

The Vegetation of Caye Caulker

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Introduction

Caye Caulker is an island in transition, from harboring a small population of fishermen to a large population operating guest houses, restaurants, and stores to support a lucrative tourism industry. An unavoidable effect of this urbanization was a degradation of natural ecosystems.

Since 2005 the authors have been making an inventory of the flora of Caye Caulker. This has resulted in a guide to the flora to help local citizens and tourists identify plants which grow on the island (Rietsema and Beveridge, 2010). We found about 270 different plant species, most of them native to Belize or Central and northern South America, but also a good many species are from other continents such as Asia, Africa and Australia.

In this paper the authors will describe what happened to plant habitats and diversity as an example of what one can expect when a human society interferes with and replaces the natural environment on a mangrove island.

Economic Development of Caye Caulker

About 50 years ago Caye Caulker was a small village of a few hundred people and the livelihood for most people was fishing. In the 19th and the early part of the 20th century coconut plantations (cocals) were a big part of the economic base. This enterprise was abandoned, although here and there some palm trees have survived. More lasting and of more importance was the discovery that Caye Caulker is an ideal place for tourists interested in snorkeling and scuba diving. Gradually the tourist industry replaced fishing as the main stay of the local economy and the population increased proportionally to 2,000 at present. With this increase in population and business, the existing forest was cut, houses were built and roads laid out. The result is a more densely populated village covering the northern half of the south island. An airstrip was installed on the widest part.

Geography of Caye Caulker

Caye Caulker is a small island located 2 km west of the Belize Barrier Reef about 20 km east of mainland Belize, about 30 km northeast of Belize City. It is 8 km long and at its widest point 2 km wide and at its narrowest only 400 m.

Some 195 to 140 million years ago the entire northeast of Belize was covered by a shallow sea (Mazzulo, 2004). Sediment was deposited which became limestone. Since then the sea level alternately rose and dropped exposing the sea floor to the elements causing the top layer of the limestone to break down to sand and clay. Since the last glaciated dry period that reached its maximum some 18,000 years ago, the sea gradually rose to its current level, leaving only the highest points as dry land creating islands such as Ambergris Caye, Caye Caulker, and Caye Chapel.

The highest point on Caye Caulker is 2.5 m above sea level, a sand ridge that remains dry except during exceedingly heavy storms when the tides become unusually high. When hurricanes hit the island even the highest points in the village may become flooded as happened during hurricane Keith in 2000.

Before 1961 when hurricane Hattie struck Belize, villagers had dug a narrow channel across the island on a narrow spot just north of the present village so boats could travel from one side of the island to the other without having to go around the ends. When hurricane Hattie struck, mangroves were destroyed, the fragile coast line broken, and a channel called the Split was the result, causing the creation of two islands, the north island and the south island. Each hurricane since then has increased the width of the Split, which today is about 70 m wide. Until recently the growth of the village was confined to the south island. Several houses have been built on the north island and a few people now live there and commute by boat to the south island. A cable was laid through the Split to the north island in 2011 to connect it to the electric system of the south island.

The climate is sub-tropical to tropical with four seasons. The average temperature is about 80 degrees. It rarely drops below 65. The summer rainy season from June through August is characterized by squalls from the east and the occasional tropical depression. It is followed by a short dry season called the “mauger” season from the Creole word for slim. The winter rains come along with cold fronts, called “northers” when the wind turns around to the north from October through January. The long dry season is usually from February until May. The hurricane season lasts from June until November, but September and October are the months when hurricanes are most likely in the western Caribbean. Caye Caulker has suffered several hurricanes that have had a severe impact on the coastal vegetation, such as, Hurricanes Hattie in 1961 and Keith in 2,000. Even when they do not directly hit Caye Caulker, any large hurricane anywhere in the Caribbean causes high tides and storm surges, such as, Hurricanes Mitch in 1998, Michelle in 2001, Ivan in 2004, Wilma in 2005, and Dean in 2008.

Although the island once was covered with a littoral forest, no more than a thin layer topsoil builds up on the sand, similar to most tropical forests. Organic matter breaks down rapidly and leaches during rainfall. The combined influence of the sea, the climate, and the thin layer of top soil on a sandy substrate makes it unsuitable for crops.

