wolcott sugar estate, I obtained from Jose Acosta Velarde, Director of the Puerto Rico Land Authority, the use of some 600 acres of densely forested hills east of Arecibo that became the Cambalache Experimental Forest. At Authority expense Jose Rodriguez Viruet became resident Guard.

He found he had 249 families dependent on the forest for cooking fuel and posts for construction. He scheduled them for continued access to wood lying on the ground for two days of the week. Mostly women came for the fuel.

Then he divided the forest into five compartments and used the Land Authority crew to thin the forest in order. He set a price for fuel for sale in quantities larger than personal needs and a better price for posts that came from his thinnings. The neighbors would pay only the fuel price for the posts until his crew cut posts only during the waning moon. He was able to liberate the most productive trees in the entire forest during the wartime charcoal market. We planted the boundaries of the Experimental Forest with casuarinas (*Casuarina equisetifolia*) that stood well above the rest of the forest. After a couple of years we found under some of the casuarinas a rare tree in Puerto Rico. It was the papayo of Mona Island (*Metopium toxiferum*), apparently brought by the white-crowned pigeons (*Columba leucocephala*) that travel from the Hispaniola through Mona to Puerto Rico every year and stop in the tall trees.

We tested the adaptability of some 20 species of new timber trees at Cambalache. In a 30-acre (12 ha) plot with enumerated trees on one of the hills we found that tree diameter growth averaged twice as fast at the base as compared to that at the top. The forest proved to be a popular center for natural life, including the cuckoo, Adelaide's warbler, butterflies, and marungay an unused ornamental Cycad.

During wartime we were on a six-day work

week. Time off could not be taken except for written confirmed medical reasons. An official diary of St. Just Experimental Forest Guard Antonio Cruz Soto came in for Thanksgiving Thursday with the words, "Dando gracias al Señor" (Giving thanks to the Lord). I had to appeal to the Secretary of Agriculture, beyond the Chief of the Forest Service, to retain him as an employee, but there was no official way that I could think of to justify his salary for that day.

We had found unexplained variation in the growth rates of adjacent trees that had been reported elsewhere in the tropics. We also had studies under way of the viability of tree seeds and how to extend it with control of moisture and temperature. The improvement of both structure and composition of sapling forest by reducing density was being explored at St. Just. By experience we found tree species that could be reproduced with wilding stock lifted from pastures and elsewhere. One outstanding was roble blanco (*Tabebuia heterophylla*). Studies had started with Dr. George Wolcott, an Experiment Station entomologist as to the relative natural resistance of different native timbers to the dry-wood termite. It was at this time that we set in the rain forest at El Verde posts of casuarina treated with hot carbolineum that remain shiny and sound 50 years later.

To a forester one of the early impressions of Puerto Rico was fence posts. Thousands of small farms were fenced with posts that lasted only a year or two. Because of the great need for post replacements the straightest, most promising young trees for big timber were sacrificed for posts. Before the Station was financed for research on fence post durability we began some empirical tests of post preservation. One that looked practical for farmers was cold soaking of the bottom half of posts in carbolineum, a petroleum derivative.

In cooperation with the Ranger of Toro Negro in 1950 we placed posts in a drum of the preservative for a specified number of days, weighing each before and after to determine absorption. The soaking period ended at the end of October. I drove to withdraw and weigh them. On the way I got to Ciales and was stopped by the Police. There was a revolution in Jayuya and highway 149 was closed. They said that if I continued in a federal car it would be pushed down a slope with me in it.

It was already afternoon but to meet the time schedule I turned around and went back through San Juan, Caguas, Cayey, Salinas, and Villalba and up highway 149 from the south side. I got to Toro Negro at about 9 PM and was able to extract and weigh the posts. Treating only the bottom half proved inadequate because although beneath the ground durability increased, the top, counted on to hold the wires, decayed just as rapidly. A memory of Toro Negro at 2,700 feet (820 m) elevation was the temperature of the shower water in the Forest office.

It became apparent that the study of agronomy lacked an understanding of astronomy. I found no agronomist sympathetic with the farmers' dogged scheduling of their activities by the phase of the moon. Irrked by the inconvenience in programming Extension activities by moon phases, those in the Agricultural Extension Service of the University of Puerto Rico, a close neighbor of the Forest Experiment Station, requested us to make a study of the influence of cutting time on the service life of fence posts.

We recognized that the rural belief was worldwide among peoples who never communicate. If there were something in it, whatever the cause, there could be a large saving in posts. Despite ridicule from our scientific peers, the study was assigned to Miguel

Hernandez Agosto, who had just returned from a degree in forest products at Michigan State. Miguel found that most farmers favored the waning moon, some near the coast when the tide was down, and others in dry areas during droughts when there were no new leaves on the trees.

Miguel designed an elaborate experiment, duplicating at low elevation in Cambalache the uplands at Toro Negro. Times of post cuttings included the waxing and waning moon adjacent to each of the four seasons of the year, days with unusual tidal range, and dry weather without new leaves. For each location two post species were included, one thought to be durable and the other perishable. For each cutting time 25 posts of 3-4 inches (8-10cm) in small diameter were cut from each species. These were to be set in the ground six feet apart at random. Testing was to be done every 6 months by a sharp lateral blow at the top from an open fist. Breakage of more than half of the posts of a treatment was time of failure.

By then I had already learned that experiments almost never were carried out strictly in accordance with plans, a conclusion supported by this experiment. One variant occurred when it was found that tides sometimes called for cutting posts in the middle of the night. A second

variant was caused by a nest of termites near the posts set at Cambalache. Without apparent lunar guidance, the termites attacked the set posts in order of their distance from its nest. A third variant occurred at Toro Negro, where the posts of higuierillo (*Vitex divarigata*) apparently did not even understand the study. Freshly cut posts of higuierillo placed in wet ground up there sprouted roots and foliage and did not fail.

Notwithstanding these limitations, the test of the rest of the 1,800 posts proceeded on schedule. All treatments failed within an 18-month period (30 to 48 months). Between each pair of treatments the time differences were even less, giving no support to the farmer's claims. The results were taken to Extension and from them to the farmers. The response was, "The study was no good because it didn't show what we all know".

Cambalache, after six years as an Experimental Forest financed by the Land Authority and full of newly tested tree species, we passed to the Insular Forest Service for the more stable protection of a State Forest. It was all forested, had a ranger residence and foot trails. As a State Forest our research therein continued.

With contributions from Ecuador and Costa Rica the Station's herbarium passed 3,000 species and the tropical wood collection by 612 species.

Selected forestry publications

1944. The first year in the Cambalache Experimental Forest. *Caribbean Forester* 6(1):34-38.

1947. Growth in the lower montane rain forest of Puerto Rico. *Caribbean Forester* 8(1):27-35.

1949. The development of the forest land resources of the Luquillo Mountains, Puerto Rico. Phd Thesis, University of Michigan. 481p.

1950. Notas sobre los bosques climáticos de Puerto Rico y su destrucción y conservación con anterioridad de 1900. *Caribbean Forester* 11(1):47-56.

1951. El cultivo forestal como una práctica de conservación de suelos de Puerto Rico. *Revista de Agricultura de Puerto Rico* 42:127-132.

Management of the National Forest

An overwhelming feature of the National Forest in 1943 was its human resident population, some 250 parcelero families evenly distributed between the Luquillo and Toro Negro Units. Surviving on some of the worst lands of the island for farming, these farm families were in many ways admirable. Their work involved all family members. The women swept a clean area around the house, maintained a small garden and a source of eggs, washing in the streams at a risk of liver flukes and resulting anemia, and frequently bearing children.

One evening at 9 PM before an open door I saw a woman bent over a candle, doing the needlework for which Puerto Rico was famous. The boys and girls brought water, picked crops and helped their parents with other chores. Few could reach schools, the oldest boy being deliberately kept to work on the farm. The men, with machetes and hoes used with skill and pride, worked from dawn to dusk to provide sustenance and a little more to trade in town. Soil preparation on steep slopes was by pick-mattock or trained ox-teams. Travel, on foot or horseback was on muddy soil. At a not-infrequent rural funeral the bereaved were stoic.

When a mother died the dependent children were readily absorbed by nearby families. My different appearance spooked the small children. I received unflinching offers of coffee, bananas, or oranges (with my refusal as a government employee to accept more than coffee probably taken as offensive Americano culture). The generosity appeared genuine and certainly was in spite of little to offer.

Despite the extreme human input, the land use of the parceleros clearly was not sustainable, and they probably most knew it. The scheme under which they were using the land, a "parcelero system" in which they planted trees among their crops, weeding both, was exchanging services for government land resources, something I was told was illegal. We



Roble recovered the forest pastures

ended up worse, having to charge the parceleros rental for the unsustainable misuse of our non-agricultural lands.

The National Forest Guards were instructed to find opportunities for the parcelero families off the Forest. They were authorized to offer transportation assistance and to permit continued cropping of parcels up to 18 months after moving.

Cattle were grazing some 4,000 acres (1,600 ha) of the National Forest recently acquired and not forested. This not only was trespass, but led to compaction of the soil and delayed reforestation. The past practice of having

Guards drive animals to Municipal corrals for arrest and penalty was time costly and temporary. Fencing was a responsibility of the owners of animals, not their neighbors, but they didn't provide it, so we fenced entry points, only to have the wire disappear. We re-fenced with identifiable yellow spray-painted wire. That persisted, and with our discovery of the success of planting thousands of pulled up roble wildings, these gradually shaded out the forage.

US Army tropical jungle maneuvers had been permitted and had unidentified, camouflaged, armed characters roaming the Forest part of each year, terrifying visitors. We cancelled the permit as a use incompatible with the conservation of the Forest.

Eighteen overnight cabins built by CCC in the recreation area of the Forest and operated under permit had become a motel. We cancelled the permit and converted the cabins to picnic shelters by removing one wall.

The natural swimming pools, with lifeguards only part-time, had led to 9 drownings. We drained them.

Two of the forest types, dwarf and palm, were excluded from tree harvesting and in 1956 a third, the colorado type.

In 1943, after I arrived, ended an 8-year period of Civilian Conservation Corps reforestation during which Jose Marrero was primarily responsible. In the National Forest it involved planting 5,561,000 trees on 3,500 acres (1,420 ha) of the acquired lands that did not reforest naturally.

As we approached sustainable control of tree cutting from the tabonuco forest type a wartime market for charcoalwood presented us with an opportunity to release the most promising trees

in the more accessible forest. Urban cooking was largely dependent on charcoal, much of it from clearcut mangroves. The accessible National Forest, although cutover, retained among good immature trees others competing with these and less promising due to crowding, bad form, or wood of value only for charcoal. To reduce this competition we increased the sale of charcoalwood to the limit that the Guards could mark the trees to sell. Foresters term this practice "refinement", the exposure to increase growth of the most promising trees. Forest Guards marked the trees for charcoal in Sabana, El Verde, Cienaga Alta, Icacó and Toro Negro. Up to 130 carboneros bought the trees, felled them, and converted the wood to charcoal in the forest, leaving standing and released the best trees. For the betterment of some 7,000 acres (2,800 ha) of forest 220,000 40-pound (18 kg) sacks of charcoal were removed during the War period. The US Army requested access to El Yunque Peak for wartime surveillance. We issued permits with required minimal dwarf forest disturbance for a short internal spur road to the Peak and to about 6 communicators for towers near El Yunque

In the National Forest we estimated the usable timber volume of the most accessible tabonuco and colorado type forests (11,800 acres, 4,800 ha) from 2% transect inventory. This approximated, combined with future data on increment, exposed the relative potential in each of 47 topographic compartments of the tabonuco type for future productivity and cutting limit.

Participating with the inventory crews was a profound forestry experience. The transects proceeded so far in that we overnights in pup tents. Nights were noisy. It rained most days and we worked in wet clothes using celluloid data sheets. Being wet was cooler and not

uncomfortable. When rivers rose we crossed with water up to our wastes. In the forest we found orchids, bromeliads, vines with prominent flowers, and raspberries. There was little litter on the soil, apparently evidence of rapid decay. In some wet spots we found thick



Crop tree selection in forest after removal of charcoalwood

sphagnum moss. The endemic tody bird was brilliant. The laughing call of the pájaro bobo mayor (lizard cuckoo) seemed to foretell the roar of an approaching storm.

The sierra palm yielded edible palmillo from the trunk. We drank from the streams and from bejuco de agua (a thick liana) cut rapidly twice to yield a stream of water. In all I became so impressed with the forest that later I understood why my predecessor, who by then had become Dr. Holdridge with a lifetime of forest ecology throughout the hemisphere, asked that his ashes be placed within this forest.

Forest inventory brought on a decision by me that you may not agree with. Some of the strip cruising was carried out by two crews, each of two persons. A first crew, using staff compass and a surveyor's chain, marked transect lines

through the woods with stakes at five chains to limit 10x100 m (33x330 ft.) plots. A second crew followed the lines and recorded the trees within 5m on each side. After the work had progressed, one of the two persons on the second crew could not continue. I advertised the vacancy to recruit a replacement. The best qualified applicant was a student in the Forestry School of North Carolina State University, and female. On a Friday I notified the other member of the crew. He saw no problem since he is the one who makes the identifications. Monday morning he reported that if he spent weeks alone with another woman in the forest his wife would leave him. Without more information I concluded that indeed a marriage was at stake that I would not want to break up. So the most qualified applicant, for reasons not explained, didn't get the job.

Analysis of the inventory data isolated indicator species for the tabonuco and colorado types. For the tabonuco type they were yagrumo hembra (*Cecropia schreberiana*), tabonuco (*Dacryodes excelsa*), yagrumo macho (*Schefflera morototoni*), and achiotillo (*Alchornea latifolia*). For the colorado type they were palo colorado (*Cyrilla racemiflora*), camasey jusillo (*Calycogonium squamulosum*), laurel sabino (*Magnolia splendens*), and nemoca (*Ocotea spathulata*). The average number of tree species in 10 acres (4 ha) of old-growth tabonuco type forest was 73, with 51 in the colorado type.

In the forest inventory the largest tree recorded was a palo colorado (*Cyrilla racemiflora*) of 104 inches (264 cm), dbh southwest of Pico Este. We wanted to see the tree, east about a mile (1.6 km) from Km 17 on PR-191 and

then farther on a northeast bearing. Before completing the first mile, we came upon a flat area with gnarled, hollow, palo colorados



The endemic tody, "San Pedrito" at El Verde



Ornamental flowers of Simaruba tulae at El Verde

large enough to serve as human shelter. Worthy of preserving and christened "The Valley of the Giants," these trees have escaped further searchers.

When Mr. Upson retired, the Regional Forester in Atlanta restored a Supervisor for the National Forest. This Supervisor was a single man Peggy and I and the children liked. We had him over for Sunday dinners. People in his apartment building questioned his morals and brought an investigation from the federal Department of Agriculture. The investigators threatened me with job loss if I did not maintain secrecy, even from within the Forest Service. I was given an assumed name, separate phone, spying instructions, and expected to report my observations.

After it was over my favorite Chief (of 14 under whom I have served!) Dick McArdle, apparently aware of the problem, came down to be sure that matters had stabilized. On the Chief's way back to the San Juan airport I confided with him that the public use of the upper Luquillo Mountains was an administrative headache, and I would offer about 6,000 acres (2,200 ha) for a National Monument or Park to make possible more dedicated effort for public administration.

The Chief, who had been continuously defending the National Forests from federal land invasions by the Park Service, said, "They are not good neighbors". He went on to say that Senator Hayden of Arizona and he opposed at every turn frequent attempts of the Secretary of the Interior to take over the Forest Service. And he said the reason for his opposition was not any incompatibility in their functions or programs. It was to keep the Forest Service in Agriculture, free from the dreaded politics of the Department of the Interior.

Sometime later during a visit of several members of the Chief's staff, after a dinner the men and wives separated. On the way home that

night Peggy told me that one of the Washington wives asked how the Supervisor was behaving. She said it left the local wives stunned, and they said nothing. I was so shocked to learn that the Service had sent a Supervisor here who the Chief's staff considered questionable that the next day I called my Alma Mater in Ann Arbor, Michigan looking for a job on the forestry faculty where there had been a recent retirement. Nothing was available. I talked with the Chief. He had suspected leaks from his staff by the Assistant Chief whose wife had spoken and wanted to use the event to get rid of him. He had me come to Washington and confront the Assistant Chief with what I knew.

The Assistant Chief served the rest of his time in the Embassy in Caracas. The Supervisor was transferred to Texas, not because he was found guilty (he hadn't been), but because he had been investigated.

The Supervisor replacement from Atlanta was I. P. Murray, fresh from Patton's army, where he said they made decisions without looking back. As I was a person under foot with prior responsibility for existing policies and one grade higher, our relationship was imperfect. After he had been with us a couple of years one evening at about 10 PM Frank Longwood, our wood machining scientist, came to my home inquiring if I was going to Washington.

He said he had just put the Supervisor's family on a ship in Ponce to go to the states where he planned to tell the Forest Service Chief that I was Communist. This, I assumed arose from a Saturday party we had for about 15 forestry trainees from other countries. About half way through, the Supervisor got on a table and called for a toast "to the United States of America that made all this possible". In the context of this course, where we were emphasizing the

building up of student country capacities, I always played down the relative wealth of the US, and this toast seemed to me in very poor taste, so I did not join it.

The Supervisor disappeared but I heard nothing of this until about two months later on a bench on Copacabana Beach in Rio de Janeiro. Deputy Forest Service Research Chief Warren Doolittle and I had arrived early for a FAO tropical forestry conference. Dr. Doolittle asked me if I thought that the Supervisor liked me. He then explained that the Supervisor had told the story to a staff meeting of the Chief. The Chief had him transferred to Wyoming.

During one rainy afternoon I was walking on the Molindero Road in the Forest and saw a rain-coated figure approaching. It was Governor Luis Muñoz Marín. He said a friend let him come to a cabin when he wanted to get away. He had seen me before in uniform at a meeting at La Serena and so invited me to the cabin, where we spent the rest of the afternoon.

He had me tell him about the Forest and what we do. He hoped that someday Puerto Rico would have its independent Forest Service. He favored our finding better homes for the parceleros outside the Forest. He described a proposal to dispel the local inferiority complex because outsiders claim that Puerto Rico is small: a horse and foot trail for the public through the mountains to demonstrate the length of the island. It later came to pass but his engineers, concerned with surface maintenance, paved it.

Relations with Puerto Rico

Some of the forestry activities of the Forest Service were of broader direct benefit to Puerto Rico as a whole. In the period of federal, Insular, and Puerto Rico Reconstruction Administration land purchase and reforestation,

ending in 1943 and administered by the Federal Forest Supervisor, the Insular Forests received the following record of tree planting in 27,130 acres (10,984 ha):

We (with Marrero) found the following timber tree species promising in the Insular

Insular Forest	Trees planted (000)		
	Natives	Introduced	Tests
Aguirre	2,764		
Boqueron	1,321		
Cambalache			11
Carite	2,033	1,244	
Ceiba	4,528		
Guajataca	1,456	284	6
Guanica	8	121	2
Guilarte	514	373	1
Maricao	432	1,310	4
Mona	263		1
Rio Abajo	1,907	444	6
San Juan	341		
Susua	65	1,424	3
Toro Negro	3,992	928	5
Totals	19,361	6,382	39

Forests: CAMBALACHE: maga (*Thespesia grandiflora*), moca (*Andira inermis*), Honduras mahogany (*Swietenia macrophylla*), teak (*Tectona grandis*); CARITE: capa blanco (*Petitia domingensis*), capa prieto (*Cordia alliodora*), eucalyptus, guaraguao, jacana, maria, nuez moscado (*Ocotea moschata*), roble, Honduras mahogany, teak; GUAJATACA: aceitillo (*Zanthoxylum flavum*), mahoe (*Hibiscus elatus*), maria, Honduras mahogany; GUANICA: bayahonda (*Prosopis berberis*), Dominican mahogany; GUILARTE: capa prieto, guaraguao, eucalyptus, higuerillo (*Vitex divaricata*), jacana, Honduras mahogany, roble; MARICAO: capa prieto, Dominican

mahogany, guaraguao, maga, maria, Honduras mahogany; MONA: Dominican mahogany, maria; RIO ABAJO: Capa blanco, cedro macho (*Hieronyma clusioides*), guaraguao, Honduras mahogany, maga, maria, teak; SUSUA:



Twelve -year old mahogany in the Guajataca State Forest

Dominican mahogany, maria. A curiosity we found in Guanica was that during protracted droughts the diameter of ucar (*Bucida buceras*) tree trunks measurably contracts.

