Creation of the Pitayal, Sonora Biological Reserves
A chronology of protecting a forest in Mexico

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Tucson Cactus and Succulent Society, to my great delight, has undertaken the financial responsibility for perpetuation of the Coteco Biological Reserves in the Masaica Indigenous Community of southern Sonora, Mexico. The reserves, one of about 63 acres, the other of roughly 500 acres, are situated on the coastal plain on lands under the control of Mayos of the Masiaca community. To place the reserves in a contemporary perspective, I will recount the history of their establishment.

In 1993 I began ethnobotanical field work in southern Sonora, some of it accompanied by plant ecologist Tom Van Devender. I chose the region because I was somewhat familiar with it from its arts and crafts, which I had imported in the 1960s. I had also discovered that while I was studying the role of useful plants, the scattered villages of Mayo people provided me with a wide reservoir of traditional knowledge. Mayos, close relative of Yaquis, live in small towns widely dispersed throughout the region and have never achieved a regional political structure. Yaquis have a rather tight communal structure, and outsiders must first obtain permission from tribal leaders before undertaking any inquiries, and such requests are often delayed or denied. No such formalities exist among Mayo villages, so it was easier to visit villages, ask around to determine who in the area was knowledgeable about plants and Mayo culture, and engage their services, than was the case in Yaqui country.

Knowledgeable Mayos were quite willing to travel into the bush and to name and describe plants and their uses. One of the first places I visited with Mayo consultants was a section of the broad coastal plain that lies between the steep and highly dissected slopes of the Sierra Madre Occidental to the east, and the Gulf of California to the west. This strip was home to a peculiar vegetation, as I had discovered through collaboration with Mexican and U.S. researchers. My Sonoran colleague Alberto Búrquez and I, along with others, came to label this vegetation *coastal thornscrub.* It is decidedly cactus-rich. It differs considerably from tropical deciduous forest characteristic of the hill and mountain country to the east and south, and also from Sonoran Desert scrub to the north. This thornscrub occupies a strip of land seldom more than 15 kilometers wide ranging from just south of Guaymas, Sonora, into northern Sinaloa, a distance of perhaps 250 kilometers. Much of the area is quite flat and consists of ancient delta soils deposited by the Mayo River and several smaller arroyos. The soils over portions of the land are high in expanding clays and are rather poorly drained, meaning that during rains, portions of them turn into quagmire. Most of the area has been cleared and converted to farmland, exploited heavily by huge corporate farms for whom ecological considerations are a nuisance.

The area of coastal thornscrub most notable for its cactus forests—and the Pitayal—lies west of Mexico Highway 15 between Navojoa, Sonora, and the Sinaloan state line. Until the 1970s it was

mostly untouched except for livestock grazing, but with the construction of the new Huites Dam on the Fuerte River in Sinaloa and the promise of irrigation water from the government, those in charge of the various parcels of land ordered huge chunks bulldozed and planted, thereby eliminating a large percentage of the Pitayal. Significant portions of coastal thornsrcrub remained, however, protected by three Mayo indigenous communities—Agiabampo, Camahuiroa, and Masiaca. They are noteworthy for the extraordinary growth of cacti, especially organ pipes (*Stenocereus thurberi*), called *pitayo* in Spanish, which seem to have claimed much of the coast as their chosen land. In some areas their numbers were overwhelming and presented a vegetation landscape so densely populated with columnar cacti, that one could easily become lost wandering only a hundred meters from a roadway. Since I first visited the area to conduct studies, the densest groves, those growing on a large tract near Agiabampo, have fallen to the agribusiness bulldozers.

Figure 1 Overview of Pitayos

In another case more than 1000 acres near the coast were bladed of all vegetation in preparation for construction of a shrimp farm. It never got off the ground and that massive scar today is bare of trees, sporting only low monotonous, shrubbery. Perhaps most insidious of all, the state and national governments in the last decade have encouraged *comuneros* (members of the indigenous community) to clear land and sow African buffelgrass (Cenchrus ciliare) as a means of improving carrying capacity for

cattle. The thickest population of cacti now survives near the Mayo village of Coteco, roughly 10 km from the coast. Following the lead of Mayos, we came to call the vegetation Pitayal, or place with an inordinate number of pitayos.