Ecosystems on Caye Caulker

Caye Caulker is a small island with a variety of ecosystems. Two are marine: the Belize Barrier Reef and the shallow lagoon between the reef and the mainland. The mangrove forest straddles the sea and the dry land; all other ecosystems are part of the solid land, including the coastal wetlands. Meerman and Sabido (2001) have mapped the ecosystems of Belize, but because Caye Caulker is so small compared to the country as a whole, their mapping of Caye Caulker is not entirely sufficient for our purposes. Besides an urban system (type 87), they recognized only two others, tropical littoral forest and beach communities (type 69) and tropical lowland, tall herbaceous swamp (type 71). We recognized the ecosystems listed below and matched them with the types described by Meerman and Sabido, bearing in mind that they are approximations and variations are common.

- 49 Mixed mangrove scrub
- 50 Coastal fringe *Rhizophora mangle*-dominated forest
- 58 Deciduous broad-leaved lowland disturbed shrubland,
- 66 Marine salt marsh with many succulent species.
- 69 Tropical littoral forest and beach communities
- 71 Tropical lowland, herbaceous swamp
- 87 Urban

The classification of ecosystems is based on the predominant plant cover: forests of various types, grasslands, and savannahs etc. The soil types and ground water level are important because together with the climate they determine the plant cover. Not only do these physical factors determine the type of plant cover, but they also affect all other aspects of the life in an ecosystem. Birds, lizards, amphibian, mammals, fishes, insects, bacteria and other forms of life are part of any particular ecosystem, but we have limited ourselves to the vegetation.

Caye Caulker south island

The northern half of the south island is urban (type 87). Almost all of the original littoral forest is gone. A few traces are left immediately north of the airstrip where the Caye Caulker Branch of the Belize Tourism Industry Association (CCBTIA) has the CCBTIA Mini-Reserve which protects two acres of more or less intact littoral forest serving as a reminder how it once was (type 69). There are small stretches of littoral forest between houses with selective clearing and planting of various ornamental and fruit trees. This area can be considered a degraded littoral forest. South of the airstrip along the east and southeast coast are large remnants of the littoral forest with some clearing for houses.

Along the west coast of the village the mangrove forest is spotty because of clearing and hurricane damage. West of Avenida Chechem a large area of swamp land has been cleared for a housing development, Bahia Puesto del Sol. The water table here is close to the surface and in the rainy season the land tends to be flooded. Small patches of swamp land remain with growth of wetland plants, herbaceous plants and shrubs such as *Salicornia*, *Batis* and *Typha* that tolerate the marsh with brackish water, and on the drier spots shrubs such as *Conocarpus erecta*, and *Crossopetalum rhacoma*.

North of the airstrip to the west of Bahia Puesto del Sol a wetland area remains where the dominant tree is the black mangrove (*Avicennia germinans*) and toward the sea is a red mangrove forest (*Rhizophora mangle*) (Types 49 and 50). South and along the airstrip a similar forest exists. Heavily damaged by Hurricane Keith in 2000, the black mangrove trees are slowly recovering.

In the center of the widest part of the Caye is a large, frequently flooded swampy area with white mangrove (*Laguncularia racemosa*) and buttonwood (*Conocarpus erecta*) as the dominant species. The shrubs are not taller than 2-3 m. The soil is clay and herbaceous growth is almost absent. It dries out in the long dry season but only for a couple of months. The water is fresh or brackish. This swamp is surrounded by higher dry land where the same shrubs grow much taller (a variation of type 49).

West and south of this woodland is a large grassy marsh area. Here we find a mixture of shrubs, herbs, sedges and grasses. Close to the shore shrubs are absent. Houses have been built close to the shore almost at the water's edge after sand was brought in to raise the land surface. As a result, the land became drier which led to a disturbance of the natural ecosystem (type 66). For instance *Salicornia* spp. and *Suaeda linearis* were replaced by *Batis maritima* and the grass *Distichlis spicata*. Hurricane Keith destroyed what was left of the black mangrove forest, but after 10 years these are recovering.

These systems cover small areas and are too small to be mapped on a national scale but they are real. They cause plants with different preferences to grow close to one another and often grow in places where they otherwise may not.