After an aggressive campaign from Elisa Colberg the State Girl Scout Camp was accommodated in the National Forest on a 11-acre (4.2 ha) site abutting the Rio Espiritu Santo. The permit required preservation of the forest cover. I proposed to make available



Mature maria trees planted in the Maricao State Forest

the El Verde Forest Guard one day a week to lead the Scouts up the river trail into the upper forest, but the Girl Scout Council, using what I thought must be the social mores of the time, vetoed men in the Camp.

The State Forest Nursery was provided 8 acres (3.2 ha) in the La Catalina Tract of the National Forest, where tree production capacity reached 6 million trees per year and where for 18 years millions of trees were propagated with federal assistance for replanting on public and private lands. We numbered trees in growth study plots in nine of the Insular Forests, a preliminary to silvicultural forest improvement. Also, at the request of the Insular Forest Service we located patches of best developed forest for preservation in Cambalache, Guanica, and Maricao. Using foreign students, we made volume tables for eucalyptus (*E. robusta/resinifera*) in Carite and white mangrove (*Laguncularia racemosa*) in Aguirre.

We tested thinning of white mangrove (*Laguncularia racemosa*) to accelerate the growth of selected trees in the San Juan and Aguirre Insular Forests. There was a market for the thinnings but we found that the growth response to thinning was minor. Since there are almost no suppressed trees, they apparently drop out rapidly and reduce the density of the forest like a thinning. Assuming prompt natural regeneration, we tested a Wagner border selection treatment, clear-cutting a strip 66 feet (20 m) wide and 660 feet (200 m) long, perpendicular to the prevailing wind. The treatment calls for progressive

clearing of strips windward to the edge of the forest, assuming rapid regeneration in each cleared strip by wind-blown seeds. We found immediate regeneration, mostly by sprouts, and cut a second strip. After the second year the



La Catalina Nursery, in the National Forest

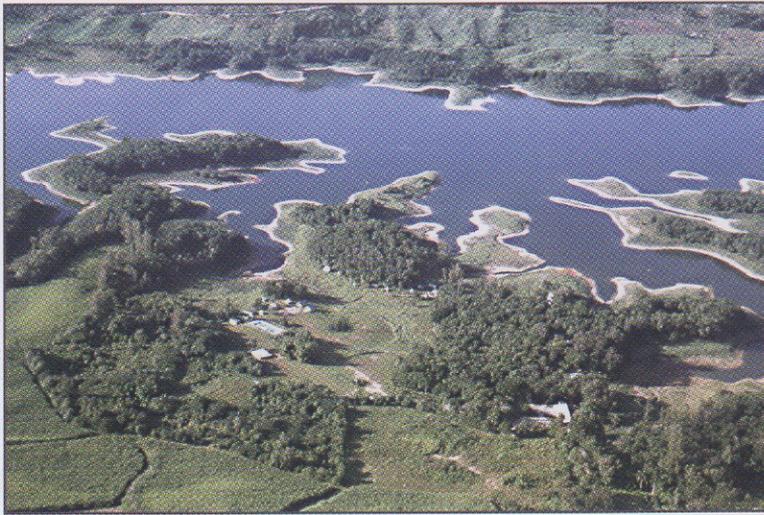


Two-year regrowth (left) of mangrove in the Aguirre Forest

regenerated trees were up to 15 feet (5 m). The seedlings, were mostly from seeds not from the wind, but those that floated in during periods of

high water. Seedling trees had a swelling at the ground level, and so were distinguishable from the sprouts. After 5 years they were taller than the sprouts.

On the campus of the Polytechnic University at San German we (with Gregory and Professor Ismael Velez) converted a hillside forest opposite Borinquen Hall into an arboretum of named and numbered trees. They found an



Guajataka Scout Reservation

overstory of large old mangos with no mango regeneration beneath. Instead there was a variety of native tree species that could be predicted for the future as a result of succession. We also numbered and remeasured a Dominican mahogany plantation nearby.

Upon arrival in Puerto Rico, seeing the intensity of agriculture, I wondered if there would be a place for forests in the island's future. The present forest cover of more than 50 percent is an unconvincing default due to social retirement from agriculture despite continuing local food requirements. Whether Puerto Rico's potentially highly productive agricultural lands produce food for Puerto Ricans or for others, shrinking agricultural lands relative to

growing global food requirements presumably will someday return those available to full use therefor.

Light has been shed on an irreducibly minimum area of the island available for forests during full prospective sustainable agricultural production. José Vicente Chandler, Puerto Rico's greatest agricultural scientist, after a career of soil conservation and scientific experiments with local crops throughout Puerto Rico, presented to the government a plan for modernized agriculture for Puerto Rico. It includes (1) his knowledge of the potential and extent of the soils of Puerto Rico to support sustainable agriculture (2) the crops these can produce within the Puerto Rican diet, and (3) the productivity of these soils apportioned among appropriate crops. Vicente's agriculture for local food, allowing an area for export, requires less than 700,000 select acres, (280,000 ha) leaving more than a million rural acres non-agricultural, most of it already

forested. This thus might be kept forest-covered to protect reservoir watersheds wildlife, human recreation, and wood. To any extent that the agricultural lands are not so used, natural forests, without help or planted, could provide forest benefits. Hopefully, if agriculture begins to recover, it will first use selected agricultural lands not forested nor in critical watersheds.

Boy Scouts of America

The shoreline of Guajataka Reservoir over limestone was reforested, apparently with funds of the PRRA Forest Service, and thus the fate of the trees was of the Station's interest. On a wide area of shoreline the government had bought we found the best mahogany plantation of the island, with trees almost 100 feet (30m) tall

and to 16 inches (40cm) in dbh. The plantation was sparse, over what had been an agricultural crop, but the tree crowns formed a closed canopy. The land had recently been granted by the government for use as a Boy Scout camp. As a former Scout I was allowed to camp there a weekend with my son and found it an ideal place for nature education, but there was none. By the Council I was accepted to introduce nature conservation into the camp program.

In 1952, in what became the "Nature Team", I trained one of the older Scouts to teach campers compliance with the Scout requirements for nature advancement and conservation, early-morning *zaramagos* (grebes) on the lake, *pitirres* (kingbirds) and *guaraguaos* (Redtailed hawks) in the open country, ventriloquist *perdices* (quail-doves) hiding beneath the trees. and visitation to the mahoganies (*Swietenia macrophylla*), tree identification, and at night four species of *coquíes* (tree frogs), endemic *múcaros* (owls), and constellations, including the Southern Cross over Antarctica.

Forestry in the Virgin Islands

At Little Princess Estate on the island of Saint Croix I saw cut trees of Dominican mahogany (*Swietenia mahagoni*) with marked growth rings in the wood that I had not seen on this species in Puerto Rico, apparently due to the sharply marked dry seasons there. This, uncommon in the moist tropics, makes possible determination of tree ages and growth rates relative to sites. St. Croix had another asset for tropical forestry research – it was accessible and yet its forests, more than those of Puerto Rico, were representative of the Lesser Antilles.

The federal Virgin Islands Corporation was closing its sugar operation on St. Croix, and the manager in 1949, Dick Bond, stated that when the time comes a tract would be available for an experimental forest. An inspection showed it to be 147 acres (60 ha) and well stocked with mahogany from seeds blown in from a fencerow to the windward. Dry, loaded with a timber tree, and unlike Puerto Rico, the tract

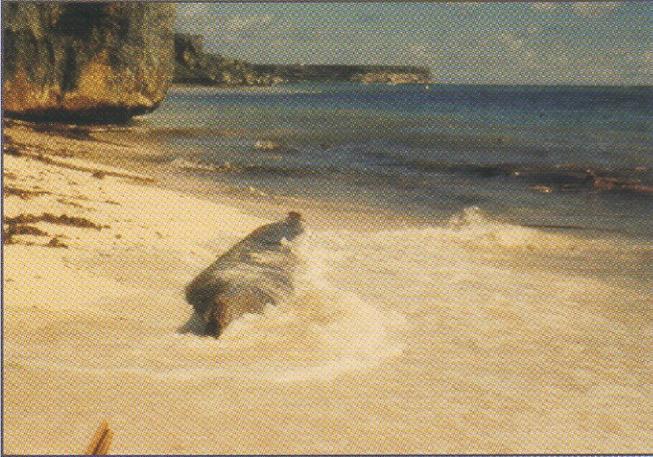


18 year old mahogany plantation at Bodkin, St. Croix, VI

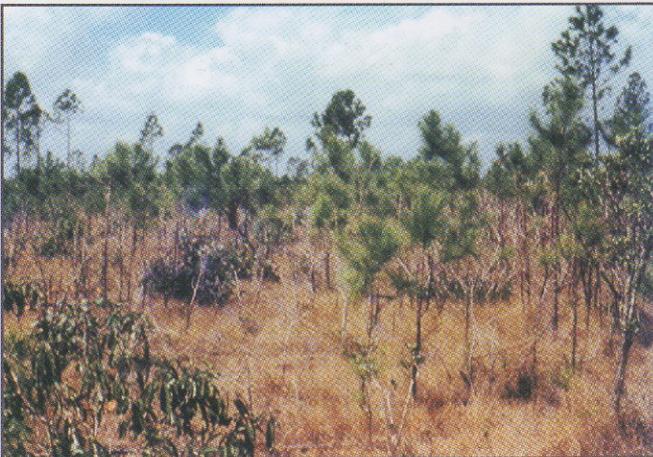
led me to respond that we were interested. In the meantime we were allowed to study the tract.

International Forestry

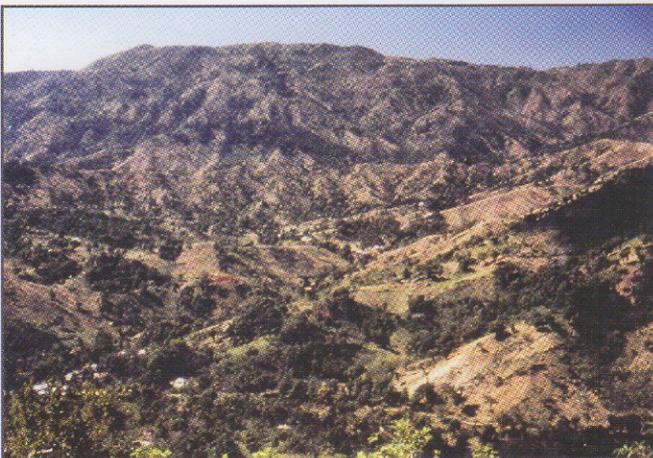
The climate and the structure and composition of forests in Puerto Rico are those of the Caribbean and Central and South America, not of the continental USA. With a title of Tropical Forest Experiment Station for us not to study and compare what exists and is being done with vast tropical forests elsewhere that might be desirable for Puerto Rican forests was unthinkable. Until 1978 the Director and staff made 118 studies of forests and forestry in other tropical countries.



A Carib canoe base from Dominica floated to Mona Island.



Pinus caribaea caribaea in Pinar del Rio, western Cuba



Deforested landscape, Vale Acul, in Haiti

Director Upson attended the First Session of the United Nations Food and Agriculture Latin American Forestry Commission in Teresopolis, Brazil. For this and continuing foreign activities the Station was strongly supported financially by the Office of the Research Deputy Chief of the Forest Service in Washington and other sources, including FAO. A direct result of foreign involvement was 19 three-month courses offered over several years in Puerto Rico to 253 foreign forestry students.

Mr. Holdridge left with me a new international Station journal, *The Caribbean Forester*, published quarterly in English and Spanish. The Librarian, Carmen Garcia-Piquera, did the translations and the Navy in San Juan did the printing. My task was to motivate outside contributions, generate articles, and edit them for printing. This, eventually reaching a mailing list of 2,000, continued through this ten-year period with many articles concerning Puerto Rico's forests cited herein.

The international intimacy of Puerto Rico was evidenced by my discovery on Playa de Pájaros of Mona Island what was unmistakably the base of a canoe made by a Carib Indian. During August there are winds that come directly to Mona from the island of Dominica, where Caribs live. The wood proved to be "gommier", the same tabonuco (*Dacryodes excelsa*) of Puerto Rico, found also on that island.

Forests and forestry studied elsewhere

The natural pine forest of Pinar del Rio, *Pinus caribaea caribaea*, heavily used and possibly adapted to Puerto Rico, was seen in western Cuba. Central Cuba, seen from the train, was mostly deforested, as in Puerto Rico. Shown the Harvard Arnold Arboretum Cienfuegos Botanical Garden by Director Duncan Clement, I saw a banyan tree (*Ficus*

microcarpa) covering almost an acre (0.4 ha). Their collection had many tree species of interest for Puerto Rico, including the native pine. We agreed to exchange tree seeds.

Haiti, like Puerto Rico, was largely deforested. Mr. Holdridge was living in the eastern mountains (Morne De La Selle) and administering for a Haitian-American Development Company a 140,000-acre tract of what must have been harvesting Haiti's last pine forest resources. In this mountainous region in southeast Haiti, where farming had not reached, young pine regeneration was abundant and might adapt to Puerto Rico. These eastern mountains and the region of Les Cayes, on the southwestern peninsula, have some tree growth and might be the most receptive areas for starting reforestation. Trees for Haiti could come from Puerto Rico better than from Florida. Fruit trees such as mangos might be a species to start. The country, with female land ownership, seemed to be a matriarchy, a factor of importance for conservation.

At this time the University of Michigan was inviting Latin Americans for forestry studies. The Haitian, Ajax Francis, returned and immediately resented Mr. Holdridge. One morning Mr. Holdridge received from his office in Port-au-Prince instructions to gather his things and wife and proceed immediately to the airport. His workers had been turned against him and were coming to destroy his house. He went to Ann Arbor, where he continued for a doctorate.

On Tortola and Virgin Gorda in the British Virgin Islands with Dr. Little we explored the mountains to round out the tree flora in the book on Puerto Rico and the Virgin Islands. We found an algarrobo (*Hymenea courbaril*) that had not been reported. Beneath it were masses

of coral gum we had not seen in Puerto Rico. Only Sage Mountain had moist forest with sierra palm (*Prestoea montana*). Most of the forests were as in the other Lesser Antilles.

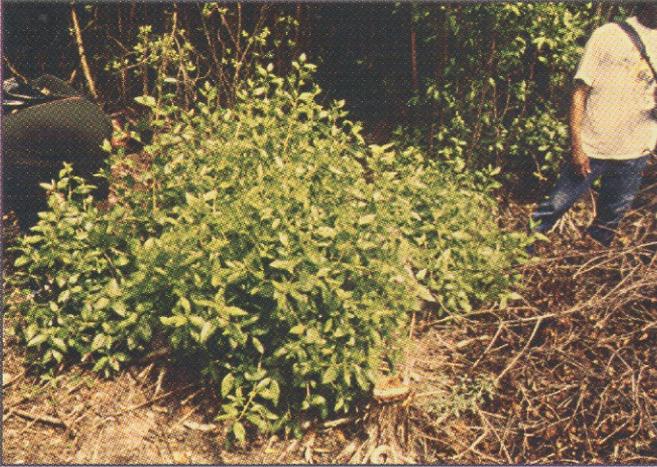
In Saint Lucia, with local representatives of the Caribbean Conservation Association, we compartmented a map of the Mankote mangrove. The forest was under a charcoaling operation run by a woman. By compartmenting different areas and using approximate growth rates from Puerto Rico's mangroves, we were



Port-au-Prince market with mahogany on the ground



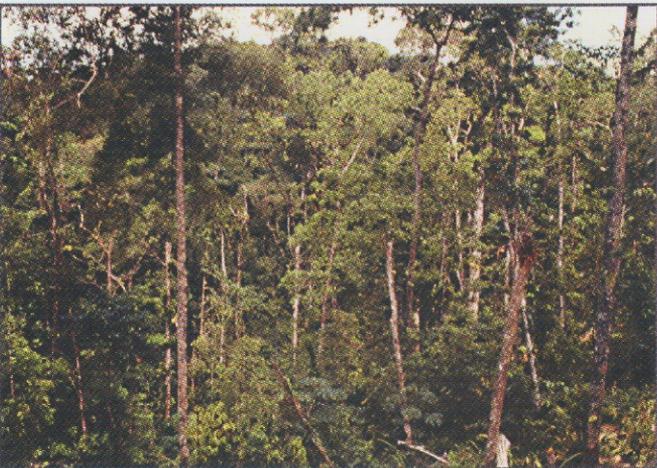
Abundant regeneration of native *Pinus occidentalis* in Haiti



Sprouting after cutting, Mankato Mangrove in St. Lucia



Reforestation of Blue Mountain slopes with pine, Jamaica



Forest after logging the Northern Range of Trinidad

able to design a sustainable operation with area control of the harvesting rate to support sustainability. In the mountains of the island, like Puerto Rico's Cordillera Central, there were extensive areas where the forests had been removed for plantations of bananas, in this case for export.

Jamaica had for many years a Forest Department with British foresters. The Blue Mountains were like Luquillo, with the foothills being farmed. British forester Christopher Swabey had successfully moved a mountain community out to save a reserve. Our same introduced pomarrosa (*Syzygium jambos*) controlled erosion on some of the deforested slopes. The blue mahoe of Jamaica (*Hibiscus elatus*) I saw in the mountains is a close relative of Puerto Rico's endemic maga (*Thespesia grandiflora*). Planting pines such as we hope to do in Puerto Rico was in progress on slopes. Jamaica uses its bigger rivers with rafts for tourism. Swabey visited Puerto Rico and wanted seed of maga, because of its prettier flower.

A regional research meeting in Trinidad in 1946 described conditions very different between the mountainous volcanic islands and the extensive flat Guiana coastlands. Other than from Puerto Rico, there was virtually no organized research in progress in the countries represented. I saw the protected but unmanaged forests of the Northern Reserve of Trinidad with several trees that looked familiar, including the big red pods of *Hymenaea*.

The extensive teak plantations in the Southern Reserve near the Pitch Lake, were impressive, older than those of Puerto Rico and mostly on flat land we don't have available. The Conservator, Brooks, was proud of them, having selected a superior strain of seed from Tenassarim, Myanmar, but John Beard, the

Regional Forest Officer, questioned their future on some sites due to teak's requirement of soil depth. Our acquaintance produced Beard's later visit to Puerto Rico where he was astonished to find palo de pollo (*Pterocarpus officinalis*) above the coast in the Luquillo Mountains. His classification of the natural forests of the Caribbean, using the degree of deciduousness, still has validity. His wife told me that he so wanted the research assignment of the fifth professional in Trinidad that when instead he was sent to protect the Southern Reserve, he cried.

The return trip for me from Trinidad I shared with a pig lashed to the mast of a sloop to consume waste and fatten for market. I remained awake through a night as we slowly sailed north to the lee of Grenada. We were carrying drums of gasoline to Dominica, The crew, West Indians of a single family from the island of Carriacou, was happy to converse with interesting information about the region. By different names they knew the trees, "riviere" and "locust", some the same as in Puerto Rico, and their uses in boat building, the great blue heron and they believed in conservation.

In Mexico, where mahogany (*Swietenia macrophylla*) is native, mature trees to 20 inches (50 cm) in dbh despite the shallow soil, had been produced and logged. Their stumps were irregularly distributed over cutover forest land, suggesting that on the shallow soil of the Yucatan general they may have access to water adequate to produce big trees only in certain places. They could be the only places possible to regenerate mahogany of timber size.