In addition to the organ pipes, the Pitayal abounds with a wide variety of plants— at least 503 species as identified in the late 1990s—grasses, herbs, shrubs, and trees, many of them spiny or thorny. The most noticeable include the columnar cactus *etcho* (Pachycereus pecten-aboriginum) and at least a dozen additional species of cacti, including the primitive leaf-bearing cactus Pereskiopsis porteri and Herrera's barrel cactus (Ferocactus herrerae). Also abundant are a dozen or so tropical tree species

Figure 2 Mammillaria bocensis

including the *guayacán* (Guaiacum coulteri), *saituna* (Ziziphus amole), endemics *jito* (Forchhammeria watsonii) and *jócona* (Havardia sonorae), *jaboncillo* (Fouquieria diguetii, F. macdougalii), *mesquite*

(Prosopis glandulosa), *papelío* (Jatropha cordata), *pasio* (Maytenus phyllanthoides), palo chino (Havardia mexicanum), *San juanico* (Jacquinia macrocarpa), and several others. Lining the infrequent watercourses (nearly always dry) are an additional wide variety of tropical and neotropical trees and shrubs. Why the pitayos have proliferated in the region is not apparent. Organ pipes are common in the lower elevations of Sonora and throughout southern Baja California, and are well represented in the canyon country of southwest Chihuahua, but nowhere are the numbers so vast as in the Pitayal--densities in excess of 600 mature plants per hectare are not unusual. The flatness of the coastal plain and the volcanic origin of the soils (high in clays) often results in poor runoff, meaning that during the

Figure 3 Pitayos and Guayacáns

infrequent periods of heavy rain the earth in places becomes a quagmire of almost indescribable gooey tenacity. The organ pipes appear to revel in that gumbo or in nearby soils with somewhat higher percentage of sand.

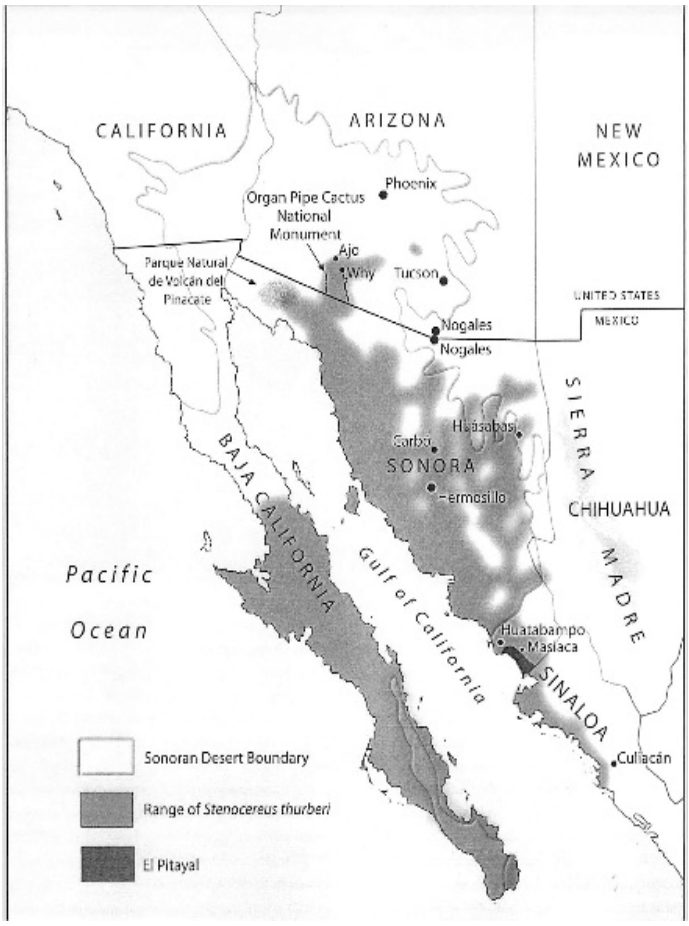
Pitayos are not only abundant in the area, but are of incomparable value to humans as well. They are clearly the most important plant for the Mayos, who have inhabited the region for more than a thousand years. Hundreds of Mayos harvest the fruits, which are sweet and tasty, in July, August, and September, both for domestic consumption (residents of the region consume a dozen or so per day) and