Caye Caulker north island

The north island is much longer than the south island, about 5 km of which almost half has been cleared for future housing. It is surrounded by a red mangrove forest, mostly a narrow fringe except on the southwest where it covers a wide area (about 500 by 200-500 m, type 50). Except for a few places where the forest has been cut to allow access, the mangrove forest is unbroken.

Inland on the higher and drier ridge that traverses the island like a spine, there used to be a littoral forest (type 69). It has been cut over a length of about 2 km. There land was given out as overflow housing for the village and roads were laid out. Some of the land has been cleared and a few homes have been constructed. On the cleared land a type of savannah grew back. Grasses, sedges and herbaceous plants now occupy the land. On the east side some trees have been left standing and there are some shrubs. This degraded ecosystem corresponds most closely to type 58, a disturbed broad-leaved leaf lowland shrubland. In time it will probably revert to forest unless building activity picks up when it will become an urban landscape.

The less disturbed northern half of Caye Caulker's north island, especially the 100-acre Caye Caulker Forest Reserve and immediately south of it, the land was once occupied by coconals which have been abandoned. The coconut palms that were left died because of disease or were blown over by a hurricane. A secondary littoral forest grew back much poorer in the number of species than probably was the original. We find *Ficus crassinervia*, *Laguncularia racemosa*, *Coco nucifera*, sedges and grasses on some open places with *Passiflora suberosa* and *Pluchea odorata* on the wetter areas. Interspersed in an irregular pattern are lagoons. The entire area is a mixture of different habitats. Perhaps it can best be described as a degraded littoral forest (type 69) mixed with patches of low land swamp (type 71).

Along the east coast are several areas of marine salt marsh with almost solid *Batis maritima*. It is flooded at high tides and often not protected by mangroves (type 66).

The Vegetation

Sea grass beds

The sea grass beds, although under water and not part of what grows on the land, nevertheless contribute to the total biomass of Caye Caulker. Daily dead leaves of manatee grass (*Syringodium filiforme*) and turtle grass (*Thalassia testudinum*) are washed ashore along the beach of the village and have to be removed regularly. As the common names imply, manatees, turtles and other sea animals feed on them. A large area of the sea has been declared as the Caye Caulker Marine Reserve to protect the reef and marine animals. Commercial, recreational, and scientific uses are managed by establishing zones and enforcing the regulations for each zone.

Coastal fringe *Rhizophora mangle*-dominated forest (type 50)

Red mangrove (*Rhizophora mangle*) grows both in the water and on a narrow strip of land with a profusion of stilt roots. A red mangrove forest surrounds Caye Caulker, except on the east side of the village where a large stretch has been removed to create a beach and easy access to the sea. Elsewhere small patches have been cut. The strong winds of Hurricane Keith came from the west, so the destruction to the mangroves on the west side of both the north and south islands is still evident, but when left alone the mangroves are slowly growing back.

Mixed mangrove scrub (type 49)

There are three other mangrove species. White mangrove (*Laguncularia racemosa*) grows on dry land next to the red mangrove without such stilt roots, but tolerates occasional flooding. On the dry land often, but not always, grows the so-called grey mangrove or buttonwood (*Conocarpus erecta*) which actually is not part of the mangrove system and frequently found elsewhere. The black mangrove (*Avicennia germinans*) grows in interior marshes with a water table near the surface that is often flooded, not along the coastal water line.

In the mangroves we find two epiphytes: the cowhorn orchid (*Myrmecophila* sp.) and a bromeliad (*Tillandsia streptophylla* sp.), but because of the difficulty of penetrating the dense mangrove forest they are seldom seen. The orchid grows in dense masses on the red mangrove branches, particularly close to interior lagoons.

Mangroves are an important barrier against heavy seas and winds. In the shallow water they are rich in animal life and a breeding ground for fish and other sea animals. A listing of species by Zisman (1992) shows the richness of the mangrove forests of fish, birds, reptiles and even amphibians. As Zisman points out, many of the observations may be of animals visiting or passing through, but not permanently living in the forest. Over 200 species of birds have been documented along the coast and in the mangroves (*James Beveridge, personal communication*). All are looking for food (insects, fruit, seeds, crustaceans) and move to where it is found. All of this diversity points to a web of dependencies.