The remaining large mahoganies had vertical trunks and yet the plentiful young mahoganies appeared deformed by the shoot-borer. Some of the attacked trees had vigorous new straight



Sailing the Caribbean with a pig from Trinidad to Dominica



Forest left after cutting by an Ejido in Chiapas, Mexico

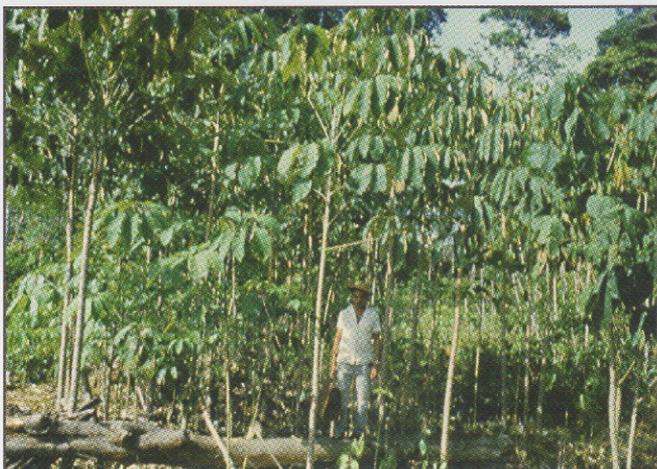
leaders that must have been responsible for the good form of the successful large trees. This suggests that we in Puerto Rico need not worry about tree deformation from the insects on this



Far upstream the Amazon is tidal



Deforestation for food production along the Amazon



At Curua Uno, Brazil our yagrumo (*Schefflera*) planted

species. In established plantations at Escárcega different designs of thinning were being tested and I added one from Puerto Rico based on basal area release.

At the Instituto Interamericano de Ciencias Agrícolas In Turrialba, Costa Rica, there was more than a thousand acres (400 ha), much of it with fruit trees, like mamey sapote (*Calocarpum mammosum*). A friend, our mata-ratón (*Gliricidia sepium*), was being tested for live fences by Gerardo Budowski. It looked like a good way to get farmers interested in trees. I was impressed by the faculty and the academic atmosphere in Turrialba. We agreed to exchange publications and library materials.

At Santarem, on a bank of the Amazon, where land clearing for farms was in progress, a modern FAO sawmill was demonstrating improved efficiency in milling logs that floated out of the tributary Tapajós River. They were sawing some familiar timbers, including algarrobo (*Hymenaea courbaril*) and pajuil (*Anacardium occidentale*). The logs came down the Tapajos in small rafts with enough floaters lashed to carry the heavy sinkers and all without bark to reduce the attack by ambrosia beetles before sawing. The Amazon, although 500 miles (800 km) upstream, was tidal. When it was low each day the murky water of the main river was replaced by clearer water from the Tapajos. While I was standing beside the sawmill on the edge of the big river, watching dolphins somebody other than a doctor warned me not to urinate directly into the Amazon for fear that something will go up the stream and wreck my kidneys.

At Curua Uno, south of the Amazon, a Belgian forester, Jean du Bois, with FAO assistance, had set up a major forestry base and created a big set of timber tree planting tests, including

our yagrumo macho (*Schefflera morototoni*), algarrobo, and granadillo (*Buchenavia capitata*), and many others, all growing well. Growth of *Jacaranda copaia* and *Schizolobium parahyba* was spectacular. He complained about malaria, which had one third of his workers in bed much of the time. One day I went with two workers for a walk to see the uncut terra-firme forest. I was surprised to find it more open at ground level beneath dense shade, possibly because of greater stability without our hurricanes. After about an hour my companions stopped. They said we were on the edge of native tribal lands where they would not enter.

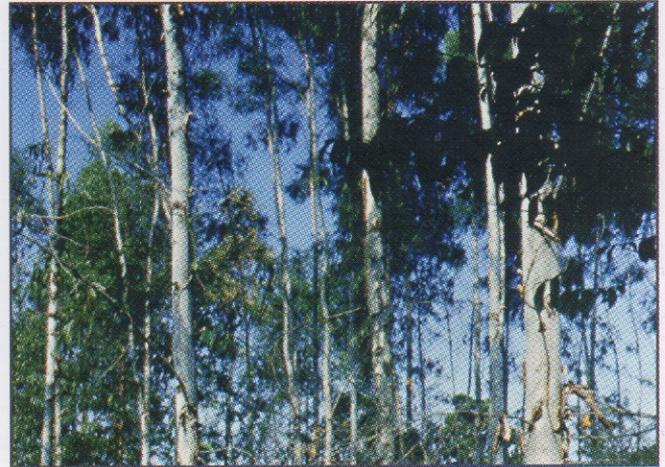
At Rio Jarí, a northern tributary of the Amazon, there was a huge commercial forestry project for producing wood pulp. Hundreds of hectares that had been logged of commercial timbers, burned off in huge fires that create convection intensity to consume big logs and eliminate seeds and roots of potential competing vegetation.

These areas, while still smoking, are then planted to rapid-growing melina trees (*Gmelina arborea*) before the native vegetation could interfere. The species selected was chosen for its rapid early growth. The owner, a Mr. Ludwig from New York, observed that only 2% of the world's people are willing to work and the other 98% should be forced to help them.

The modern railway of the Companhia Paulista de Estradas de Ferro from São Paulo to Rio Claro, Brazil was fueled from wood from beautiful tall plantations of eucalyptus (*Eucalyptus spp.*) at each station along the way. The fuel supply looked sustainable. These species have done well in the Toro Negro Forest.

My first contact was a Señor Navarro de

Andrade of the Railroad Company, kin to the Edmundo, who went to Australia to bring 100 species of eucalypts to Brazil. He explained that the Lord had gotten to Brazil after having conceded all the good things wanted by the other countries and left Brazil only with its government.



Remarkable 4-year growth of *Eucalyptus* at Curua Uno



At Jari, Brazil, huge areas were burned to plant trees

Near Belo Horizonte, in the midst of many pulpwood plantations, I interested my hosts with a remarkably close ocular calculation of their relative volumes. The standard they were using for timber volume in m^3/ha was mean tree height times basal area divided by 3. Since



Eucalyptus plantation in Uruguay, a country mostly pasture

mean height is complex to determine, I used ready visible extreme height times basal area divided by 5 and came remarkably close. On worn-out agricultural soils, as in Puerto Rico, an introduced tree species was outgrowing a native. Pino paraná (*Auracaria angustifolia*), a native species, was doing poorly on lands formerly farmed. Eucalyptus, introduced, apparently without the enemies of its homeland, was growing rapidly, as in Puerto Rico.

In Peru I saw a new use for our ausubo (*Manilkara bidentata*). Our same species is common in these forests and because of its hardness and durability it was being cut into blocks for parquet flooring. With Gerardo Budowski of Costa Rica, we talked to students in a forestry school in Huancayo in the uplands.

In Uruguay, with flat windy treeless pastures, cattle corrals were protected by *Eucalyptus*

plantations. In the northern Argentine Province of Misiones, loblolly pine (*Pinus taeda*) of the US and pino paraná (*Auracaria angustifolia*) of Brazil had been widely planted by Paraguayans. The plantations were highly productive and, using some rule of thumb, they were being thinned for industries downriver. They were utilizing down to diameters of about 5 inches (12 cm). The thinning practices were mechanical and looked good but they were taking no data.

As the only US delegate to a FAO Latin American Forestry Commission Session in Buenos Aires I received for the only time a political assignment. A World Forestry Congress was coming soon, and two countries had made bids for it, India and Argentina. I was instructed under no circumstances to vote visibly for Argentina. With President Peron

anti-US, many Argentine lawyers in the Session, and the rest Latin Americans voting as guests of Argentina, my single vote against Argentina could get me sent to the airport. Fortuitously, Eino Saari, the Finn who led the first World Forestry Congress in Helsinki, was in Argentina as a consultant and I knew him. When he heard my plight, in the meeting he so painted the costs of their Congress, some of which the Finns had not yet paid years later, that the Argentines, in a country economically strapped, did not bring the subject to a vote. My treatment by the Argentines at this time, despite political differences, even personally from the President himself, was with the same courtesy that I received from professionals and technicians from Puerto Rico and throughout the world. The Congress went to India and I submitted a paper (cited herein) but because of Communist participation no official foresters from the United States, including me, attended.



Auracaria plantation with beautiful crowns in Argentina



12-year loblolly pine (Pinus taeda) thinned in Argentina

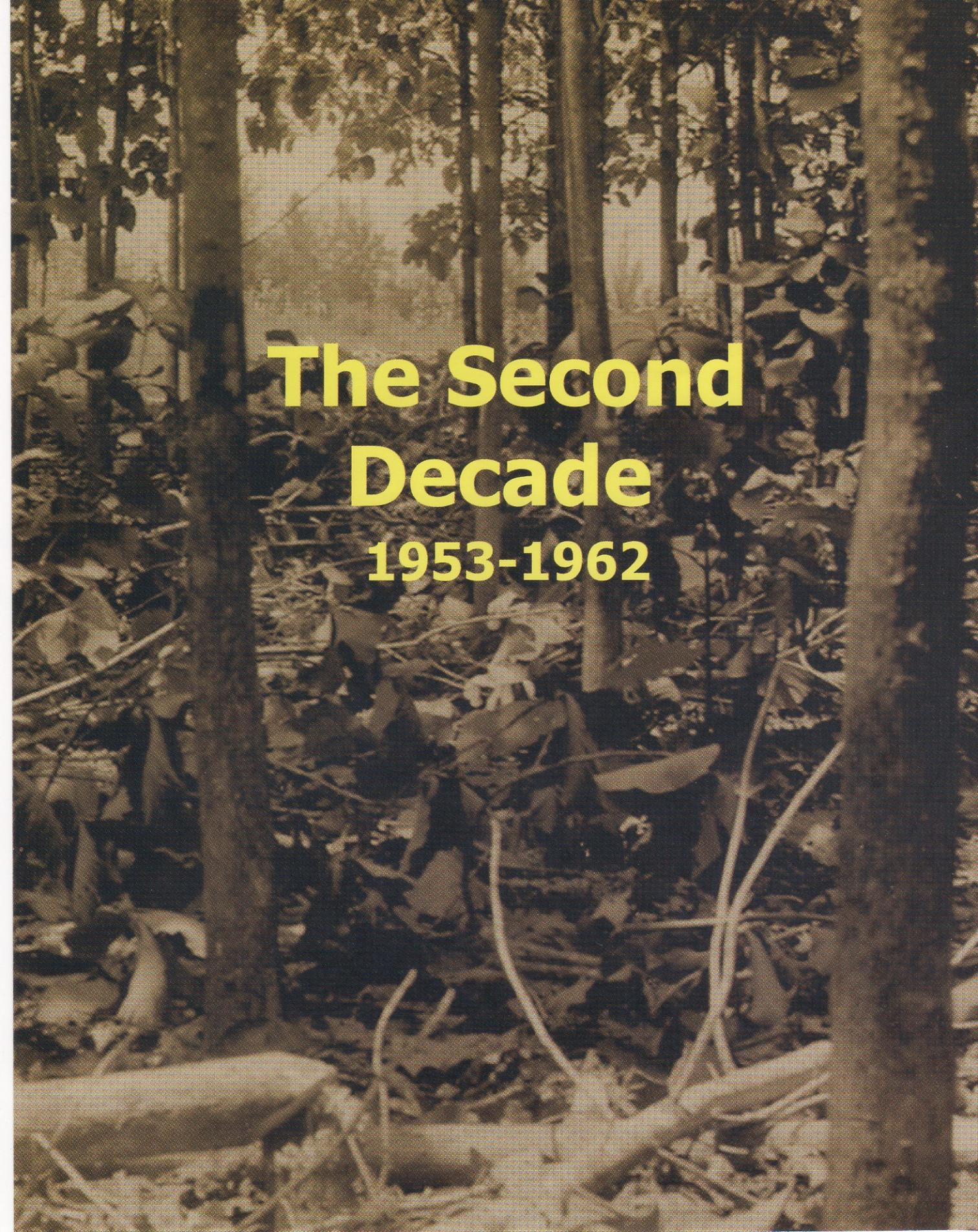
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**The Second
Decade
1953-1962**

Forest Research

Tree growth data from 11 plots in the National Forest began to show different growth rates for visible reasons. Tree growth in both the natural forest and plantations, almost regardless of tree size, was most responsive to illumination, separating dominants from codominants, intermediates, and suppressed, with corresponding relative average growth of 100 for dominants, 90-110 for codominants, 60-70 for intermediates, and 25-35 for suppressed. These differences also indicate the gain to be expected from releasing a tree up one class. The number of trees in each class was reciprocal to mean growth rate.

The day of the miracle! Many of the tree growth plots in the Luquillo Mountains were very inaccessible. Of a set of eight one-acre (0.4 ha) plots in the colorado type (slopes and valleys) one has not been found again. Two cutover forest plots near the west end of the Forest gave us trouble. With three companions we spread out one morning looking for them with agreement to come back out to the road, regardless, at lunch time. At about 11 o'clock I found the numbered trees in the plots.

I shouted but my companions were too far away in the mountainous topography to hear me. I was in so far that if I went out to the road the plots might again become lost. What I consider a miracle took place when I looked down and saw almost between my feet a rusted machete stuck in the ground. Although its handle was gone, with it I was able to blaze the trees on my way out so we could relocate and measure the trees in the plots in the afternoon.

An income of \$10,000 from trees! Beside the main highway near Cayey we found a unique commercial private forest. It was an unusually

dense tract of 50 acres (20 ha), surrounded by cultivated and pasture lands. Entering with visiting forest ecologist Dennis Fanshawe of British Guiana, we found men cutting ausubo (*Manilkara bidentata*) poles and dragging them out. The forest being left was rich in straight young ausubo trees. The owner, Angel Montserrat, had been managing the forest, selling poles for derricks for sugar harvesting. Over many years he had received more than \$10,000 for his poles and he was carefully producing more. His heirs sold off the forest for pasture.

After nearly one hundred introductions of seeds of the pine trees that produce the largest volume of wood imports to Puerto Rico, we appeared to have succeeded in its introduction. Litter from a loblolly pine (*Pinus taeda*) forest in Georgia was distributed around every other tree in a yellowing experimental test plantation of Caribbean pines (*Pinus caribaea hondurensis*) in the State Forest of Maricao. Within 60 days the treated trees turned a good green and later most of the rest as well. An obligate symbiotic pine fungus responsible, formerly apparently absent in Puerto Rico, assists the trees to absorb phosphorus. Further introductions by Briscoe and others followed.

A test of the sphagnum moss native in wet valleys in the National Forest as a medium for tree propagation showed it, after 3 months, to produce larger stock than 4 other potting media.

The opening of forests activates recovery plants, among which vines that pull down young tree leaders are prominent. In underplantings such vines require frequent removal, costing as much or more than the planting. Experimental opening of natural tabonuco forest to a density of 80 ft²/acre (18 m²/ha) of basal area did not produce troublesome vine invasion. This means

that trees underplanted beneath such a canopy should be free of vine deformation.

Dr. Little, a former cabin-mate, at my invitation, began a series of visits to describe in a book the common tree flora of Puerto Rico and the Virgin Islands. His purpose was to facilitate the identification of the trees by the public. For this he preferred ink drawings to photographs. We hired two artists with emergency funding and over years collected specimens to get drawings made. After exhaustive coverage out in the forests Dr. Little's requirements in the basement for writing the text of the book included a chair and desk, reference books from the library, a typewriter and paper, a cot, and a raceme of ripe bananas.

Sets of 100, 10 x 10 checkerboard-separated variable-radius circular plots separated by about 100 feet on three sites in tabonuco forest were located with numbered central pipe stakes. Within these plots crop trees of diverse timber species have been selected and their competitors have been reduced. The purpose was to measure potential forest increment, variations, and causes.

The entire Caribbean National Forest an Experimental Forest! To our surprise, by action of the Chief in Washington the National Forest was administratively proclaimed also the Luquillo Experimental Forest. The stated justification was that to the US all management of tropical forest is experimental.

At the close of this period, continuing the Forest Proclamation for timber, I expanded Station activities to include professional scientists for more formal studies in wood utilization: wood properties, seasoning, and preservation and a related State and Private Forestry Program of information for farmers and industrialists.

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Management of the National Forest

The 250 parcelero families all moved off the National Forest, a triumph in land use adjustment probably impossible in Puerto Rico at any other time, before or since. In that period, after the application of the 500-acre (200-ha) law, the government offered voters lands much better than the Forests, and the parceleros, with no lands of their own, were eligible candidates. Emilio Solis, the Toro Negro Ranger, with instructions to get the land back in trees, relocated all of his 125 families outside the Forest (some to the US!) without any complaints or problems. He was awarded in Washington by the Chief of the Forest Service for "bringing into balance people and forests" Mrs. Solis enjoyed Washington, and upon her return revealed her stamina by saying, "Everything there is close". The parcelero's houses disappeared but they are remembered in the Forest by their concrete cisterns.

Offering "summer home" lots in the National Forest was in Puerto Rico a gross Forest Service

mistake. National policy in the Temperate Zone provided permits for sites for summer homes built by citizens on National Forest land. On this Forest this was misuse of a scarce and unexplored resource. Some 30 homes built, largely of wood, deteriorated in the wet climate and were vulnerable to vandalism during workday permittee absences. Without much opposition we cancelled almost all of the permits for faulty maintenance.

One permittee appealed to the White House in Washington, promoting me as "Julius Caesar". In our defense we showed that the permit was for use, not possession, and that in the case of the complainant there had been no electricity consumption for 11 months. The law required permittees to remove their summer homes, but we participated to erase evidence of a mistake and get the forest back.

I got the governor to agree to a revision of the National Forest Proclamation boundary, the limit to which the government of Puerto Rico must permit National Forest land acquisition. It was no increase. The past boundary was tight against recent acquisition in the Catalina area that included the Insular tree nursery and omitted desirable mountain areas.

The Forest at this time was being managed for the first time with mapped land-use assignments according to my management thesis: (1) 8% for preservation of primary forest, (2) 10% for protection of soil and water, (3) 12% for wildlife habitat (the parrot), (4) 6% for recreation, and (5) 64% for timber. When the slow growth in the colorado forest type became apparent the type was assigned entirely to protection, increasing the total to 49% and leaving 21%

of the Forest in the tabonuco type already exploited for timber. This last area, some 7,000 acres (2,800 ha), had the 47 topographically

defined compartments in each of which the standing timber volume and the growth rate prediction had been ascertained from repeated tree measurements, a limit to harvesting with forest volume sustained.

In the following 20 years forest basal area was reduced by releasing further the better trees from competitors all of which could not be removed by the carboneros without excessively opening the forests, a reduction of about half of the basal area. In practice there was a gradual shift from reduction of forest density to focused release around selected trees. As a result, growth on the remaining better trees produced net forest volume increment from 1953 to 1974. The assignment of 3,200 acres (1,300 ha) as a "parrot area" proved a Wadsworth illusion. This area was selected because it was not needed for any other use. But this did not convince the parrots to go there. They required habitat elsewhere.

The National Forest sawmill started in 1934 had closed in 1951, and sawtimber logging from the Forest was discontinued. Sawtimber elsewhere in the island and local furniture manufacture was disappearing. From Toro Negro we made the last sales of long eucalyptus piling for use in Arecibo harbor. A post-war importation into Puerto Rico of 140,000 kerosene stoves ended the market for charcoal.

The only remaining promising use of local woods was that of artisans making attractive ornaments. With talent they could uniquely bring prices to one hundred times the value of the wood in the forest. The selection and release of crop trees in the 7,000-acre (2,800 ha) tabonuco forest timber production area continued at government expense. A first thinning was applied to 3,200 acres (1,300 ha) of National Forest plantations to accelerate

growth of the better trees. Eliminating abnormal trees that start in the plantations, it leaves much better trees less crowded.