for sale in local and regional markets. The wood from the dried branches and the base is the basic source of fencing and roofing lumber. The flesh is made into a variety of medicinal remedies. Without the pitayo, the culture of the Sonoran Mayos would be different, indeed.

Figure 4 In the Reserve.

This was the area that I happened upon in 1993, guided by a close Mayo friend named Vicente Tajia. In addition to describing the natural history of the pitayo, Vicente provided me with the names and uses of the numerous plant species, and I dutifully jotted down his comments in my notebook. I returned from that experience convinced that the Pitayal was one of the world's great forests, a place unlike any other on Earth. Over the next few years several groups of outsiders came to visit the forest. Their response was universally one of wonderment. Walking through the groves one appears adrift in a sea of huge cactus arms, most of them reaching heavenward, but many reaching every which way. Because the Pitayal is situated on a coastal plain, no landmarks orient the visitor, and one is easily lost in a sea of great cactus branches. In the early morning or late afternoon sun, the thousands of many-armed cacti and the shadows cast by their myriad arms produces a dizzying effect. After a few walks through the forest, I concluded that as much of the Pitayal as possible should be protected, if only for esthetic

reasons. As I became more familiar with it, its plant diversity produced equal wonder in my brain and made an equal claim for protection.



I was at a loss as to how to begin to protect the Pitayal. All the lands there are communally owned, that is, included in Mayo Indigenous Communities. Under Mexico's laws of agrarian reform, outsiders may not own or occupy land within indigenous communities, and members, called *comuneros*, cannot legally *own* the land, so purchasing tracts is out of the question. As unusual as the vegetation is, the land has no charismatic species that cry out for protection that attract the attention of international conservation organizations. Working against protection of the resource is the historic fact that Mexico's constitution and laws work strongly against protected areas.

Conserving natural areas in Mexico is a far cry from establishing similar protected areas in the United States. In this country, in addition to numerous private parks and preserves, we have abundant public land, wilderness areas, national and state parks and monuments, trails, national, state, and local

wildlife refuges, and various primitive areas, all with some sort of limitations on usage and protection against unauthorized use. We have a strong national support for preservation of lands in their (more-or-less) natural state and (usually) trained rangers to (in varying degrees) enforce park protection. Mexico not only has nothing comparable, but also shares in the ancient Iberian ethos that non-exploitation of land for personal gain is irrational. Mexico's constitution provides remedies for taking over lands that are not put to productive use (*terrenos baldíos*). So profound is the ancient connection between livestock use and wealth, (the Spanish term for livestock—*ganado*—is the participle of the verb *ganar*—to win or gain) that excluding livestock from land with available forage is virtually unthinkable, sort of like beating oneself over the head. Lands not used for "human benefit" are subject to "invasion" by squatters.

In keeping with this ethos of almost compulsory exploitation, all non-urban lands in Mexico are grazed; most are overgrazed. The lands of the Pitayal are no different. They are all overgrazed, so much so that all or nearly all native perennial grasses have disappeared and cows and goats rely instead on shrubs (including cactus) and annual herbs for forage. Only after heavy rains do grasses appear and these are primarily annuals. Any functioning reserve would require fencing to allow re-germination of plants virtually eliminated by decades of grazing.