Marine salt marsh with many succulent species (type 66)

The coastal wetlands on both the north and south islands are characterized by flooding in the rainy season when the tides are very high. The dominant plants are saltwort (*Batis maritima*), glass worts (*Salicornia bigelovii* and *Salicornia perennis*), and seepweed (*Suaeda linearis*). On the east side of the north island there are large stretches of almost exclusively saltwort. All these plants can be found at water level of salt or brackish water. Cattail (*Typha domingensis*) and saw grass (*Cladium jamaicense*) can be found here also, but are being reduced because of habitat loss. Bay cedar (*Suriana maritima*) used to be found on drier spots but has disappeared almost completely, except in a few gardens. All of these species are native.

One foreign species has been found on the east side of the village in a very wet grassy area: water hyssop (*Bacopa monnieri*) from the Far East.

Tropical tall lowland herbaceous swamp (type 71)

Some plants that grow on wet places, but not necessarily in coastal wetlands, are seaside oxeye (*Borrchia arborescens*), saltweed (*Blutaparon vermiculare*), sea rocket (*Cakile lanceolata*), seaside heliotrope (*Heliotropium curassavicum*), Christmas flower (*Rhabdadenia biflora*), verdolaga (*Sesuvium portulacastrum*), beach morning glory (*Ipomoea pes-caprae*) and sea lavender (*Tournefortia gnaphalodes*). The *Borrchia* appears to have been recently introduced as only one large shrub was found during the inventory period, but later several more appeared.

On the north island Santa Maria (*Pluchea odorata*) is common in wet grassy areas behind the saltwort marsh.

Tropical littoral forest and beach communities (type 69)

The littoral forest once covered the entire dry sand ridge of Caye Caulker, but most of it is gone today. This ridge runs from the southern end of the south island to the northern tip of the north island.

If we look at the Mini-Reserve as a representative example of a largely undisturbed littoral forest, we see a mixture of trees and shrubs characteristic of this ecosystem. There is little or no herbaceous undergrowth except on a few spots where sunlight can reach the floor. Among the outstanding trees are the gumbolimbo (*Bursera simaruba*), cocoplum (*Chrysobalanus icaco*), sea grape (*Coccoloba uvifera*), zericote (*Cordia sebestena*), fig (*Ficus crassinervia*), black poison wood (*Metopium brownei*), xo-coi (*Pithecellobium keyense*), and saltwater palmetto (*Thrinax radiata*).

The forest canopy is no more than 10 m high. No tree has a trunk diameter of more than 30 cm. This may point to a young forest or one where the big trees have been cut for timber. Villagers always have seen the forest as a resource, which may explain the scarcity of the palmetto, a tree with a long straight long stem which makes it suited for construction and other purposes. Most other trees are too small or too few to harvest.

Shrubs are mostly on places where sun light is admitted and here we find wild cherry (*Crossopetalum rhacoma*), golden creeper (*Ernodea littoralis*), black torch (*Erithalis fruticosa*), wild sage (*Lantana involucrata*), and potato tree (*Solanum donianum*).

A total of 16 species have been recorded for the Mini-Reserve. In tropical forests, trees of the same species are usually found at some distance from each other. Because the Mini-Reserve is so small, more species might be found in a much larger littoral forest. For instance, a fruit producing *Manilkara* was found in a nearby vacant lot.

The forest on the north island has fewer species, possibly because it is still young and secondary.

No ferns and mosses were seen anywhere on Caye Caulker. The sandy soil, sea wind and salt spray and the alternating dry and wet seasons may make it unsuitable for them.

Although a *Pouteria* grows in the Mini-Reserve, the tree is too small to produce fruit. To the south of the airstrip a very tall tree is still standing but it is difficult to reach and may or may not produce fruit. Zericote (*Cordia sebestena*) is found here and widely planted as an ornamental. The brilliant red flowers attract the local hummingbirds. In some areas on the north island it grows in quantity.

The fig trees are often planted, or at least not cut down, with some outstanding very old trees found on Avenida Chechem in front of the new high school. Figs are very common in the Caye Caulker Forest Reserve.