The Jimenez, Sabana, and Bisley forest roads, built for timber access, were completed and became State roads for other purposes. The volume of communications and needed towers kept increasing, as did the number of communication permits near the peaks, with required sharing of sites to reduce dwarf forest impact. By 1960 there were more than 100 channels active in the vicinity of El Yunque.

I lost an argument with the priest of a church within the Toro Negro Purchase Unit. The church was white, and Forest Service regulations called for buildings within National Forests to be natural wood, green, or brown, I supposed subordinate to nature. The priest was furious and stated that highly visible white had attracted more members. To confirm his position he got a donated contribution of white paint and had volunteers repaint the church. Although the parceleros were leaving the Forest, it was clear that he considered his Authority higher than mine.

As Director I attended annual meetings of Forest Service Regional Foresters and Directors with the Chief, usually in Washington. On one occasion the Chief announced that President Eisenhower had been asked by the timber industry to increase the National Forest annual timber cut from its present 13 billion board feet to 21 billion feet (30 to 49 million cubic meters). The Chief asked the Regional Foresters at the meeting to use the noon hour to

call their timber staffs to obtain the maximum cut possible under the sustained yield plans existing for all of the National Forests.

After lunch they concluded that with road requirements met it could be done. Then the Chief asked, "What would our position be if I were still asked but it wouldn't be sustainable?" The Regional Forester from Milwaukee stood up and said, "I would resign". They all supported him. This was an emotional moment



Thinned teak plantation in the Rio Abajo Forest

for forestry. As it turned out, the Congress did not appropriate the huge needed road funding, and so the issue died.

Relations with Puerto Rico

A 36-year partnership of the Forest Services under a single Supervisor and Director had come to an end. By this time Puerto Rico had acquired its own professional forester required as Chief of the State Forest Service. Miguel Hernandez Agosto became Chief of that agency under the Secretary of Agriculture. Close personal relations among the employees and federal research studies in the (now) State Forests continued until there were 112 federal

Forest Service tests in progress in the State Forests. We also used the State Forests to show foreign students different conditions and measured growth and tree volume therein.

I instigated with Nathan Leopold a successful "rediscovery" of the endemic guabairo (whip-poor-will), based on unidentified night calls and a bird we found on a road in the Guánica forest.



A Nature Team of Scout trainers at Guajataka

At the request of the Junta de Planificación I submitted a tabulation of areas that should remain in forests. It used limits of 200 cm (80 inches) of rainfall annually and 60% slopes on clay and 40% on sandy soils. It included roughly 1/3 of the island.

Boy Scouts of America

The camp water source was locally unreliable and municipally costly, and yet there was an unused well on the property. I obtained the support of Mennonites from Castañer to build two cylindrical concrete cisterns on a hill concealed among the trees with gravity flow to all the campsites and the pool. They had a

capacity of a week's water requirements and were kept full by Camp Director Manolin Gonzalez by use of a pump from the well. As a result only the mess hall depended on municipal water.

The Nature Team I started in 1952 had grown to six Scouts and added exploring of older Scouts to its training. I found the camp so attractive with 50 species of trees and 60 species of birds that I wanted to intensify its exposure to Scouts. I participated with Scouts in reforesting parts of the camp with mahogany, mahoe, ceiba (*Ceiba pentandra*), endemic manaca palm (*Calyptronoma rivalis*), and bamboos to shade campsites. At the close of the four weeks of training each year Professor Luis Quiñones, Astrophysicist of the University at Mayagüez showed the Team an evening in a planetarium and with the main telescope. From camp we canoed, both day and night, up the two-mile Guajataka canyon

that impressed even a Brazilian visitor. Summer camp each year was followed by week-long Team expeditions to Mona Island, courtesy of the Coast Guard and the University of Puerto Rico at Mayagüez, where we explored forests, beaches, reefs, caves, wildlife, and the stars.

Scoutmaster Orlandi in the same vehicle leaving camp complained to me that his troop was losing the older Scouts he needs to share leadership. He had read the description of the Order of the Arrow, the advanced Scout outdoor service organization to help retain the older Scouts, and wondered if we could not have a Lodge. Since I already belonged I got the books and brought together Scout leaders, Paco

Bueso, Paquito Joglar, Luis Matias Ferrer, Jerry Santerre, Max Brall, and others and in three weekends, in "taparabos" (Indian costumes) we prepared camp for an Ordeal Ceremony to bring in overnight the first 8 candidates. The ordeal nights were spread out on the lake, the final ceremony to the north and the Vigil site hidden in the woods. Hundreds of Scouts have entered since.

I accompanied 40 advanced Scouts on an unprecedented two-day 2,000-foot (600-m)

Natural History Society

I led a successful Society campaign to prevent within the only remaining old forest in the Maricao State Forest a preparatory training facility for forthcoming Olympic Games in high-elevation Mexico City. My arguments alone, including a weekend in the forest with the Sports Department Director, were not enough. It was stopped by Governor Muñoz Marin who apparently wanted the place for his foot-trail the length of the island. I also participated in



Cacique Peak in the National Forest ascended by 40 Scouts

ascent of the northeast face of Cacique Peak in the National Forest. On the top we wrote our names on a paper stored in a sealed bottle wedged into a crotch of a tree. About two years later, from a source unidentified, the paper came to me through the mail from Vieques.

Society shared opposition to waste dumping by 5 Municipalities in the island's deepest canyon. It was stopped by land purchases by the Conservation Trust.

International Forestry

Forestry in Puerto Rico at this time, with many reserves marked on the ground and protected, professional foresters employed, reforestation success with tropical trees, and a research Station, was ahead of forestry in many other tropical areas. The widely distributed Caribbean Forester and frequent international visibility by travels of our personnel produced an interest in tropical forest training in Puerto Rico.

Beginning in 1955, we were able to get federal funds for training courses in tropical forestry of up to three months, beginning with seeds and ending with forest administration. For subjects we couldn't cover well we brought trainers from elsewhere in the Forest Service and some came from FAO. Ten courses of this description were held at the Station during this period. Students came from 15 countries. I directed the training but much of it was presented by staff and visiting faculty. During this period we also had two tropical forestry training courses for students of the New York State College of Forestry at Syracuse University. I edited the Caribbean Forester with four issues each year of the period, including papers on Puerto Rican forest conservation.

After hosting in Puerto Rico a 5-day Session of the North American Forestry Commission of the Food and Agriculture Organization of the United Nations, including trips to forests, the Station staff collected data for the Regional Research Committee of the FAO Latin American Forestry Commission from 387 of the fastest growing forest plantations in Latin America. The plantation report, cited herein, included 34 plantations from Puerto Rico and various studies of the Commission's Silvicultural Study Group in northern Mexico.

We had resourceful forestry students during

our many international training courses. One year we had 5 young Colombians who, while travelling in official Forest Service vehicles in the cities, commented (with piropos) to the ladies along the way. I pointed out that this was not in conformance with Forest Service policy. They solved the problem by holding hats over the identification shields on the vehicle doors.

Graf Siegfried von der Recke and his wife had silently walked off one evening to the east, leaving an estate and escaping Germany. A prominent forester, he took over a FAO office for Latin America in Brazil, and visited us to discuss regional forestry in Puerto Rico. He was appreciative of the marked public forest boundaries and our research. With wartime scarcities in Brazil he hoped while in Puerto Rico to find clothes for his wife. In a San Juan shop his metric size numbers appalled the attendant, who said, "We have nothing that big". He spotted a woman like his wife and got her sizes.

As Director I had the honor of housing Harry Champion the Chief Conservator of Forests from British India and his wife in my home in Puerto Rico. He showed the same philosophy and disciplined determination of Gus Pearson. A memorable story he told was from one of the Silvicultural conferences held in India. A forester reported complaints from his district about the decision to plant pure teak because durable fallen teak leaves kill ground vegetation and lead to soil erosion on slopes.

Conservator Champion, after asking him if he knew anything better than poor teak, responded, "It is true that we do not know all that we need to know to make these decisions. It is true that we never may, and it is also true that we must move ahead and do the best we can with all the information we have and weigh what we



The Yaque del Norte watershed in the Dominican Republic



Spanish cedars growing on Mayan ruins, Tikal, Guatemala



A sawmill operating in the llanos of Venezuela

get to make the next decision better". Mrs. Champion, driven through the streets of San Juan by our wives, knew the many Asian street trees better than her hostesses. A highlight for the Champions, after the National Forest, was a swim in Luquillo Beach.

Forests and forestry studied elsewhere

In Tortola, in the British Virgin Islands, at local request, I left with the government a statement of forest problems of the island and desirable conservation. I used information from Puerto Rico.

In the Dominican Republic, with a hydrologist we made recommendations for forest land use on steep loose sandy soils in the watershed of a proposed Yaque del Norte reservoir, the approval of which depended on the plan. The prospect for erosion and sedimentation from felled pine forests there was worse than in the sandy Caonillas watershed in Puerto Rico. At Tikal, in Guatemala, in a climate like the south coast of Puerto Rico, our same Spanish cedar trees (*Cedrela odorata*) were reforesting the stony slopes of Mayan pyramids. Unlike in Puerto Rico, the trees were not deformed by shoot borers. I taught graduate tropical forestry for natural forests for about 6 weeks at the Instituto Latinoamericano Forestal de Investigación y Enseñanza in Merida, Venezuela. Although the elevation was higher, my examples were mostly from Puerto Rico. There I discovered at supper time that substituting wine for questionable water was not helpful for morning teaching.

From Dammis Heinsdijk, a big man, I learned that the US military had radar coverage of the Amazon. He used their data to guide a transect sample of hundreds of miles of the forest on the ground from east to west, going between each of the main tributaries. Those who went with him in the forest described him as a driver. He

presented me for the library several volumes of his results between the major rivers. He also had excellent thinned plantation growth data from southern Brazil including for the US loblolly pine (*Pinus taeda*).

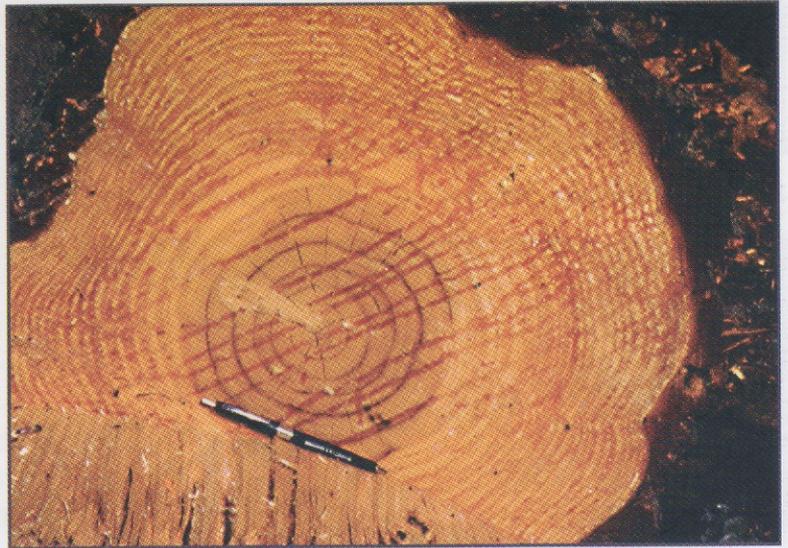
At Campos do Jordão, at high elevation near São Paulo, I found an old forest of pino paran (*Auracaria angustifolia*) with many dead trees lying on the ground. They had decayed except for the knots, two of which I collected and had turned (Goytia) in Puerto Rico into attractive highly polished conical paper weights.

In Argentina with Golfari and Leonardis we compared short-rotation eucalyptus coppice and close planting loblolly pine spacing for pulpwood uniformity for Celulosa Argentina, both practices conceivable for eucalyptus for other purposes in Puerto Rico.

After crossing Rio Uruguay in a rowboat from Argentina to Brazil, a straw-hatted Brazilian inspector questioned my appearance as a US citizen, my passport from Puerto Rico, my speaking Spanish and coming from Argentina. He finally remembered that there is a Puerto Rico in Argentina and let me in. I didn't question him.

In Chile, looking for fast-growing plantations for the Research Committee report for the Latin American Commission, Hugo Sartori took me to Tom on the rainy coast below Concepcion. The plantation he said was 17 years old and yet had big mature insignis pines (*Pinus radiata*). It was raining, but I doubted what I had been told, so I inserted a Swedish increment

borer into a big trunk. One of the annual growth rings was so wide that it apparently confirmed a plantation age such as I was told. I was so impressed that from my room in Temuco that evening I wrote to the Chief of the Forest Service in Washington that if I weren't married I might not come back.



Fast Pinus radiata growth South of Concepcin, Chile



20-year-old Pinus radiata South of Concepcin, Chile



Forest on Kilimanjaro, Tanzania - like our colorado forest



Precision whip sawing in Tanzania, subsequent planeing slight



Ranger school students in Uganda

In 1962 I was the US observer in a 5-week British Colonial Forestry Conference in Kenya, Tanzania, and Uganda. With some 60 of the world's most renowned tropical foresters sharing technical observations, this was a career highlight. They were working with many species of fine African timber trees that looked adapted to Puerto Rico. Their problems of plantation protection from hippopotamuses and elephants we don't have. An up-to-date wood laboratory more complete than ours was seen at Arusha, Tanzania. The large crooked trees of the upper forests on Kilimanjaro looked very much like those of the colorado forest type in Puerto Rico. In Tanzania I saw also pit sawing with fine saws that was smoother than ours, the boards needing only light surfacing. Dawkins in Uganda had a rational national forest plan on a 70-year rotation worth study for any country and an ingenious technique for seasonal tree diameter growth measurements, ringing trees at ten levels above the ground to produce a vernier effect for precise changes in short periods. Practices of thinning and pruning eucalyptus seen appear worthy of trial in Toro Negro. With independence for many of the colonies only a year off, families of foresters had been returned to England with the forester staying an extra year to assist in hurried final training of native staff. They were interested in training opportunities in Puerto Rico.

On the overnight train trip between Nairobi and Entebbe my British room-mate, Leslie Vernell, said he would be a poor companion because he had diarrhea. I asked if he had medicine. He did not. He had not even heard of what I was given for the trip, enterovioform (then federally approved). I explained that this was supposed to stop diarrhea forthwith

and he was welcome to a pill. He not only took one but asked if he might take on the train some to friends with his problem. I told him that I didn't need to use it because I carried a small squeeze bottle with chlorox diluted half in water, applying a drop five minutes to water at the table before drinking and had no trouble, even in Chile and Mexico. He returned with the bottle empty.



Train from Nairobi, Kenya, to Entebbe, Uganda

Forest study reports

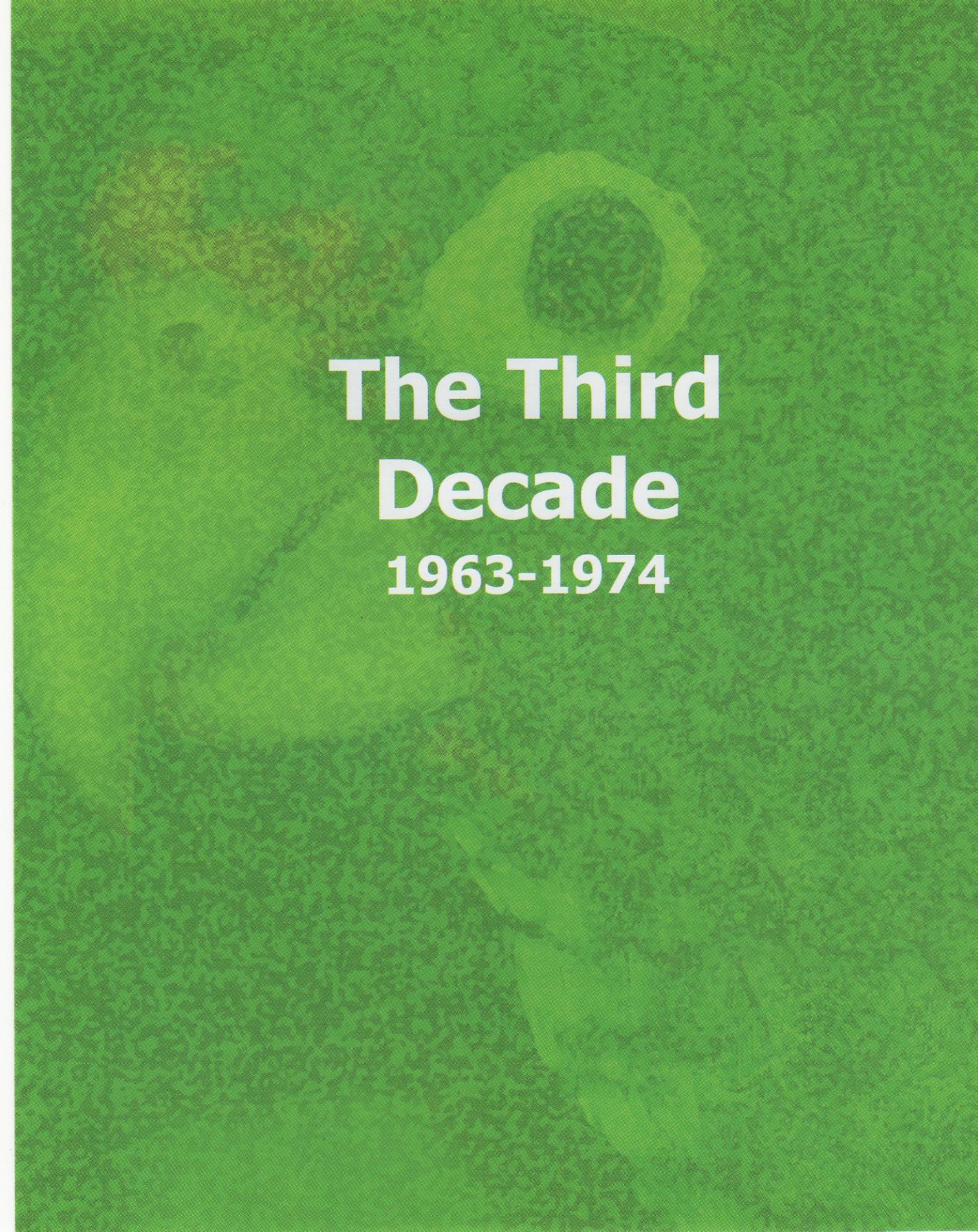
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**The Third
Decade
1963-1974**

Forest Research

At the time that the Puerto Rican Parrot was officially classified as in danger of extinction Forest Service Chief Edward Cliff visited Puerto Rico. I pointed out that the few birds remaining are all within the National Forest, so if it were to disappear the egg would be on the face of the Forest Service. Upon his return to Washington the Chief obtained funds from the Bureau of Sport Fisheries and Wildlife of the Department of the Interior and the World Wildlife Fund to start a Forest Service recovery research program that began with the appointment of Cameron Kepler from the Department of the Interior to the Forest Service in 1968, field research, and a first Recovery Plan for the species.

What in 1963 proved to be the last recorded sighting in Puerto Rico of native white-necked crows, I saw six over the Rio Icacos Valley “talking” and barrel-rolling in flight.

We issued Special Use Permits for research in the Forest:

- To the US Atomic Energy Commission for a study of impacts on tropical forests of gamma radiation from explosions anticipated in the construction of a second canal between the Atlantic and Pacific Oceans. This, by a phalanx of graduate ecologists, produced in El Verde what was touted as the most studied forest in

the tropics, with results consolidated in a published volume of more than 3,000 pages. Previously unknown radiation effects were found no longer a concern. Upon completion, the study area in the National Forest was continued by the University of Puerto Rico for ecological research.