Most *comuneros* share the perception, widely entertained in Mexico, that cleared land is more attractive (and valuable) than naturally vegetated land. Parcels bulldozed of all vegetation are widely viewed as *limpio* (clean) and more attractive than those still cluttered with native plants. Nature must be conquered for value to be created. Even a parcel with no apparent use is widely considered more valuable in a denuded state than natural. How could this cultural supposition be overcome and local people convinced that the land would be more valuable to them in its natural state? The revenues from ecotourism might one day convince residents otherwise, but in the meantime the common assumption was that for lands to be valuable, they must be mechanically altered.

Even more daunting, however, was the fact that most of the indigenous people of the region are desperately poor. Unemployment is very high and permanent employment is almost unknown. Few houses have running water, and even fewer have easy access to their own motor vehicle. Transportation by public bus, bicycle or beast-drawn cart is still the rule. The loss of any grazing land would mean an immediate loss of desperately needed money. Consequently, any strategy for preserving lands would have to include a provision guaranteeing that local users did not suffer an economic loss by creation of a

preserve. Even more important, local people would need convincing that the ongoing existence of a preserve was to their advantage.

I was fortunate to have known Vicente. His family for several generations had lived within the Masiaca community and he was a close friend right up until his death in 2015. He knew the Pitayal well and over the years together we hiked miles of paths through it. He understood my desire to see it protected from the bulldozer and from bovine imperialism as well. He articulated well to other Mayos the benefits of a preserve: a haven for deer (which Mayos value above all wildlife), a place where baby pitayos could grow and not be trampled, an assured reservoir of pitaya fruits, a place where controlled research on plant growth could be undertaken, a place that children would respect as "natural," and so on. Vicente was an uneducated but eloquent Mayo-speaking spokesperson for a reserve.

He turned out to be a tremendously valuable political ally as well. Federal law permitted groups of *comuneros* to form *sociedades* ("societies") to exploit natural resources within the confines of the community for their mutual benefit. Vicente's society (Sociedad General Román Yocupicio) was allocated some 1200 ha. (about 3000 acres) in the heart of the Pitayal, which they used exclusively for grazing cattle. He suggested that I might rent some land from the sociedad, fence it, and ask the *socios* (members) to protect it. Following his suggestions, I held several meetings with the socios, usually accompanied by colleagues. I suggested that with their permission I would raise funds to build the fence to protect 25 ha (63 acres) and to compensate them for the loss of grazing. They would be encouraged to gather pitaya fruits and wild edible plant products, but not firewood. With Vicente's help, I explained the rationale. I also had assistance from Sonoran ecologist Alberto Búrquez, researcher from Mexico's National Autonomous University, who helped explain the rationale of the reserve to the socios. Alberto had already begun to conduct research on the growth and development of pitayos and hoped to use the reserve as a control.

The socios readily accepted the proposal, probably due in large part to Vicente's strong endorsement. From their standpoint they had nothing to lose. They would gain a well-built fence (probably worth $5,000 U.S.), receive rent money in return for non-use, and have the distinction of being owners of the only protected reserve in the region. For funding I approached the Tucson Audubon Society, the Wallace Research Foundation, and the Melody S. Robidoux Foundation. All three recognized the extraordinary natural values of the Pitayal and contributed funds for the fence. With funding in hand, I once again presented the proposal to the sociedad and the members voted permit the

creation of the reserve of 25 ha (63 acres). This was a small area, tiny by many standards but one extraordinarily rich in thornscrub plants and an ideal “pilot” protected area.

Vicente helped mark off 25 hectares. In June 2000, six members of the sociedad began building the fence—two kilometers long, five strands high—to keep livestock out of the new reserve. The reserve was close enough to where the workers lived that they could easily walk or bicycle to work from the village of Coteco, about 4 km distant.