The cocoplum, called “*hicaco*” in Spanish, is abundant. The Spanish name for Caye Caulker is “Cayo Hicaco”.

Many birds, lizards, ants, termites, crabs, boa constrictors, and spiny-tailed iguanas were seen in the Mini-Reserve. Even in the small Mini-Reserve a slow walk allows one to see the diversity of life.

Urban (type 87)

The urban ecosystem is not a coherent system but a collection of habitats, mostly unconnected with each other and occurring in a densely settled area. The dominating animals are humans and their pets, mostly cats and dogs. Our activities are destructive of everything that is natural, which leads to an artificial environment for plants and animals.

The village of Caye Caulker is witness to this. Where two or even one decade ago there were still many vacant lots often undisturbed, now almost all are gone except in the thinly settled area north of the airstrip along Avenida Chechem and Avenida Mangle where some remnants of the littoral forest still remain. The rest of the village is built up and only gardens and yards are left. The amount of open space is greatly reduced. The plants we find in these areas for the most part have been planted with ornamental purpose. Where weeding has not been done, as along road sides and in the few vacant lots, herbaceous plants grow, plants we would not normally expect to find on the island. They are brought from the mainland either deliberately by villagers for their own use, accidentally by natural agents like wind and water, or as seeds attached to stuff.

The plants we find in the village are those that withstand the constant salt-laden sea wind from the east and the occasional north winds when a cold front passes, as well as the saltwater when floods happen or when roots penetrate deep enough below the surface to touch upon brackish groundwater. This limits the diversity because only “proven” plants occur. Once in a while a new type of plant is imported, such as, recently a number of potted plants with a species of the fish tail palm (*Caryota*). How well they will do on Caye Caulker remains to be seen.

Along the roads and on a few remaining but frequently cut and now fenced in properties and along the beaches dominant plants are the cloud berry (*Ageratum littorale*), tropical milkweed (*Asclepias curassavica*), shasta daisy (*Bidens pilosa*), claudiosa (*Capraria biflora*), several species of spurge (*Chamaysyce* sp.), beach pea (*Crotalaria verrucosa*) trefoil (*Desmodium tortuosum*), polly-red-head (*Hamelia patens*), spider lily (*Hymenocallis littoralis*), false primrose (*Ludwigia octovalvis*), snow square stem (*Melanthera nivea*), chanca piedra (*Phyllanthus* sp.) verdolaga (*Portulaca oleracea*), daisy (*Ridax procumbens*), blood berry (*Rivina humuilis*), chi chi be (*Sida acuta*), rabbit’s paw (*Sphagneticola trilobata*), clavo de oro (*Turnera ulmifolia*), *Ziziphus mauritiana* (an invasive shrub) and others. Almost all of these species are common on the mainland. All of them are native to the neotropics and neo-subtropics.

Besides these species listed above, a number of plants were found less frequently (Rietsema and Beveridge, 2010). A few are of foreign origin: yellow sweet pea (*Crotalaria retusa*) from Asia and Africa, yellow necklace (*Sophora tomentosa*) from the old world tropics (but common in Florida), wild cow pea (*Vigna luteola*) from Asia and Africa, but even these are common on the Belizean mainland.

In gardens and in backyards the composition of the flora is much different. Ornamental shrubs and trees and fruit trees are found here: the crinoline (*Acalypha amentacea*), aloe (*Aloe vera*), Norfolk island pine (*Araucaria heterophylla*), breadfruit (*Artocarpus altilis*), *Bougainvillea*, canna lily (*Canna x generalis*), Australian pine (*Casuarina equisetifolia*), garden croton (*Codiaeum variegatum*), ti plant (*Cordyline fruticosa*), *Cycas*, flamboyant (*Delonix regia*), hibiscus (*Hibiscus rosa-sinensis*), siempreviva (*Kalanchoe pinnata*), mango (*Mangifera indica*), even the banana (*Musa x paradisiaca*), Oleander (*Nerium oleander*), pandanus (*Pandanus* sp.), mother-in-law tongue (*Sansevieria hyacinthioides*), and many others.