- To the US Department of Agriculture for



The Puerto Rican parrot in the Luquillo Forest

testing arboricides to expose enemy snipers hiding in trees along the shores of rivers in Vietnam. Led to isolation and acceptance of Agent Orange, essentially 2,4D plus 2,4,5T including dioxin.

- To Harvard University for an Arnold Arboretum study of the ecology of the dwarf forest of West Peak.

Yagrumo hembra (*Cecropia schreberiana*), commonly thought of as a forest “weed” of no timber value was recognized as a beneficial participant in forest recovery. In moist tropical



Yagrumo hembra tree starting recovery near El Verde

forests near yagrumo trees their seeds lie idle on the forest floor, ready when illuminated to germinate and send trees leaping up. Their crowns attract birds that bring and drop seeds of native trees that thrive beneath the open, short-lived yagrumo shade, accelerating forest succession to shade tolerant tree species that have no problem in rising through the yagrumo.

Outstanding forest plantation growth had come to light in Puerto Rico. Pine lumber (*Pinus caribaea hondurensis*) was produced in 14 years. Boards of kadam (*Anthocephalus chinensis*) were produced in 8 years. Mexican cypress (*Cupressus lusitanica*) at 1,000 m (3,300 ft.) elevation with 28 cm, (11 inches) dbh in 6 years. *Eucalyptus* to 27 cm (10 inches) dbh in 5.2 years.

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Management of the National Forest

Underplanting of mahogany (*Swietenia macrophylla*), an introduced tree species closely related to native guaraguao (*Guarea trichilioides*), was successfully introduced on 150 acres (60 ha) added to the Forest as a result of land exchanges. The exchanges of the Toro Negro Purchase Unit to the government of Puerto Rico as a State Forest and the private exchange of the 27-acre (10.9 ha) St Just Experimental Forest, discontinued because its soil typified very limited additional territory in Puerto Rico, added seven percent to the land area of the National Forest in the Luquillo Mountains.

We applied a second thinning to the most advanced half of the plantations in the Forest, the last anticipated before the dominants are to mature. We had silvicultural releasing of the better accessible trees in the natural forests continue through the period, using girdling or arboricides. The total forest area treated to date was 6,756 acres (2,700 ha). An area of 1,770 acres (717 ha) of the demonstration timber received a second silvicultural treatment. No timber was being sold. To permit monitoring of sustainability where harvesting was planned we laid out an equidistant set of 135 plot centers in the accessible tabonuco type forest.

An apparently well-heeled citizen from Oklahoma appeared with a Swiss engineer looking for where to put pylons to support a cableway from Luquillo Beach to El Yunque peak. He said he was a personal friend of President Johnson's. I registered opposition because of the prospective impact of crowds up there. I was supported in Washington without comment and heard no more of the proposal. But it gave me the idea for an observation tower

beside a highway half way up, from which both the lower and upper forests could be seen. As soon as the Forest Service acquired a suitable tract beside PR-191 from Hiram Ferrer and I could get a soil test I had the Yokahu Tower built. It had (1) to reach above the forest height for the view, (2) to be wide enough for two-way internal traffic on the stairs, (3) to have frequent stairway rests with windows on all sides for leeward observation of the forest during storms, and (4) to be covered with ivy-like hiedra (*Ficus pumila*). The tower was built rapidly by Mennonites who had come to Puerto Rico as wartime conscientious objectors. They used slip-forms for seamless agricultural silos. Six brass lightning arrestors on the edges around the top disappeared within weeks. The name, "yokahu" was suggested by Archeologist Ricardo Alegria, as God to the tainos.

I have been vilified for not putting an elevator in the central hollow. We had a problem of graffiti on the inner walls until we learned that the problem is the first one and can be controlled by daily repainting. Three attempts to get hiedra up the wall were abandoned when people tore it off to take home cuttings for their gardens. Were I assigned there I would persist until, trimmed around all of the windows and the rim at the top, so concrete in the middle of a forest would be concealed by clinging green leaves.

Ascending the tower, the interior of the forest can be seen, the three stories of trees and possibly some birds. From the top the topography of the mountain and much of northeastern Puerto Rico and Culebra Island are visible. The four forest types, tabonuco (irregular surrounding with white-leaved yagrumos), colorado (smooth to the south), palm (on the steep slopes), and dwarf (on the ridges), are distinguishable,



The Yokahu tower for visitor forest overview

as is the dense old forest of the Baño de Oro Research Natural Area in the upper Mameyes Valley to the east.

A Navy request for a road to East Peak for surveillance of marine maneuvers in the Vieques Passage was held up until borderline invasion of the Baño de Oro Research Natural Area, adjacent to the roadway, had been found without serious reduction of any of the four forest types included. The road replaces a footpath. During its construction I had regrets because before we could protect the excavations the sediment escaping was visible all the way to the Atlantic Ocean.

Beautifying both sides of six miles of the highway into the National Forest (now PR-191) were exotic flowering trees and a hibiscus hedge planted by a Forest Service landscape architect, concealing from visitors the forest they come to see. From the back of a pickup we (Lefebvre) sprayed them and were seen

later removing all but one live tree, the big fat kauri pine (*Agathis robusta*) from Borneo, too attractive to eliminate.

A landslide closed Forest Highway, PR-191 at Km. 19 in the Icaco Valley due to replacement of former resident camineros by absent urban crews. The camineros emptied the roadside ditches, disposing of the loose sand of the rainy slope. With full ditches the runoff passed over the road and eroded the slope beneath. With the slope steeper than the angle of repose of the sand, the slide was moving up the slope above the roadway into old growth forest. Only for a restored road would control of the erosion into the forest be mandatory.

Disagreement existed within the Forest Service, in part due to concern for the parrot, but as Supervisor concerned with continuing erosion and forest loss I favored reconstruction, but the decision was made by the Puerto Rico Highway Department. Then the erosion, uncontrolled,

continued up to the top of the ridge, old colorado type forest being replaced by knee-high ferns.

Excess pet cats discarded in the Forest were threats to the bird life. We instructed Ranger Lefebre, with a firearm and a good shotgun hunter, to get rid of the cats. He responded by teaching me what to expect from a compassionate society. Instead of killing the cats, he trapped them and released them from body bags far from the Forest.

In 1973 I discontinued my direct relation with the management of the National Forest, turning it over to Leonard Lindquist and Juan Muñoz, responsible to the Regional Forester in Atlanta, keeping at the Institute the research the State and Private Forestry and the International programs. As Supervisor of the National Forest there had been unpopular things I was responsible for that were opposed by thoughtful citizens, probably more than I know. At least two, particularly José Colón and Noel Snyder, were memorable to this birdwatcher because they held that for protection of the fauna of the National Forest I should have enforced stronger policies concerning public access. It was true that I was never satisfied that we had controlled removal of pigeons or shrimps.

Relations with Puerto Rico

The 7,000-acre (2,800 ha) Toro Negro Purchase Unit of the National Forest, in the absence of prospects for further federal land acquisition, was transferred to the State Forest Service, adding a distinct State Forest. All of the US tracts except one, acquired by transfer from other federal agencies, were transferred without charge. The Doña Juana tract (4C), having been acquired with Weeks Law funds, had to be exchanged for land for the National Forest in the Luquillo Mountains.

At invitation we assigned two ITF staff

personnel (Larry Hill and Charles Noble) two years to the State Forestry Division. We met weekly with the Division to discuss tree seed sources, reforestation techniques, recreational development and wildlife conservation.

I was junior author of a detailed, illustrated book by Dr. Little that was published at this time, describing 250 common tree species of Puerto Rico and the Virgin Islands. My contribution was field identification characteristics. After the first 5,000 copies it went through four reprintings and an update in 1987.

At the request of the Puerto Rico Environmental Quality Board I mobilized 14 scientists that produced a two volume report describing the natural resources of Mona Island, adding arguments influential in the decision to abandon a proposed petroleum superport there. My contribution to the text, after disagreements between two archeologists, was a 37-page summary of the island's historical resources, including records from the National Archives in Washington.

At the request of Governor Ferré I presided a group of specialists concerned with consolidating government care of the natural environment, with Geologist Pedro Gelabert, Wildlife Biologist Felix Mejias, and a consultant Ed Crafts, ecologist, Deputy Chief of the federal Forest Service in Washington. DC. It was followed by the creation of the Department of Natural Resources that took over Puerto Rican forestry responsibilities.

Research results were completed concerning the resistance to the dry-wood termite by local woods we supplied. Included were inorganic and organic preservative treatments necessary with most native woods. An outstanding finding of Dr. Wolcott's was that lignin-content, a variable indigestible component, was influential on wood

resistance to termite attacks as well as wood density.

I lost the ball. Puerto Rico received a federal Youth Conservation Corps camp calling for components of training and work in conservation within the National Forest. We provided a location on the El Verde road and issued a permit to the Department of Education. After the camp was built the Department obtained the funds directly and with instructors uninterested in the Forest instruction became but another high school.

With José Lefebvre we confirmed the rediscovery of the plain pigeon near the Cidra reservoir. Pepe brought down one of several birds seen.

As a result of a request I prepared a forestry technician curriculum for the Catholic University in Ponce. I submitted a requested design for planned use of rural land resources to the Institute of Urban Law, University of Puerto Rico. We transferred publication rights to the tree book to the University for a translated edition.

Boy Scouts of America

The Nature Team had grown to 8 members and we always had more candidates than could be financed through the summer. Some stayed through the training planning to return the next year or to share summer camp periods. I continued every year bringing specialists for the four-weekend spring training. The Nature Team had discovered a cattle egret rookery near the lake at camp. During four successive years at 5:30 AM the Team spread out in the four directions around the rookery to count the number of herons that departed in all directions toward their cattle. Each year the count came to more than 600 birds.

I went with four members of the Order of the

Arrow to a National Conclave at the University of Indiana and came out with greater confidence in Puerto Rico. The program the first day included a demonstration of the Ordeal Indian Ceremony to bring in new members. To me it was being done poorly, without close conformity to the ceremony rules. I heard my companions talking among themselves, and it worried me because I didn't want them to question the ceremonies we were following strictly. I had with me a Scout Peña from Ponce who in our Lodge served as Meteu, the medicine man, giving the prayers. I asked him if he remembered the prayer of the Ordeal. When he assured me of this I went down behind the stage and asked permission to insert in the demonstration the final prayer as done in Puerto Rico. Peña in blanket and feather, hardly 5 feet tall, gave the long prayer with such fervor that I couldn't have been prouder. He brought down the house. Two thousand Scouts on their feet applauding, even though most of them knew not a word of his Spanish.

With a personal donation of \$30,000 from my father's will I was able to get the Scout Council to match the fund to increase camp land ownership, striving toward a national standard of one acre per camper.

Natural History Society

I participated with three other scientists of the Society with a contract from Westinghouse to photograph and measure the Mar Negro Mangrove that was threatened by hot water effluents from a proposed atomic power plant. The plant wasn't installed but the data, including tree sizes and photographs are still of value for studies of change in that mangrove forest.

For two years I led young Society members

in weekend exploring of interior watersheds, upriver and downriver on foot from bridges. We recorded our findings comparing impressions of the quality or beauty of vegetation, waterfalls, rivers, and caves. We found so many beautiful natural sites on abandoned farmland, the value of which appeared unrecognized, that we concluded that there are hundreds. Society membership applications from real estate agents whose purposes might include change at the expense of nature led us to conceal the results and terminate the activity

I organized annual 3-5-day Society excursions to Boy Scout camp Guajataka and Mona Island. 1965-1975.

Forestry in the Virgin Islands

In 1963, when the time came for VICORP to relinquish the property for an experimental forest it was offered at "book value". When the Research Deputy Chief in Washington was told that the 147 acres (60 ha) of young mahogany forest could be acquired for \$39.37 per acre (\$100/ha) he said he was ready to pay for it out of his own pocket. I had been able to get support for management of the tract from VICORP of \$5,000 per year until 1958 and now was able to get continuing personal and crew support from VI Agriculture (Larry Bough).

When we needed to hire a professional forester I received a letter from a Robert Nobles, State Forester of Colorado, who had visited the island. He appealed for an appointment so emotionally that I got to wondering about him. I had a good forester friend in Colorado and asked for information. The report came back totally in his favor. During the war in the Pacific in high sea he had been thrown against something on a ship and doctors recommended a warm climate for him. Bob rapidly became well known and extremely effective within the St. Croix community. In addition we hired Lambert Fredericksen, a well-known native agronomist. In the forest they had charcoal-makers eliminate inferior trees, set up a mahogany nursery for trees for private lands, a fence-post preservative treating plant, and brought from

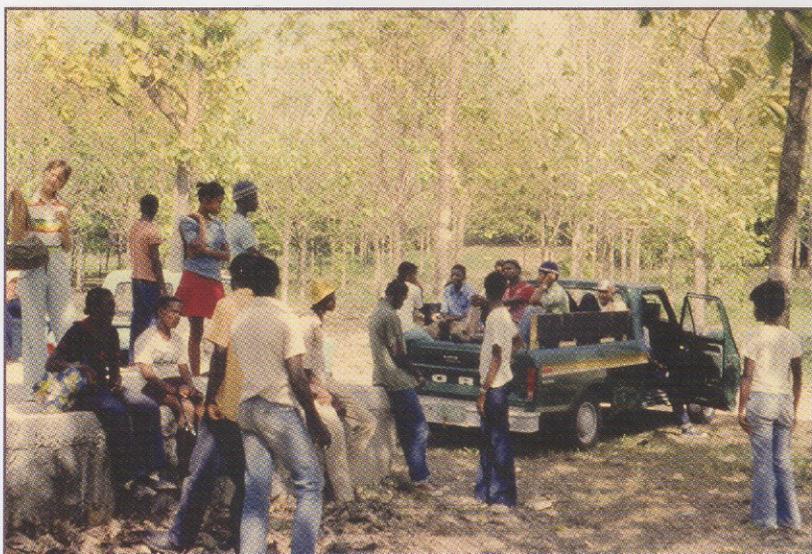


Estate Thomas Experimental Forest in St. Croix, VI

Puerto Rico a left-over American No.1 sawmill and milled old, deformed mahogany wolf trees. The valuable lumber went to local artisans,

including Fletcher Pence, a craftsman training young candidates making beautiful, thick, tung-sealed cheese boards and other items of mahogany, all taken by the tourist trade.

Estate Thomas Experimental Forest became a site for school student visits, open house activities for Bob's Rotary, and studies of tree growth, thinning, and the identification



Student field day in Estate Thomas Experimental Forest in St. Croix, VI

of genetic differences within the West Indies mahogany (*Swietenia mahagoni*). One marked by multiple branchlets was a rippled-grain variant called "plum pudding". One study, denominated "scorched-earth" had all vegetation removed from radial functions of the dbh of mahoganies to make it possible to measure moisture competition, even from grasses.

Mahogany thinning in Estate Thomas was done where the natural stands had >100 ft²/acre of basal area (23m²/ha). Thinning to 58 (13m²/ha) doubled the subsequent five-year tree growth, a response to the dry climate.

Recognition that fencerow trees near Estate

Thomas had, to the leeward, regenerated more than 300 acres (120 ha) with young mahogany trees, and that much of the rural land of the island was idle, we concluded that mahogany trees at the windward extreme of the island, without any help could increase mahogany over the island. A pilot took a big sack of seeds up in a single-engine plane and pushed them out an open window over Lambert, standing in Cotton Valley Estate. The site chosen had tall grass and no results were evident. Later, a few trees direct-seeded there have come through.

Teak is so impressive a tree with its thick vertical stems and huge leaves, and so well adapted elsewhere to climates like St. Croix that I was oversold. One of my most visible follies was to have it planted throughout the open central valley of the Experimental Forest without considering the soil. Since this averaged only 14 inches (0.4 m) above rock the tap-rooted teak became branchy and useless. Mercifully a

hurricane laid it flat. Teak planted elsewhere on St. Croix on deeper soil (by Whitmore) was promising.

International Forestry

The nineteenth tropical forestry course at the Institute of Tropical Forestry was completed, the last, bringing the total to 283 tropical students from both hemispheres. The publication of the Caribbean Forester was terminated in 1964 by a decision of President Johnson who saw an issue with none of our own articles and decided that it was excess. Bound copies by years are in the Institute library and the text is available electronically.

I went personally to the directors of 16 forest research institutions in Latin America to ascertain their needs. (Report cited herein). Their priorities were for artificial regeneration, plantation thinnings, and wood use development. All wanted more training for their scientists. The Director of the Centro Tecnológico en Sao Paulo, where excellent work on Brazilian woods had been done, was not in favor of sending his staff away for more training. Two had returned, away two years for advanced degrees, then willing only to do theoretical studies he saw as useless for Brazil. What he suggested was to send him an expert scientist for a period. He promised to support him so long as he was useful.

Forests and forestry studied elsewhere

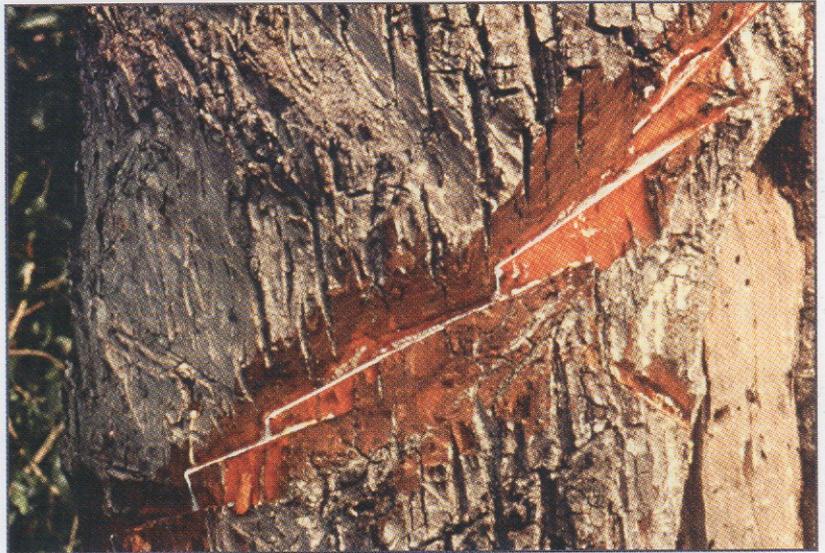
In Tortola charcoal makers were again threatening Sage Mountain. I left with the government more specific recommendations as to how much land to preserve.

I made several trips to Dominica to study the rainforest of Layou Valley, much like that of the National Forest. Growth data from Puerto Rico appeared applicable. With the Forests and Wildlife Department personnel we marked plots for growth and selected crop trees and their competitors. A plan for sustained yield by using topographic compartments and surface control was proposed.

In Yucatan, with Patricia Negreros, we assessed the success of more *ejido* tree plantations of mahogany on abandoned agricultural openings. The sites, over limestone, were like the Puerto

Rican Forests of Rio Abajo and Guajataca.

A Saturday night after a day in the National Park in Tuxtla Gutiérrez, Mexico, on a park bench with another forester watching the parading youngsters I contracted malaria. Within a few days was the World Forestry Congress in Madrid. I had a paper to present. The plane refueled in the Azores and seven



Extraction of chicle in Mexico from sister of our ausubo swarthy passengers came on board. At Madrid my baggage appeared immediately and I took a taxi to a hotel and went to sleep. I was almost immediately called on the telephone by Peggy, my wife. There had been a shoot-out in the Madrid airport with two Americans killed. Because of the malaria a Conference tour into the pine forests had me shivering continuously. When the time came to present my paper I couldn't even hold it steady. Bruce Lamb of our staff who also went had to present it.

In Honduras I became acquainted with the Manilkara latex (chicle) industry. The collection is labor intensive. Those who cut the tree bark and collected the sap travelled on bicycles among the trees.

With some of the best forestry students of Latin America at the Instituto Interamericano de Ciencias Agrícolas of Turrialba, Costa Rica (The predecessor of CATIE), I lectured on principles for sustained yield of timber from tropical forests. At Golfito on the final afternoon, after two days practicing in the forest, it rained. I used the time by asking the crew what they really thought about the US programs of international assistance.