The fence took three months to build. There were several glitches. I had suggested metal fence

Figure 5 Example protective perimeter fence

posts, which would be both cheaper and environmentally more benign than wooden fence posts that would require the sacrifice of trees. The socios vetoed that idea at the outset. Metal fenceposts were easy to pull out, they warned, and they would be stolen almost at once, the wire rolled up and pilfered at the same time. No, they needed hardwood posts. These had to be hauled from the foothills twenty miles away and at considerable cost. The posts are heavy—roughly 25 pounds apiece, and all 900 had to be carried and laid at their appropriate postholes. To construct the fence, it was necessary first to clear a *brecha*—a fence line roughly 7 feet (2m) wide[1], requiring felling a depressing number of trees. But without the fence, protecting the reserve would be impossible. Some of the workers did not want to labor in the intense heat, so work was suspended at times during the pounding heat of July and August when temperatures uniformly exceeded 38°C (100°F) and 70% humidity. Under that heat stress the physically demanding digging of holes and driving posts was nearly physically impossible. Rain also caused some delays, more from the thick, gummy mud it produced than from the inconvenience.

In spite of the holdups and inevitable cost overruns, the fence was finally completed in early September. The socios agreed to be paid $8,000 Mexican Pesos ($880 U.S.) a year for "rent," i.e., for compensation to them for lost grazing potential. They understood clearly that in order to receive the annual payment they would have to keep livestock out. I understood clearly that in order to perpetuate the reserve, the payment would have to be made on time. It seemed an equitable agreement.

Within a month someone cut through the fence. Socios believed it was done by a disgruntled cowboy from a nearby village accustomed to using a route that ran through the reserve and resentful about having to change his travel plans. They repaired the break and installed a gate and a professionally made sign at the location of the cut. It was promptly stolen, apparently because it contained valuable sheet metal. Another was installed with heavy screws and posts. The sign announced that this was the Coteco Biological Reserve, a joint project of the Sociedad Gral. Román Yocupicio and Tucson Audubon Society. Before long graffiti were scratched in the sign, crudely denouncing the reserve as a sellout to outsiders. It still stands, though mutilated and nearly unreadable. To date, however, there have been no further intrusions. The vegetation is gradually recovering from overgrazing. Inside the reserve the *monte* is enchanting.

Shortly after the completion of the Coteco Reserve, Vicente was approached by socios of a different society (Zacate Blanco), who had authority over the adjacent parcel, parts of which had even denser growth of pitayos. The socios had learned of the reserve and wondered if I would be interested in

[1] The thornscrub is dense and spiny. It would be impossible to construct a fence without clearing a space in which to work

creating another reserve of 100 hectares (247 acres, ultimately 200 ha—about 500 acres) under roughly the same terms as the first. I was, indeed, but knew that this would be a greater challenge, for the costs of building the fence would be more than $15,000.

In November 2000 leaders of two Arizona philanthropic foundations accompanied me to the Pitayal. They were stunned with its beauty and diversity and agreed to fund the construction of the fence. Establishing a second reserve would be much easier than the first, I thought. I was wrong.

I met several times with members of the Sociedad Zacate Blanco, describing the goals of the reserve. They agreed to accept $30,000 pesos, roughly $3,300 U.S. as an annual payment in lieu of grazing. I would supply the funding for the fence—materials and labor, and they would construct the fence. The workers would all be members of the sociedad, so constructing the fence would directly benefit them with several months of employment.

This last provision was a most reasonable and important request, for construction of the fence would be a source of employment, but it would substantially increase the cost of the fence, since all of them lived in the hamlet of San José de Masiaca, some ten miles from the reserve. Each morning one of their members would load seven workers in his truck and bring them to the site, then take them home at night. He charged for the use of his truck, not an unreasonable amount, but still the total cost to the project for transporting the workers was about $1,500 U.S. The workers on the first reserve lived close enough to the project that they walked or bicycled to work.

Furthermore, the size of the new reserve, one kilometer by (as it turned out) two kilometers, was such that merely toting the fenceposts to their position on the fence was a major labor component. Carrying a 25-pound fence post a kilometer is no picnic, so the cumulative cost of delivering the posts—2,500 of them—was substantial, proportionally more than for the first reserve.