A number of common shrubs and trees are from the neotropics such as *Agave* spp., angel’s trumpet (*Brugmansia suaveolens*), pride of Barbados (*Caesalpinia pulcherrima*), caimito (*Chrysophyllum cainito*), chaya (*Cnidoscolus chayamansa*), Surinam cherry (*Eugenia uniflora*), amapola (*Pseudobombax ellipticum*), guava (*Psidium guajava*), firecracker plant (*Russelia equisetiformis*), May and golden plums (*Spondias* spp.), mayflower tree (*Tabebuia rosea*), false oleander (*Thevetia peruviana*), and others. These fruit and ornamental trees form a mixed group. Some are from Asia, Africa and South America, others are widespread in South and Central America.

These plants probably did not grow in Caye Caulker before settlement, so we can say that the biodiversity of the island as a whole has increased, but at the expense of the native flora. It is questionable whether these foreign introduced plants would remain or would disappear if they were left alone and not taken care of. When foreign plants are introduced, the agents needed for pollination or their natural pests usually do not come along with them. Where such plants are dependent on certain insects or birds that are not on Caye Caulker, they may not be able to maintain a presence and over time would vanish. This almost certainly would be the case with introduced fig species that depend on specific wasps to produce seeds.

In conclusion, the dense settlement of the village has caused great changes in the environment: new plant species have been introduced and native flora has disappeared.

Discussion

Even though Caye Caulker is a small island we have seen that it contains a number of ecosystems, several in a degraded condition because of human settlement, some because of its geography. This is reflected by the fairly large number of plant species, more than would be found before the island became settled. Up until perhaps 1970 the population was small and the villagers lived from fishing. After Caye Caulker became a tourist spot, the population swelled to about 2,000 and the littoral forest and part of the mangrove forest were cut down. An urban environment was created; many new plant species were brought in; and the original ecosystems became degraded.

The sea beds and the mangrove forest underwent little change except that the mangroves were cut extensively on the east coast of the south island. Elsewhere the damage is spotty. The number of plant species did not change, none disappeared and none were newcomers.

The littoral forest, or what is left of it, may have lost plant species. Tropical forests usually contain a larger number of plant species but often the distance between two plants of the same species is considerable. Small leftovers of the forest may not contain all of the original species. There is no way of determining what was lost when the forest was cut down. For instance one small *Pouteria campechiana* was found in the Mini-Reserve. *Manilkara zapota* has been found nearby. Other plants such as the milkberry (*Chiococca alba*) are rare and the palmetto (*Thrinax radiata*) occurs only as a small tree because the larger ones are harvested.

Meerman and Sabido (2001) list some species typical of the littoral forest-beach community (Type 69) that were not seen on Caye Caulker during this study, such as *Euphorbia trichotoma*, *Myrica cerifera*, and the plant parasite *Cassytha filiforme*.

All of the 15 species found in the Mini-Reserve are native to Central America. In addition, two vines normally found in a littoral forest, *Passiflora suberosa*, and the semi-parasite *Struthanthus cassythoides* were found were found in other locations, the latter near the south point of Caye Caulker..

Of the 19 species found in wetlands that are not grasses, only one is of foreign origin, *Bacopa monnieri*, which originates in Asia. It was found only once on the west side of the south island in a very wet grassy area where it was abundant. Another wetland species, *Suriana maritima*, has been seen only twice in private yards. *Borrhichia arborescens* appears to have been introduced only recently as it was found only once. *Typha domingensis* has become rather uncommon. *Pluchea odorata* is common in wetlands on the north island, but rare on the south island.

The grasses and sedges present a mixed lot. Of the 18 species collected, 11 are native to the American Hemisphere and seven are from Old World tropics. No grasses were deliberately introduced as cattle fodder because there are no cattle on Caye Caulker. *Zoysia* has been introduced as a popular ground cover in backyards. It stays low, does not need mowing, and spreads fast. The other grasses may have been introduced as seeds by wind, sea or on human baggage.

In summary, the natural ecosystems consist of plants almost all native to Central America. It may be that not all species have been identified, but it seems likely that in spite of the now more limited area that these ecosystems occupy, the diversity has not yet been seriously affected.