I noted 18 points, of which the following were most memorable: "(1) Contributions that commit most of the investment for required consultants and equipment sources are not donations. (2) Projects that do not include enough training for local continuation simply add to country dependency. (3) Project

formulation that does not include those who are to do the work promotes too much and too big a change from tradition. (4) Sovereignty should not deter Northern nations from modifying or terminating projects where funds are misused or objectives frustrated." The presentation was calm and friendly. I wished that Congressmen or USAID personnel could have heard it.

In Surinam I was shown level land that had been abandoned after farming. The vegetation had been cut and swept into piles preparatory to tree planting. In the second year after planting the trees near the piles of trash were twice as tall as elsewhere, indicating the nutrient or water conserving value of trash vegetation. This should have application by Puerto Rican farmers



Dr. Holdridge at an ant hill in Paraguay



Natural autumn leaves of raulí (Nothofagus) forest of Chile

Prior to a meeting in Quito, Ecuador, I came down to the hotel restaurant for dinner, and there was Ed Cliff, the Chief of the Forest Service and his wife. He had come to get away from a request for a keynote speech in an annual meeting of the Society of American Foresters in Tucson, Arizona, a place he considered as fit for a forestry meeting as for a submarine base. During the dinner he received a phone call and took it in an adjacent room. He said nothing about it until the next day. The National Lumber Manufacturers Association had scheduled a hearing in Washington for which they told him to either come back and appear or they threatened to get his job. I asked him how he responded. Thick-skinned and apparently used to such tactics, he just gave them the phone number of his boss, the Secretary of Agriculture.

The Chief sat through much of the meeting and kept asking me to translate information. I think I convinced him that I understood it all.

In Curitiba, Brazil, at the Universidade Federal do Paraná, I learned from female students. My discussion of tropical forestry to the students was late on the program and extended to 11PM. Good questions from 2% of the women students for an added half hour at that time of night convinced me that a 2% audience response was a successful presentation.

In Paraguay in the Park beside the Puente Presidente Stroessner, across Rio Paraná between Paraguay and Foz do Iguazu, Brazil, I attended a two-day presentation by Dr. Holdridge on tropical ecology and added comments on forestry before a group of

Paraguayan students. With Holdridge I went to Filadelfia in the Chaco Boreal, seeing many birds that resembled those of the US. The streets

past extensive plantations of yerba mate (*Ilex paraguaiensis*). With Hutchinson, fresh from a visit to Rio Piedras, we planned a national forest inventory to control logging sustainably, an assignment he had there from FAO.



Protected primary forest of *Auracaria* in Chile



Our *Cordia alliodora* after 11 years at Sakpopa, Nigeria

of Asuncion were lined with tipa, a beautiful flowering tree native of South America (*Tipuana tipu*). To see some of the forests we travelled by train behind a wood burning locomotive

In southern Brazil and Misiones, Argentina with Golfari we entered many pulpwood plantations I considered too dense and suggested to private landowners practices for wider spacing and thinning to shorten the rotation to harvest. Thinned plantations had larger trees but there were no data. For pulpwood, biomass may be more wanted than tree diameter, but logging costs come down with larger pieces.

In southern Chile I saw the autumn change of leaf colors and also the primary *Araucaria* forest. I had a close one. Preparing a management plan for the Malleco forest several of us were living in a cabin in the woods. On a weekend all the Chileans went to their families in town and left me alone. They had left a few glowing embers in the wood stove. When lunch time came I added wood and went to the bottle of kerosene they stored outside of the cabin. I added what turned out to be gasoline and took off all the hair on my arms. Luckily I had retired the bottle before the flames shot up and I was able to smother the flame with

the stove plate. So much for my appetite. When leaving Chile after three weeks I was surprised by two of my young co-workers seeing me off at the airport, having come some 350 km from southern Chile. They explained it by saying, "You care for our forests more than we do. When

it rained you kept on measuring, something we would not have done without you." Makes one consider working in Chile.

In Ghana, Alistair Foggie showed attractive secondary forests resulting from several years of silvicultural treatment such as we are testing in Puerto Rico.

In Nigeria Spanish cedar (*Cedrela odorata*) and capa prieto (*Cordia alliodora*), natives to Puerto Rico, were doing well in plantations. In natural forests Macaranga, a Euforb genus with many species, looks like and apparently acts like our yagrumo hembra (*Cecropia schreberiana*).

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1966. Problemas dasonómicas de los trópicos húmidos de América, Lima

1968. Public forestry research in Latin America, its status and needs. USDA Forest Service, International Institute of Tropical Forestry. Rio Piedras, Puerto Rico.

1968. Techniques for surveys and the ecological exploitation of tropical forests. Fundacao para la Conservacao de Naturaleza, Rio de Janeiro.

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1971. Forestry potential and its development in Central America, Tegucigalpa.

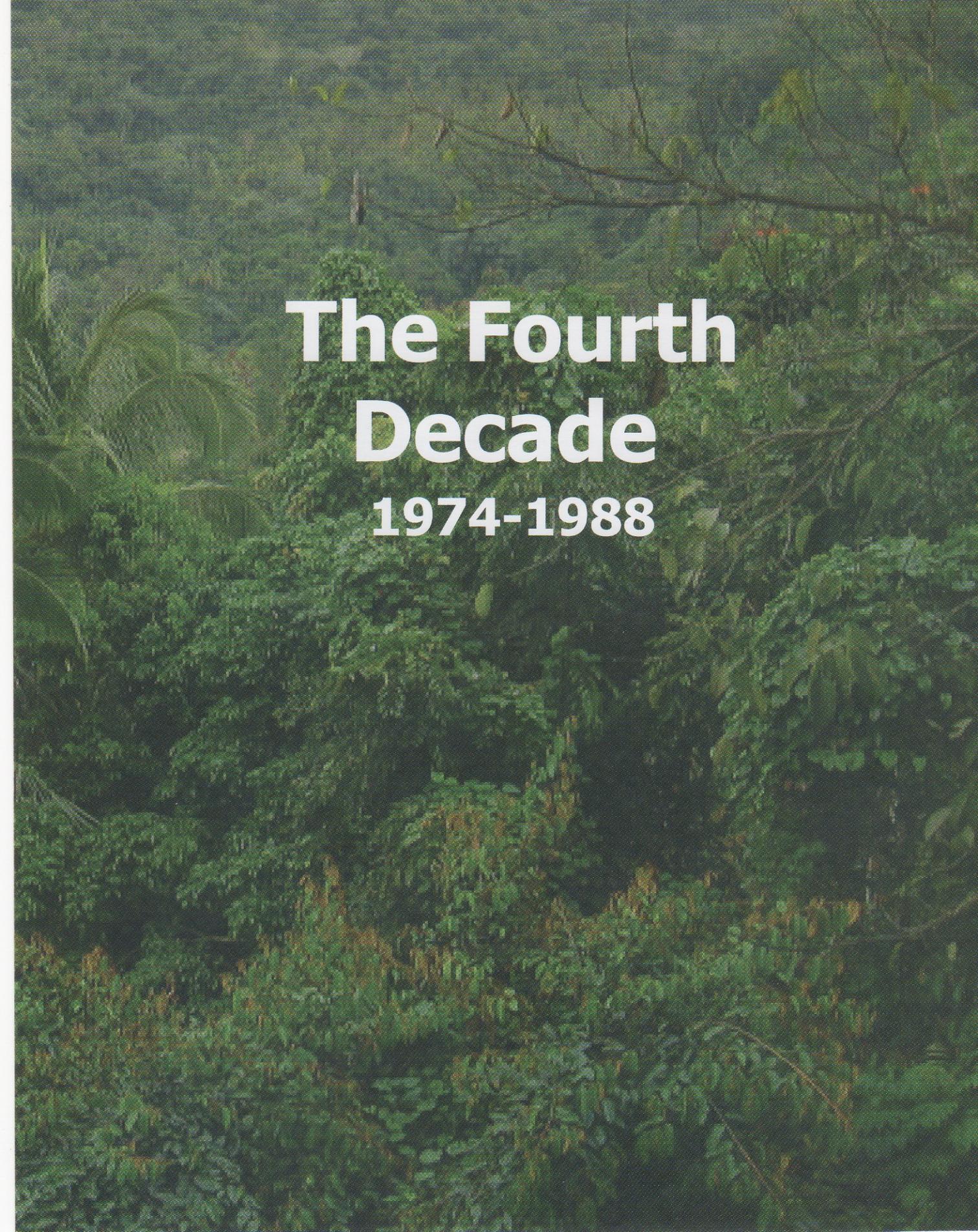
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Additional foresters consulted

G.N. Baur, J. G. Bene, L. Cummings, A. Foggie, G. Galloway, W. E. Hiley, R. Howard, L. Huguet, I. Hutchinson, W. B. J. Jonkers, R. M. Keogh, F. K. S. King, L. A. Luna, R. C. Marshall, O. M. Oseni, G. de las Salas, J. P. Schulz, J.W. Simoes.



**The Fourth
Decade
1974-1988**

Forest Research

In the Luquillo Mountains we found that one fourth of 1,400 selected crop trees of 12 timber species had during 24 years grown twice as fast as the rest. Some individual trees were growing 5 times as fast. We found also that tree growth due to released density around trees to 20 m²/ha (87 ft²/acre) of surrounding forest density could produce as much as 5 m³/ha/yr (72 ft³/acre/yr) of choice timber.

On occasions I lectured in temperate zone universities (eight in all) about tropical forests and usually what students interested might do to conserve them. The general answer I offered is involvement, so suggestions included studying up on the subject and writing about it, or my favorite, join the Peace Corps. I feel that the Peace Corps, where one of my sons served in Chile, has produced many returnees who were successful and could and would continue giving at least short-term foreign service of a quality rare at the far end from others within the US.

We obtained for the library 3,000 publications

from a library on the mainland. We led the revision of a Parrot Recovery Plan, produced by a local committee.

At about 1975 I concluded that the Institute needed a new Director. From Washington I was given freedom to recruit. I hoped for a Puerto Rican successor. A best candidate appeared to be Dr. Ariel Lugo, a Phd ecologist currently employed in Washington at the Council on Environmental Quality. I wrote him a personal inquiry as to his interest in the position. I received no reply. Some two years later we met by accident in a hall in Washington and I pursued it. He apparently had not seen my letter. He was instantly interested although he actually had a higher grade than my position. I had him interviewed by Research in the Forest Service. It was a time that ecology was penetrating Forest Service "ecosystem management", and he came through with flying colors. Like I tried to do, Dr. Lugo for more years has built the Institute in his image, and I have no regrets.

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1981. The management of forest lands in the humid tropics under sound ecological principles. In F. Mergen, editor. Tropical Forests: utilization and conservation. Yale University, New Haven, Connecticut. p. 168-180.

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1987. Tree growth as a guide to the management of secondary tropical forests. In Lugo, Ewel, Hecht, and others, editors, People and the Tropical Forest. Washington, D.C., U.S. Man and the Biosphere Program, Tropical and Subtropical Forest Directorate. P. 57-60.

Relations with Puerto Rico

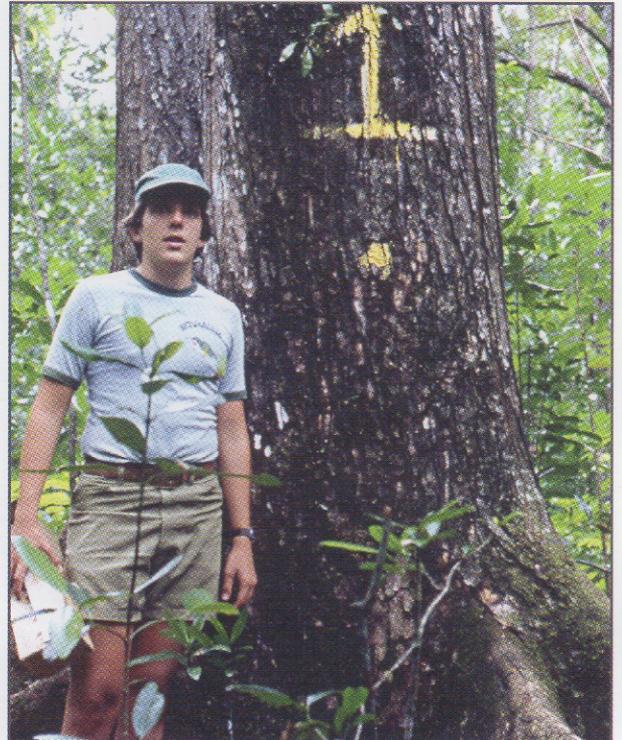
A frustrated vision. I exposed for preservation the tree species I considered most really endangered in Puerto Rico. There are about 30 native tree species not in any State or federal Forest, and another 14, so exposed, are endemic to Puerto Rico only. These species are rare, only on private lands not dedicated to trees or even known by their landowners. Assuming that saving them ought to add a substantive value to the academic subject of botany, I proposed to botany professors in the UPR of Rio Piedras and Mayagüez the possibility of offering masters degrees to students who take two species, propagate them, and get them planted successfully in two appropriate public forests.

A field botanist offered to assist with identifications, and the Conservation Trust was prepared to assist with propagation. This proposal has interested some students, and in my view is of growing importance, but has not been taken up.

As junior author, I added field characteristics to the text of those botanical in published Volume 2 of the Trees of Puerto Rico and the Virgin Islands, including 500 more species illustrated, completing the flora at the time.

We had the Forest Products Laboratory of the Forest Service submit to the Puerto Rican government plans for simple, wind-resistant wooden houses. At request, we recommended reorganization of the natural area functions of the Legislature. At request, we identified desirable resource acquisitions for the Conservation Trust. We offered a 5-day presentation on environmental education to Puerto Rican government employees. We also sent twenty-nine pages of suggestions for a forestry program in the Departamento de Recursos Naturales

y Ambientales. We led four-day workshops for employees of the Department of Natural Resources and Environment on forestry for the State Forests. We combined the herbarium of the Institute, with more than 3,000 sheets, to that of the University of Puerto Rico.



Scout and mahogany Guajataka

With the death of former governor Muñoz Marin his widow, Doña Inés, asked me for guidance in the landscaping of their property in Trujillo Alto. They had received many unusual tropical plants from foreign dignitaries. I was unsuccessful because she didn't really want to move anything. She confided in me that Muñoz had died melancholy because the migration of the people to the cities had proved a mixed blessing. I told her in compensation that in that migration he had brought more forests to the island than anybody else.

Boy Scouts of America

The Nature Team, trained each spring as usual, in 1978 took on the tape measurement of diameter growth of some 100 mahoganies (*Swietenia macrophylla*) that had been planted in the camp in 1937 and were up to 30 inches (76cm) or more of dbh. They remeasured the diameter of the trees at breast height every year thereafter and thinned out their competitors of other species.

As a Council Board Member I directed attention to the idle time of campers in Guajataka during frequent showers. Response was the Ramos Building, with large sheltered space for activities during inclement weather.

A frustrated vision.

In my travels I became aware of two phenomena that deserved international attention. One, in every country of Latin America, was the related problems of neglected forests and water. The other was that all countries apparently had youth organizations, some Scouts, and some different. My proposal was to direct the youth organizations to the problems of water related to forest conservation to influence entire societies to conservation action.

I sold USAID, the federal government foreign aid agency in Washington on a three-year proposal. The first year two adult Scouters, bilinguals, from Puerto Rico were to visit all the capitals of Latin America and identify good youth leaders, and we were to host them at US expense for two weeks in Camp Guajataka to produce a common forest/water conservation study and action program for each of their organizations. The second year was to be a second meeting somewhere else to report on progress, unravel difficulties, and improve the program for the future. The third year was to be

a jamboree of all the groups somewhere in the Amazon Basin. USAID went for the first two years and required a US administrator.

I assumed that the National Headquarters of the Boy Scouts in California and Texas should want to extend their influence to Latin America and be the logical candidate. Although I offered to the Chief Scout federal funding for the travel and the two meetings, the BSA, despite its International Division, brushed me off during three years in which international BSA activities were essentially social, and the opportunity was lost. In the meantime the need to motivate youth to arouse public concern for growing forest-water problems continues to increase throughout Latin America.

Natural History Society

I contributed to monthly Society field trips to points of interest. We searched in vain for an available site for a Nature Center close to the metropolitan area to introduce school students to a forest.

Forestry in the Virgin Islands

The active forest production program in St. Croix came to a halt. Lambert Fredericksen, a fine employee and person, died. Bob Nobles was transferred to Puerto Rico, an advancement. Juan Muñoz and Pepe Lefebre were each sent to St. Croix for a year to maintain the project, but funds became a problem and Estate Thomas, a demonstration mahogany forest, was left by the Institute for future research.

International Forestry

J. L. Whitmore of the Institute staff was sent at our expense for two years to teach forestry to the Centro Agronómico Tropical de Investigación y Enseñanza (CATIE), in Costa Rica.

In 1978 I began generating the ISTF News begun earlier by the late Tom Gill, a bilingual quarterly newsletter of the International Society of Tropical Foresters with officers throughout the world. It took on chiefly excerpts of abstracts from tropical forestry journals. Each issue contained about 30 items. It was published in English and Spanish and distributed by the Society from headquarters in Bethesda, Maryland to at most, a worldwide mailing list of 1,500.

A flight from Belem to Manaus over a sea of mixed moist forest produces philosophy in a forester. This forest is said by some to have been "degraded" by logging, although almost none of its biomass or vertebrate fauna have been effected. Forests not so degraded are termed "primary", thought to be an expression of nature without human influence. This brought to my mind the viewpoint of the late Alf Leslie. A value of untouched total biodiversity with all of its interdependent complexity, known and unknown, although possibly not vital to human survival, is certainly worth saving. It is late and so in some places slightly modified forests may have to substitute for restoration. In forests no longer primary there may still provide most of the other forest products and benefits, equally sustainable. None of these uses require all of the forests, so if they are incompatible, like oil and water, they should be kept apart. Biodiversity, as irreplaceable, and possibly irrecoverable, needs to be identified, located, and preserved first, but again not all of the forests.

Its true preservation calls for learning before touching, contrary to the wording of the US Wilderness Act, calling for "untrammeled"

wilderness and yet assigning equal priority to incompatible "human enjoyment". If indeed primary ecosystems are as complex as science is revealing, much more needs to be learned scientifically about such areas and unassessed human visitation impacts before other visitation should be permitted. The cost to adjacent societies of keeping primary forests free of human influences suggests that they be limited in extent to truly unique conditions.



Headquarters of the Emberá tribe in the Darien of Panama

It is the very natural forest biodiversity that is responsible for the sea of forest remaining beneath the plane. It is too diffuse and varied for economic utilization. Yet it protects the soil, water, and fauna and inescapably produces wood. Should timber interests get out of the forests? Clearly no, because forests with only the other values may not resist proposals for other purposes, including deforestation and oil palm conversion, as has been so criticized. An economic forest value, even eventual, tends to fend off competing land uses in favor of retention. In Puerto Rico timber production

from such forests might then not be pitted against biodiversity as at present but in favor of soil, water, wildlife, human recreation, and diverse wood production.

Forests and forestry studied elsewhere

In the Darien of Panama. (with Heckadon) we answered a request from the Emberá, a native people on the Colombian border that used blow-guns to oppose the Pan-American Highway. At a meeting in a large thatch-roofed building an elderly lady with a wizened face



Forest of *Catavo* (*Prioria*) where Emberá were selling trees

that photographers couldn't resist, a Senator of the tribe, presided. She explained that their forefathers had told them never to let the forest go because it was their livelihood. She said that the tribe is now offered \$50 US per mature *cativo* tree (*Prioria capaifera*) and the tribe could use the money. Her question to us was, "How many *cativos* can be cut without losing the forest?" From the helicopter we had seen them, with large light green crowns, standing out in the forest canopy. This, with the obvious willingness of the tribe to listen, was

an extremely attractive niche for a forester. But during our visit all I could recommend, based on experience in Puerto Rico, was to leave half of the big trees until the two Emberá agronomists in the meeting get forestry training in CATIE in Costa Rica. As our helicopter returned we saw the *cativo* forest along the rivers.