Building of the fence around the second reserve commenced in May 2001. Construction moved along, always costing more than projected. It took nearly a month to clear the *brecha* (fence line). The posts arrived and the more than 2,500 postholes were excavated. At some point in the project, one of the workers stole some 300 fence posts, worth $1.25 each. This theft presented a dilemma, for the materials had to be left unguarded at night in the wilderness of the Pitayal. The alternative was to hire a night watchman, but no one was willing to sit alone all night in the buggy solitude of the Pitayal. Furthermore, the budget did not include *vigilancia* (monitoring and guarding) This problem was never resolved. In spite of the theft, though, the high quality of the fence (it has lasted well) and the fact that the work was very hard and under hot conditions made it a bargain.

Getting the money from the United States to the workers and making sure that money was being appropriately spent required someone to oversee the operations. Unable to be present full time at the reserve site, I hired a young man from nearby Alamos to direct the project and two others taking place in the Pitayal. He was well educated and enjoyed a good reputation as an honest, knowledgeable administrator. I learned in late August, however, that handling the sizeable payroll had become too good a temptation for him: he had absconded with a month's payroll, and falsified numerous expense claims, pocketing about $6,000 U.S. The theft underlined an ongoing problem: an honest person with some administrative skills had to be present at all times to direct the operation, pay the bills, and keep the receipts. Most of the workers had only limited education (some are without reading and writing). In the end I asked Vicente, whose honesty is impeccable, to oversee the completion of the fence and I turned over to him the difficult task of making sure the workers were paid, the materials ordered and delivered, and the boundaries correct. This was asking a lot, for he never attended school and had to work out sums in his head. Fortunately, he did that well.

I visited the area mid-construction in late July 2001 and I walked the fence line with Vicente and several of the workers. They were justifiably proud of their work. At a point where the fence reached a corner, one of the leaders suggested that if I were to cover the cost of the additional fence, they would extend the boundaries to the extent that the size of the reserve would be doubled. They would ask no additional pay for the increment, they insisted. Once back in Tucson I checked with the donors and they agreed to fund the additional fence. I held my breath and gave the approval. The estimate for the completed fence was now more than $18,000 (plus the embezzled money, which I forked over).

By Fall 2001 the fence was completed, and a dandy fence it was, and still is. *Socios* patrol the reserves, at least sporadically, and have even replaced fence posts. They (supposedly) visit it once a month to make sure cows are not getting in (a couple of heifers have made it inside on occasion).

The intervening years have been marked by ongoing severe-to extreme drought, the same climatic phenomenon that has plagued the southwestern United States. All the vegetation in the Pitayal has suffered. Watercourses in the region have dried and some of the towns in the Pitayal have been at least partially abandoned as water supply dwindled or disappeared.

Figure 6 Nurse Plant and Pitayos.

Private water haulers now bring in tank trucks and sell it to residents at a price they can barely afford. Numerous old organ pipes have perished and recruitment of a new cohort within the reserves has been minimal, much to my bafflement. (Young organ pipes seem to emerge with equal likelihood inside and outside the reserves.) Outside the reserves, livestock has punished the landscape as the animals struggle to survive. During the intervening eighteen years, a student has completed a Ph.D. dissertation using the reserves as a research base. The vegetation has recovered from grazing, though some theft of firewood and destruction of cacti takes place. Notable growth among some cacti has been measured. Some large plants have died and their remains have become home to a variety of critters. The smaller reserve has become overgrown with vegetation to the extent that passing through it is difficult, a result I had hoped for. Patches of the larger reserve where no plants grew remain barren. Deer find refuge inside, though poachers have tried to follow them (deer are relentlessly persecuted, usually illegally, everywhere in Mexico.) The thicker vegetation provides refuge to all manner of creatures, especially rattlesnakes, which are always killed when spied, but now have a haven of admirable size.