USAID requested guidance for the protection of the Panama Canal. I was flown in a helicopter over much of the Canal. It was apparent that

80 percent of the slopes on each side had been cleared of forest and cultivated, like upland Puerto Rico. Some 100,000 people lived in the watershed. With such misuse, and the resultant erosion, the canal couldn't long retain its required depth. Under the title "Deforestation, death, to the canal", I left in Panama a statement of the need to shift the use of the lands in the watershed from cultivated crops to pastures and fruit production, resting the soil. In opposition were the US engineers of the Canal Zone, wanting to continue the world's largest dredges 24 hours per day. What I wrote was translated by Heckadon and widely publicized.

In Chile FAO asked me to review nursery practice. I started north of Santiago at Ovalle, where the product was trees for fixation of coastal dunes. At the main nursery in Chillan and many others a main species was raulí (*Nothofagus alpina*) a beautiful wood my son during a Peace Corps assignment had found capable of rapid forest regeneration (*renovales*) if freed from an aggressive bamboo. The nurserymen proved to be a determined lot, mostly former farmers.

Each one developed his techniques individually.



Nursery stock of *Pinus radiata* at Aysen, Chile

From experience in Puerto Rico a widespread visible common deficiency was the use of heavy soil, a favorite for farming food crops needing continuous water but not ideal for young tree root development. This deficiency was easily demonstrated by small root systems on the trees. But in most nurseries there was no post-planting communication to feed back low survival or slow initial growth. Only in one nursery at Aysen, 400 miles (650 km) south of Puerto Montt, did I find a nurseryman who mixed light sandy soil and had really good root systems. Interestingly he was producing healthy ponderosa pine that reminded me of Arizona, but was having trouble in the plantations with rabbits.

On the island of Mindanao in the southern Philippines, a paper industry had produced a sustained second generation supply of pulpwood from fast-growing leguminous (*Paraserianthes falcataria*) plantations. This species is being tested in Puerto Rico. Under a tree there I got a good haircut for US \$0.35.

In Australia I went to Cairns, of the same latitudinal distance from the equator as Puerto Rico. There was rainforest and also *Pinus caribaea* improved repeatedly genetically. There they have gone farther in the improvement and uniformity of the species growing in Puerto Rico than anybody else. Their seed should be tried in Puerto Rico.

There I also saw a dense plantation of *Araucaria klinkii*, a species testing in Puerto Rico. In Sarawak, Malaysia with Hutchinson



24-year old Leguminous regeneration in Mindanao, Philippines

we studied his big plots in hill dipterocarps with the release of crop trees we had agreed upon while he was in Puerto Rico. On excellent sites, these plots were installed and treated by forester Silvester Tan. They expose the prospects from intensive, selective silviculture. If continued, the crop should mature within 40 years. We also saw the residual forest left after logging hill dipterocarps and replanting of mangroves.

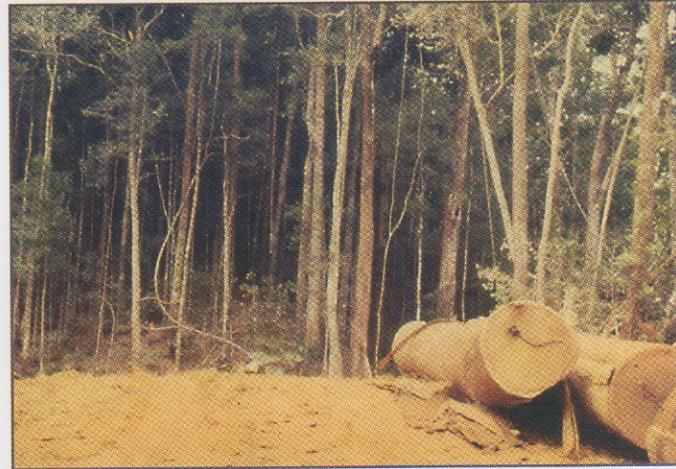
I joined ten international forestry specialists to the interior of Sarawak in response to extremist allegations of dipterocarp timber harvesting impacts on the orangutan and genocide of the longhouse human population. There were indeed logging roads in mountainous forests that had gone through native cemeteries.



19-year Australian *Auracaria klinkii*,
dbh 24 cm (9 in.)



Hutchinson hill dipterocarp liberated plot 106, Sarawak



Residual hill dipterocarp forest left after logging, Sarawak



*Mangrove with *Rhizophora* planting, Sarawak, Malaysia*

We also exposed covert liaison between leaders of the longhouses and the logging companies. After three visits I generated the silvicultural part of a group report that called for a shift of logging to above the orangutan habitat



The Penan longhouse people of Sarawak, Malaysia



Logging teak at Cepu, Java, Indonesia



Eighth-century agroforestry-Borobudur Temple, Java

elevation and away from the longhouses with suggestions for hill dipterocarp selective logging with minimum reduction in future productivity and other forest benefits.

Java had the world-famous 70-year-old Nilambur teak. I was impressed by the intensive use made of teakwood, even small slivers of heartwood. On the 8th century temple of Borobudur were stone frescos depicting trees with mangos and what today would be called agroforestry, crops growing beneath trees. On farmlands I saw taugyna, the practice of using an interplanted crop of corn to justify weeding planted timber trees (*Tectona grandis*) with a leguminous tree (*Leucaena leucocephala*) for nutrients. I also was impressed by selectively logged slopes where a good protective forest canopy was left. The Bogor Botanical Garden, as one of the oldest in the tropics, is composed of mature trees, including many species of *Auracaria*. Especially impressive is a row of mature trees of the "Pride of Burma" (*Amherstia nobilis*) with arguably the world's most attractive tree flower candelabras. On a Sunday the garden was densely packed with families with children. We also saw a commercial tea plantation.



Teak taugyna with maize, rice and Leucaena, Java



The flower of "Pride of Burma"

In Jakarta a building of an entire city block has a floor dedicated to woodcrafts with so many new ideas for Puerto Rico that somebody leading Puerto Rican artisans should spend some time there and bring back samples and illustrations. It was in the World Forestry Congress in Jakarta where Jack Westoby made his widely quoted



Tea plantation in Java

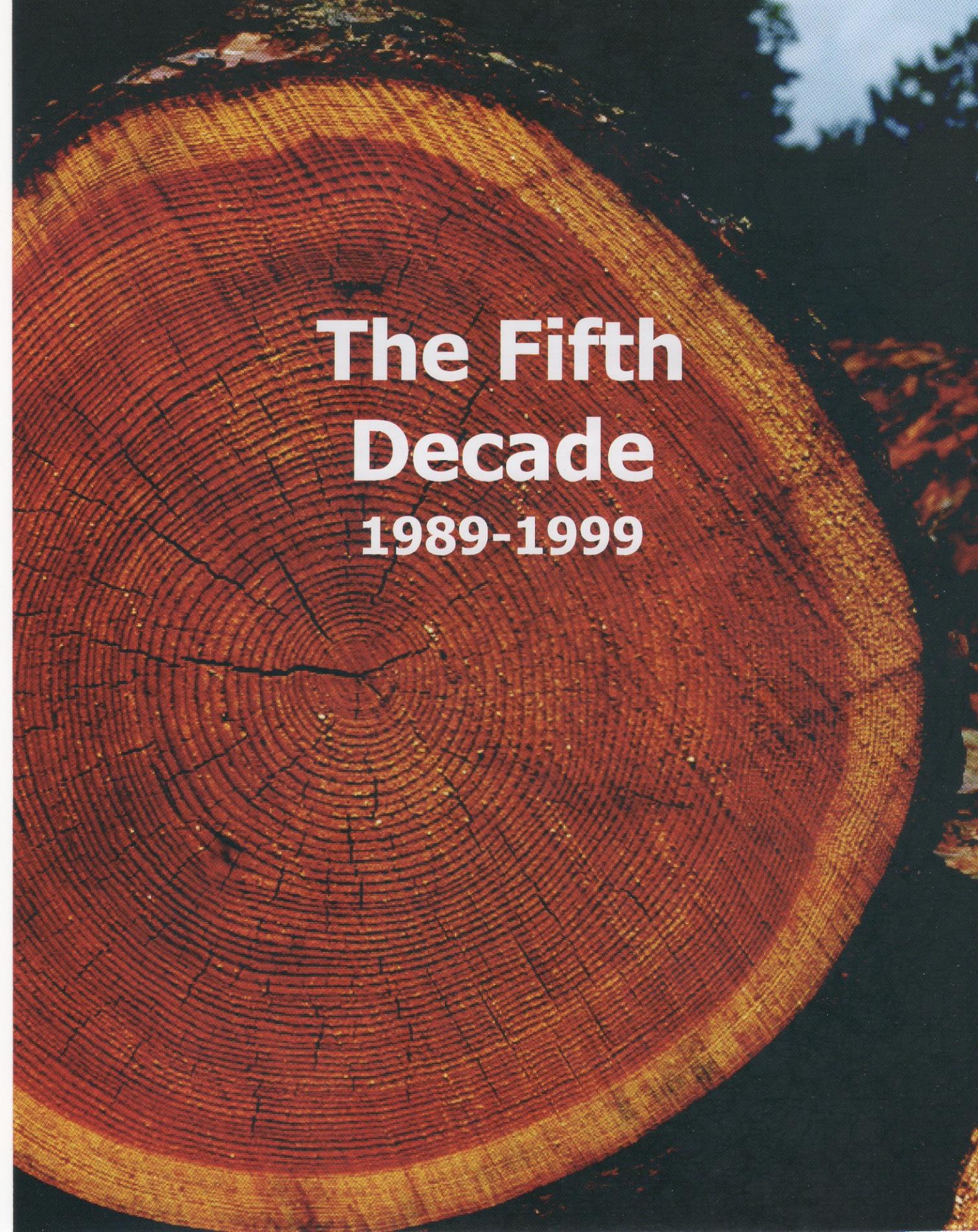
statement that "There is a misconception that forestry is about trees: it's about people." An excursion to Bali found the southernmost native pine in the world. At a Holy Forest with huge trees there we had box lunches. My wife, Peggy temporarily pocketed a hard-boiled egg and lost it to a watchful monkey.

Forest study reports

- 1975. Natural forests in the development of the humid American tropics, Caracas
- 1976. A forestry program for the Instituto Superior de Agricultura, Santiago de los Caballeros
- 1976. Mejoramiento de las bases técnicas de silvicultura, Santiago, Chile
- 1978. Manejo de forestas tropicais anais do seminario sobre planejamento de desenvolvimento e da uso de terra. Instituto Brasileira de Desenvolvimento Florestal, Belem
- 1975. Natural forests in the development of the American humid tropics. IUCN, Caracas, Venezuela p. 129-138.
- 1979. Principles of management for sustained yield: evaluation and prospects, San Jose
- 1981. Hill forest silviculture for Sarawak, UNDP. Kuching
- 1981. Management of a tropical forest, Durango
- 1985. Deforestación, muerte del Canal de Panamá. Biocenosis 1:15-16.
- 1986. A focus for forest conservation in Jamaica, Kingston
- 1988. Tree increment indicators in a tropical wet forest, Kuala Lumpur

Additional foresters consulted

J. E. M. Arnold, U. Aung Din, H. Chapuis, J. G. Laarman, W. E. Ladrach, S. Heckadon, H. Lamprecht, D. G. Nikles, D. Poore, S. Pringle, T. J. Synnott, H. M. Tschinkel, C. D. Whitesell, T. C. Whitmore.



**The Fifth
Decade
1989-1999**

Forest Research

Trees of twelve timber species were found concentrated in location in the Luquillo Mountains according to surface drainage, slope, or aspect. This suggests that their growth rates, not yet compared, may also be so skewed. If this is true, we may have uncovered additional explanation of the growth variation and where to favor (or plant) each species on the mountain.

The Scout Nature team, using bark gages and increment borers, obtained the bark and sapwood thickness of a variety of mahogany tree sizes at camp, making it possible to relate heartwood diameter and volume (the most useful wood) to diameter outside bark and height. On the basis of an algorithm from their measurements Edgardo Gonzalez and I found

that heartwood volume was still increasing more rapidly than ever in 70-year-old trees. (Published article cited below).

Findings from different studies in the tabonuco forest support the following recommendations for sustainable wood production from existing forests:

1. Retain any existent partial shade, tree species, grass and litter
2. Select for a crop the potentially most productive trees
3. Eliminate competitors crowding crop trees
4. Keep basal area around crop trees below 20m²/ha (87 ft²/acre)
5. Natural regeneration of crop tree species to be expected

Selected forestry publications

1989. The forest resources network in the Caribbean. *Interciencia* 14:341-343.

1992. Temperate zone roots of silviculture in the tropics. *Ecology and Silviculture of Mixed-Species Forests* 40:245-255.

1992. Unos componentes de la educación ambiental. *Acta Científica* 6:151-154.

1995. A forest research institution in the West Indies: the first 50 years. In A.E.Lugo and C. Lowe, editors, *Tropical Forests, Management and Ecology*. Springer-Verlag, New York. P.33-56.

1997. Forest production for Tropical America. USDA Forest Service, International Institute of Tropical Forestry. *Agricultural Handbook* 710, 563p. (2,000 710-S. Spanish)

Relations with Puerto Rico

At request, I submitted to the Puerto Rico Chamber of Commerce a study of feasibility for a forest industry. At request, I submitted to the Department of Natural Resources and Environment a plan for the administration of the State Forests. At request, I submitted recommendations to the Legislature for a technical basis to restore a forest industry. At request, I submitted a proposal for a graduate forestry curriculum to the University of Puerto Rico.

Boy Scouts of America

A purely Puerto Rican forest! I continued Nature Team training on four weekends at camp each spring with volunteer specialists as instructors. The Team, composed of about 8 volunteer Scouts, trained more than 2,000 campers in nature advancement each summer. Members of the Nature Team, after 12 years of measuring mahogany trees, an exotic, requested a pure Puerto Rican forest to measure. With them I laid out an acre (0.4 ha) and they girdled exotic trees. The plot is square, with 9 sub-plots and 16 native trees measured in each sub-plot. Measurements were repeated each year after 1990.

A Frustrated Vision.

Complaints from both Scout leaders and Scouts who repeatedly visit Camp Guajataka refer to the monotony of the program, always the same for those who repeat. Since the camp is located in a very interesting landscape, with forests, rivers, waterfalls, canyons, caves, and limestone hills I proposed what I called Operation Cibao, after the local tainos, a single short one-night hike out from camp during camp weeks could provide diversity. To simplify the

start it might use sites within the camp property for first overnights. It would require Council approval, with round-table announcements so the units would come prepared to camp out one night and the camp kitchen would need hiking provisions. I assumed that the Order of the Arrow, a service organization with members always at camp, could locate hiking routes, permission for campsites, and lead the hikes. A member of the Nature Team could go along to point out plants, animals, night sounds, and stars. On three successive summers I obtained and marked places of interest on the four topographic maps around camp and presented them to the camp directors before the summer. Neither the Council, nor Unit Leaders, nor the Camp Directors took the idea seriously. For lack of promotion, not merit, it failed.

International Forestry

In my travels through Latin America I became aware that the forestry schools lacked a local text to work from. Some used one from Spain, others from the US. Dr. Robert Buckman, Deputy Chief of Research for the Forest Service, urged me to fill this gap. It took me eleven years and was late. The result was the 500-page "Forest Production for Tropical America" that appeared in 1997 (cited herein). The first 100 pages are forest ecology foresters should know. Data presented may not all be last minute research findings, but they show general relations not expected to change more than in degree. The book was translated into "*Producción Forestal para América Tropical*" by CATIE in 2000, and CD disks in either language are available from the Forest Service Institute of Tropical Forestry in Puerto Rico.

Generation of four annual issues of ISTF News continued throughout this period.

Forests and forestry studied elsewhere

In Saint Lucia the Mankote Mangrove followed recommendations. Extraction was seen to have continued as prescribed and the partially cutover tracts were already well stocked. The plan could apply to some of Puerto Rico's mangroves to replace the charcoal imported.

In Mexico with the FAO Silvicultural Study Group of the North American Forestry Commission, we started in 1977, I was involved in development of forest refinement practices for secondary forests that conserved biodiversity like that of Puerto Rico. With Patricia Negreros Castillo we reviewed sustainability practices with the community of the *Ejido Plan Piloto*, including utilization of trees formerly cut for crossties, and the integration of forest planting with agriculture under gaps in the

forest canopy, such as might be tried in Puerto Rico. In Campeche I presented to members of Mayan Ejidos Puerto Rican experience in the reforestation with mahogany. We studied and recommended reforestation practices for abandoned mine lands. In *Ducks Unlimited* workshops in northwestern Yucatan we presented to Park administrators selective forest extraction practices compatible with park protection.

Hurricanes in Honduras too! Past-hurricane cleanup in lowland broadleaf forest was seen. Down timber was being utilized better than in Puerto Rico.

In Costa Rica, using with Hutchinson tree growth data from Puerto Rico, we determined that with their crop tree release in experimental plots the forest increment rate should double in 17 months.



Forestry Commission Study Group, Quintana Roo, Mexico

In Guyana I reviewed forests logged by Reduced Impact techniques and post-logging release of crop trees (as studied in Puerto Rico) under large scale conditions in attempted compliance with Forest Stewardship Council Certification. Where compliance was not fully

species. With the Tropical Forest Foundation (Johan Zweede) we applied a test of a treatment of controlled forest density around selected crop trees we had developed to a specified degree in Puerto Rico to stimulate growth. It involved the use of an arboricide on tree competitors. A 20-hectare forest was treated and another was marked (crop trees identified and enumerated) without the treatment. The treatment significantly stimulated measureable growth in three years, and results were published (cited herein).



4-year-old pruned mahoganies at Paragominas, Brazil

attained, FSC accepted a commitment for a later date.

In Brazil Reduced Impact Logging prescribed by FSC included the beginning of post-logging release of crop trees. In Bolivia post-logging silviculture such as we propose was also being tested.

At Paragominas in the lower Amazon Valley, I came upon a timber cutting operation that had left a forest of many immature trees of timber

In Peru I found Flavio Bazan, one of our former students in Puerto Rico, the Chief of the Forest Service for nearly 20 years. I asked him how he stayed on top so long in a country with frequent political change. He said, "In this job I have had to break all the rules my mother taught me, but every time it looked good to get

out I found that my apparent successor would be someone even less prepared, so I stayed."

A review of western Kalimantan of Indonesia was made (with Tschinkel) in search for a desirable location for a British forest research station. Entrance at Pontianak and exploration by air, river, and road in Barat led us to a negative response to the United Nations Development Programme because of absence of basic living conditions for scientists.

Forest study reports

1988. Plan for development of Sage Mountain, Tortola

1988. Silvicultural plan for the Layou Forest, using tree growth data from Puerto Rico. Roseau

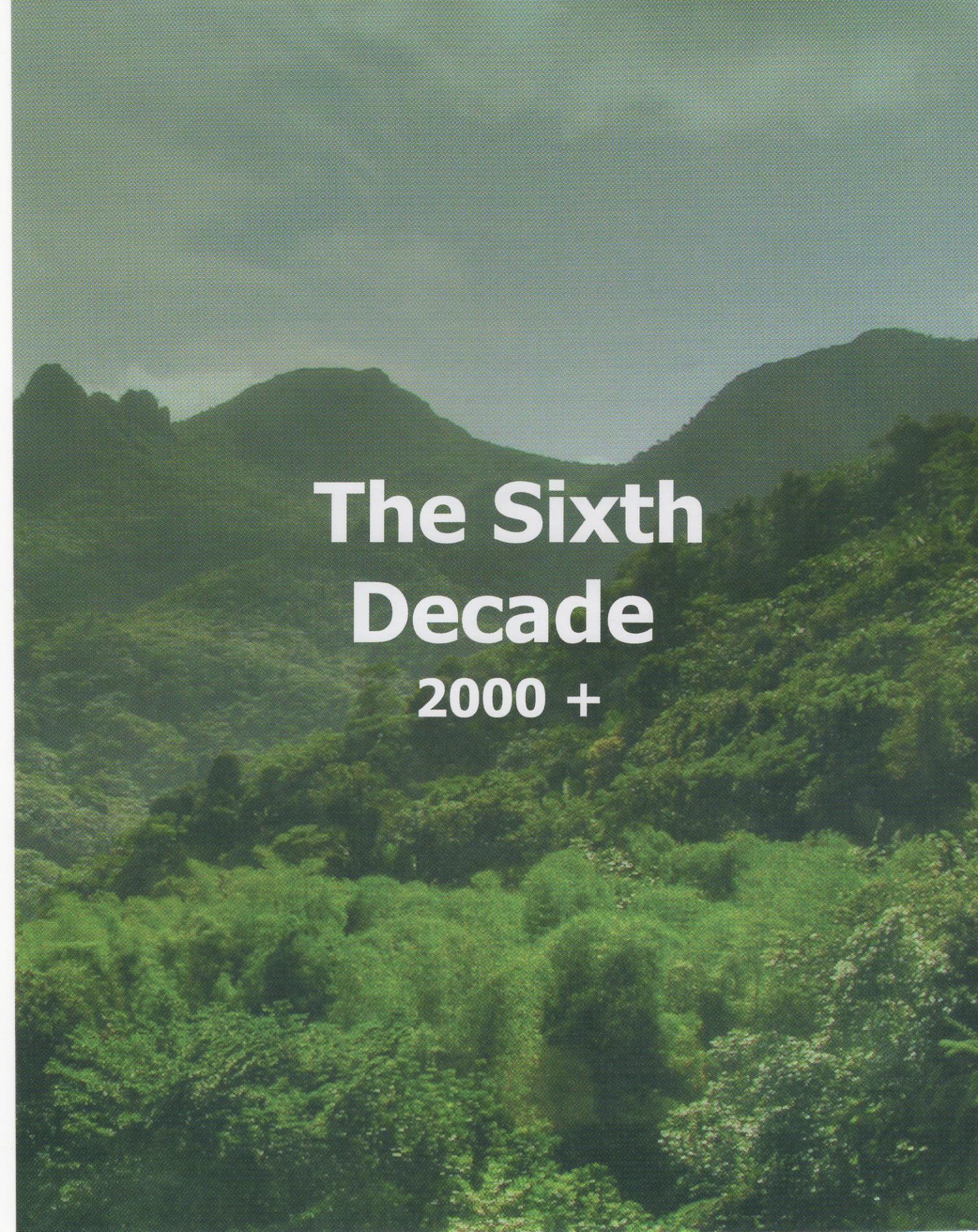
1989. Investigaciones dasonómicas en América Latina, su estado y necesidades, Mérida, Venezuela

1990. Sustainable forest management for the hill dipterocarps of Sarawak. Kuching.

1990. Recommendations for reorganization of the USAID Tropical Forestry Program. Panama City.
1991. Plan for the sustainability of the fiber resources in the Carib watershed in Dominica. Roseau.
1992. Workshops of the Silvicultural Study Group of the FAO North American Forestry Commission. Rome
1992. Application of Asian and African silvicultural systems to naturally regenerated forests of the neotropics. In F. Mergen and J.V. Vincent, editors, Natural management of tropical moist forests: silvicultural and management prospects of sustained utilization. Yale School of Forestry and Environmental Studies, New Haven, Connecticut. P. 93-111.
1996. Comment on Mankote mangrove needs. Castries
1997. La silvicultura ecológica, practicas que protegen el ambiente y a la vez favorezcan la sostenibilidad, Chapingo, Mexico
1997. Aspectos críticos para la práctica silvicultural en los bosques naturales de América Latina. Pucallpa, Peru
1998. Report on Bolivia management plan and silviculture. La Paz.
1998. Algunas potencialidades de los bosques latifoliados de Honduras. Rio Piedras.
1998. I. D. Hutchinson & F. Wadsworth. Efectos de la liberación en los bosques secundarios de Costa Rica. Recursos Naturales y Ambientales 46:155-160.
1999. Montane forest management in the insular Caribbean. USDA Forest Service, International Institute of Tropical Forestry, Rio Piedras.
1999. St Lucia trip report. Rio Piedras.
1999. Some observations on forestry in the Caribbean and Dominica. Roseau.

Additional foresters consulted

N.R.de Graaf, H. de Irmay, R.R.B. Leakey, N.Silva, J.K. Vanclay, J. C. Westoby, J. Zweede.

A photograph of a lush green forest covering a valley, with mountains in the background. The text is overlaid on the image.

The Sixth Decade

2000 +

Forest research

Significantly different frequencies of 12 timber tree species in topography on the Luquillo Mountains, reported earlier, was seen to vary by species, suggesting new possible sources of unexplained local growth differences.

Confirmation of the relation to tree growth rates is still pending.

Selected forestry publications

2000. Producción forestal para América tropical. USDA Forest Service International Institute of Tropical Forestry. Manual de Agricultura 710S

603p.

2006. And J. C. Zweede, Liberation, acceptable production of tropical forest timber. *Forest Ecology and Management* 233:45-53

2008. And E. Gonzalez, Sustained mahogany (*Swietenia macrophylla*) plantation heartwood increment. *Forest Ecology and Management* 255:320-323

2008. Growth of *Pinus caribaea hondurensis* relative to spacing and trunk diameter on two soils in Puerto Rico. *Caribbean Journal of Science* 44:236-241

2010. And B. Bryan and J. C. Figueroa-Colón, Cutover tropical forest productivity potential merits assessment. *Bois et Forêts des Tropiques* 305:33-41

Relations with Puerto Rico

At the request of the Tourism Company, I provided counsel regarding the natural features of the island attractive to tourists.

Dr. José Mari Mutt, of the Mayaguez University of Puerto Rico recorded electronically a long illustrated general report I had prepared, "Los bosques y el uso de madera en Puerto Rico", available at

<<http://www.edicionesdigitales.info/biblioteca/Wadsworth2012.pdf>>

I donated to the library of the International Institute of Tropical Forestry of more than 2,000 photographic slides covering personal forestry activities throughout much of the tropics.

Knowledge of trees in the forest does not an urban forester make. It is true that when requested by Dr. Ricardo Alegría my recommendation of guayacán (*Guaiaicum*

officinale) for the San Juan Plaza was the right tree. However, at a meeting of the Garden Club where I was asked for good trees for the city, every tree I recommended was subject to criticisms from the audience. The native moca (*Andira inermis*) I recommended for parkways in front of houses grew very well but because it is deciduous, dropping all its leaves at once,

the neighbors do not like it. Worse still, for a shade tree for a big university parking area, my selection, the most attractive tree of the limestone hills, ucar (*Bucida buceras*), grew beautifully but is no longer there because tannin from its fruits puts a persistent stain on vehicles.

Frustrated Visions

Develop in the schools a generation of Forest Guardians as follows:

1. See a forested watershed, waterfall, river, and reservoir
2. See water collection, storage, and treatment before and after use
3. Attend 3 lectures on forests, forest values, and conservation
4. Visit a forest ecosystem, day and night, and during rain
5. Write a theme on a favorite species of forest tree or animal
6. Undertake a guided brief experiment in a forest ecosystem
7. Take a family picnic in a forest
8. Tell experiences, receive identification and recognition

Tourism support of forests

Treat nature as supplementary, not adversary to traditional tourism

Recognize the greater numbers and repeaters of intrinsic family tourism

Present Yokahú as an environmental base for Puerto Ricans and tourists

Support more paradors with access to attractive forests

Offer management counsel, marketing

Give credit for quality air, water, and sewage disposal

Boy Scouts of America

Millions for camp improvement. With the support of friend Scouter Rene Colón whose son Carlos was the Administrator of the Tobacco Industry indemnification funding that came to Puerto Rico, I obtained a large commitment for camp improvement. With engineering estimates and Council President Bertram Finn we requested and obtained \$7.7 million. Camp Board Member Maria Molinelli and I were instrumental in prioritizing initial use of nearly a million dollars of the funds for the acquisition of lands acquired by the Scout Executive, rounding out camp land ownership.

The Nature Team at camp has grown to 12 members, including very effective young women, and has been provided a constructed lodge. In 2002, after 50 years, I discontinued training the Team. I authored and made available to the Nature Team copies of a 140-page Manual de Naturaleza (in Spanish) with all of the up-to-date Boy Scout advancement requirements and how to complete them, from cubs to second and first class and the following merit badges: astronomy, bird study, environmental science, forestry, insect life, nature, reptile study, soil and water conservation, and weather. Training of the Team was taken over by professionals, including foresters Edgardo Gonzalez and Jeffrey Glogiewicz, and Geographer Eliezer Nieves. Many members are repeaters and become trainers. Several of the former members are employed in related work.

We (and Edgardo Gonzalez) summarized and interpreted the 25-year Nature Team mahogany growth data from camp and had a paper accepted by a refereed scientific journal, showing that not only heartwood but heartwood increment even after 70 years, continues to increase. The paper is cited below.

I prepared a 114-page guide to Mona Island and contributed 4,000 printed copies to the Council to forestall threatened discontinuation of Scout use of the island's excellence for youth development after the death of a Scout who, unlike the adults involved, followed all the rules of safety he had been taught.

After two years of unsuccessful proposals to the Council I obtained intensive, on-the-site US Environmental Protection Agency review and requirements for the correction of a violation of pollution by the camp of a reservoir destined for human consumption.

Natural History Society

After years of searching I located an agreeable site for the Nature Center I thought the Society should have. Containing almost 100 acres in a limestone forest on the edge of Bayamon accessible to nearly 200,000 school children, the Park Service of the State Government conceded the use of the area and four abandoned military bunkers. The Society developed it as the Centro Ambiental Santa Ana for the public exploration of the forest. The first year I obtained two guides from the Nature Team financed by Fernando Lloveras, Director of the Conservation Trust. A three-hour program in the woods is offered. To assist the guides of the Centro I prepared a 100-

page manual of the different natural features to present. In 6 years more than 20,000 students have been processed, some at night. Currently the Interamerican University, that finances the guides, is beginning to use the area for research that will support the student's visitations

International Forestry

Generation of the ISTF News continued until 2012, to the end of funding from the International Institute of Tropical Forestry. This ended 58 years of my enjoyable editorial work, first on the Caribbean Forester from 1940 to 1964 and then the ISTF News from 1978 to 2012. A disk with all the ISTF reports is available at the library of the Institute. In all this period of shortening and summarizing documents I have received no complaints from authors, possibly because they were glad to get the publicity.

Forests and forestry studied elsewhere

In Mexico I made further studies of forest regeneration on abandoned agricultural lands (like those in Puerto Rico) with mahogany and other native tree species. In Costa Rica I interacted with CATIE and Universidad de Heredia students in silvicultural discussions and research proposals, using Puerto Rico experience.

Forest study reports

2001. Not just reduced but productive logging impacts. *International Forestry Review* 3:51-53.

2002. And C. M. Eckelmann. Field manual, a practical approach to secondary forest management on small Caribbean islands. USDA Forest Service, International Institute of Tropical Forestry and UNDP FAO Office for the Caribbean.



Retirement

2000+

Looking Back

Looking back over the island that I came to know the following are those natural features that most impressed me. I hope they can be preserved:

Cabo Rojo; Caja de Muertos; Caño Tiburones; the Forest of Pterocarpus Maní; Cabo Norte; Canyon de San Cristobal; Convento; El Faro; Monte Pirata; Rio Guajataca; Rio Tanamá; Bajura de los Cerezos; Bahía Fosforescente; Caverna del Camuy; Cueva Lirio; Laguna Cartagena; La Peña; Piedra Escrita; Punta Yegua; Sierra Bermeja; The following in the Public Forests: Aguirre: Josefa Black Mangrove; Mar Negro; Cayos de Barca; Boqueron: Las Concheras; Cambalache: Cueva de las Golondrinas; Carite: Pico Honore; Charca Azul; Ceiba: Macho Mangle; El Yunque: Baño de Oro; El Cacique; Rio Espiritu Santo; Rio Mameyes; Valley of the Giants; La Hueca; El Verde; Guajataca: Cueva del Viento; Guanica: El Tamarindo; Las Cobanitas; Guilarte: Pico Guilarte; Maricao: Rio Maricao; Descanso; Rio Abajo: Infierno; Calichoza; Quebrada de los Puercos; San Juan: Islote de Juan Perez, Terraplen; Susua: Rio Loco; Toro Negro: Cerro Punta; Pico Doña Juana; Lago Guineo.

Affiliations

I may be introverted but believed in mutual action toward conservation. I have belonged or belong to the Les Voyageurs of the University of Michigan, the International Society of Tropical Foresters, the Society of American Foresters, American Forests, the Forest History Society of the United States, the Caribbean Conservation Association, the Island Resources Foundation, the Conservation Trust of Puerto Rico, the Natural History Society of Puerto Rico, the Puerto Rico Council and the Overseas

Arrowman Association of the Boy Scouts of America, Official Volunteer Service to the International Institute of Tropical Forestry of the Forest Service of the United States of America, and the National Association of Forest Service Retirees.

Family Situation

After 43 years together, in 1983 I lost to asthma my remarkable wife, Peggy, an avid church-goer and from birth adjusted to the impacts of



Margaret Pearson (Peggy)

forestry on family life. Despite my frequent and lengthy absences she supported me and brought through two sons that became interested in nature. For her leadership in the opposition to coal-fired energy production in Mayagüez and her proof of prospective contamination of the Mar Negro mangrove from effluent from the Aguirre atomic power proposal she was honored by the United States Environmental



Isabel Colorado Laguna

Protection Agency. Our younger son, while at 32 still living by the golden rule, we lost to cancer. He received a master's degree in biology posthumously from the University of Puerto Rico. Our older son, Robert, earned a forestry Phd in the dynamics of the El Yunque forest, and had Peace Corps experience in Chile, where he married Jo, from Michigan. The two of them have completed careers with the Department of Natural Resources of the State of Washington, with son and daughter in marine biology.

During the solitary period following Peggy's passing I attained another impression of Puerto Rican quality, a young local forester from Caguas, Jeffrey Glogiewicz, came to live with me. We had much in common.

About a year later I married Isabel Colorado Laguna (Isabelita), a highly religious person who also had lost her spouse. She, with four jobs at that time, three daughters not through school, and a growing social agenda, with minimal assistance from me has done proud with her Puerto Rico. While managing a 200-acre (40-ha) spread near Yabucoa with 2 hours daily in travel time, raising cattle and plantains commercially and sustainably, she saw her daughters through universities. She planted fruit trees, and together we planted pines, teak, and eucalyptus. From there she intensified with a six-acre (2.2 ha) farm with fruit trees, heliconias, bromeliads, and other ornamentals that has become a beauty spot. In addition to all this, Isabel's care, reflecting 14 years in a medical environment, has extended my life more than a decade beyond that of my family. Her daughters: Clara, Sylvia, and Isabel, after they overcame my oddest idiosyncrasies, have accepted me and shown me love. Despite an unforgettable loss of Paquito, I have been very fortunate.

A Viewpoint on Forestry for Puerto Rico

Forests returned painlessly to the mountains

Forests are now visibly key to freshwater

Acceptance of forests is now de facto

All native tree species are still here

These are prospects for forestry.

Some goals for future foresters:

General

Keep abreast of relevant forestry progress and technology elsewhere

Preserve somewhere the complete variety of mature native forests

Exploit the outspoken love of Puerto Rico for forest appreciation

Expose school students repeatedly to forests and their benefits

Harmonize forest conservation and economic development

Specifics

Claim for forests rural lands unsuited or for sustainable agriculture

Increase government incentives for private forests above reservoirs

Increase watershed coverage of public forests

Introduce into public forests native tree species now not therein

Increase trees that support wildlife

Utilize wood sustainably for artisans, furniture, structures, charcoal

**From the Arrow I received self-confidence,
From forestry and the Service, I saw potentials,
And from Puerto Rico what and how to approach.**

Companions generated the following encouragement:

The forestry profession

USDA Forest Service

Research Forester

Superior Service Award (2)

Bernhard Fernow Award for foreign forestry service

Chief's Award for New Century of Service

Emeritus Scientist, International Institute of Tropical Forestry

Renewable Natural Resources Foundation

Sustained Achievement

Society of American Foresters

Fellow

University of Michigan

Member of Les Voyageurs and Sigma Xi.

New York State College of Forestry and Environmental Sciences

Doctor honoris causa

Puerto Rico

Universidad de Puerto Rico, Mayaguez Campus

Doctor honoris causa

Universidad de Puerto Rico, Cayey Campus

Doctor honoris causa

Universidad de Sagrado Corazón, San Juan

Doctor honoris causa

Boy Scouts of America

Chicago

Lone Scout to Eagle Scout

Ordeal Member, Order of the Arrow

Puerto Rico

Cub master and Scoutmaster

Yokahu Lodge Order of the Arrow Founder

Brother and Vigil Member, Order of the Arrow

Distinguished Member, Order of the Arrow

Silver Elephant, the Overseas Order of the Arrow

Silver Beaver

Chairman, Council Camping Committee

Northeastern Region, New York

Hero

National Council

Hornaday Award

Puerto Rico Natural History Society

Member Emeritus

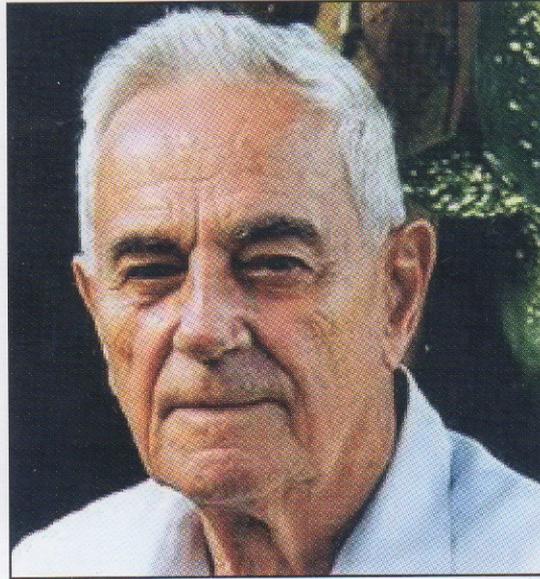
International

UN, FAO, Latin American Forestry Commission

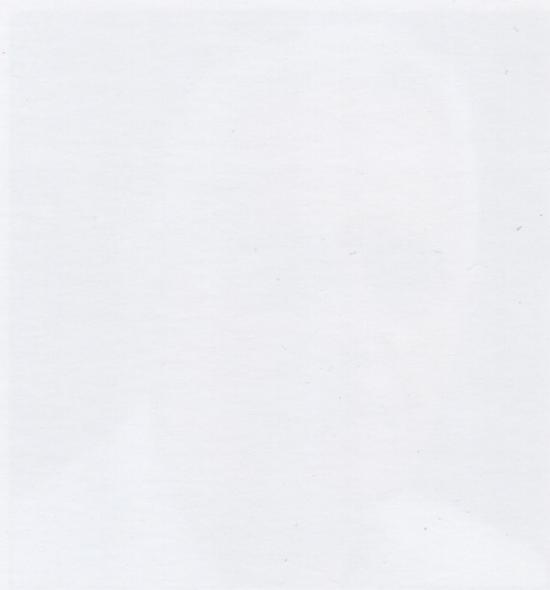
Six-year Chairman, Regional Committee on Forest Research

Centro Agronómico Tropical de Investigación y Enseñanza, Costa Rica

Doctor, honoris causa



¡Muy agradecido!



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