The urban ecosystem is very diverse: roadsides and abandoned lots show mostly herbaceous species, gardens often more shrubs and trees. In gardens and yards many of the shrub and trees species were planted for their ornamental value, usually from foreign countries. Some trees have been brought from the mainland for their fruit, flowers and medicinal value.

Six species of *Cyperaceae* have been identified, all of them occurring widespread in the Americas. It is likely that not all grasses and sedges that exist on Caye Caulker were seen in this study. Meerman and Sabido (2001) list *Fuirena* sp., *Juncus* sp., and *Spartina cynosuroides* as typical for marine salt marshes, but they were not seen in this study. Later searches may find one or more of these.

Palms are common on Caye Caulker, but only one is native on the island: the palmetto, *Thrinax radiata*. The other six palms have been introduced and of these only one, the multistem shrub (*Chamaedorea seifrizii*) is native to Central America. All others come from Asia, including the recently introduced *Caryota*, fish tail palm,.

The 53 species of plants we found along the roads and in vacant lots are almost all herbs and many have medicinal value. There are still several people in the village who apply herbal medicine. It is cheaper than the pharmacist's pill and often it works. More than once we observed some species abundant one year and absent the following years. None of these herbaceous species has any ornamental value and are not grown in gardens. They are looked upon as weeds. These roadside and vacant land species overwhelmingly originate in the Americas. Only six appear have a foreign origin: *Crotalaria retusa*, *Crotalaria verrucosa*, *Oldenlandia corymbosa*, *Portulaca oleracea*, *Sophora tomentosa*, and *Vigna luteola*,. But they undoubtedly came to Caye Caulker from the Central American mainland. Two species have a worldwide distribution without a clear place of origin: *Boerhavia coccinea* and *Ipomoea pes-caprae*.

Some species are uncommon or even rare. *Strumpfia maritima* has been seen only once in a garden and is carefully protected. It is an important medicinal herb used in childbirth. *Pluchea carolinensis* is almost gone. When people still had chickens it was used to keep fleas away in chicken nests. *Pluchea odorata* is uncommon but common on the north island. Spiderling (*Boerhavia diffusa*) was found only once in quantity but it is no longer there. *Crotalaria retusa* from Asia and Africa was found only in a vacant area that was not mowed. Peppergrass (*Lepidium virginicum*) was seen only once but weeding considerably reduced the stand. *Mimosa tarda* was found only along the airstrip. Four o'clock (*Mirabilis jalapa*) was found only once. Devil pepper (*Rauvolfia tetraphylla*) has been seen only once in a vacant lot where it escaped the lawnmower because it grew under a shrub. The same holds for *Ruellia brittoniana*, which was seen only once. Yerba mora (*Solanum americanum*) was seen frequently at the beginning of the study, but by then end of the study it was rare.

In gardens and yards we find many ornamentals, planted only because of their colorful flowers or foliage. Of the 92 species we classified as garden plants, 49 came from outside of the American hemisphere. Even the banana does not originate here, but probably in Asia. Some are *Bauhinia* sp, *Dracaena americana*, *Galphimia glauca*, *Hyptis pectinata*, *Lagerstroemia indica*, *Manihot esculenta*, *Mussuenda phillipica*, *Parkinsonia* sp., *Plumbago* sp, and *Plumeris rubra*. *Casuarina* and *Terminalia* are popular because they grow fast, both providing shade.

Of the 16 climbing plants, six have foreign origins.

It would appear that development has led to a large increase of foreign plants. At the same time, the diversity of the local flora has not yet been much diminished. Table 1 is a summary of the numbers of species seen on Caye Caulker and their origin.

However, if degradation or elimination of the local original ecosystems continues, a real decrease in the biodiversity of these local ecosystems can be expected. Until now none of the introduced plants has spread beyond control. But for the future the villagers need to be aware of what can happen so that they can take steps when needed.

Conclusions

Our observations based on the inventory of the flora and the current ecosystems have led us to the following conclusions:

To date, settlement has not yet severely affected the biodiversity of Caye Caulker as a whole, but has resulted in severe degradation and loss of the natural ecosystems. Continued development will probably lead to more losses and reduction of the natural biodiversity.

Settlement has led to considerable introduction of new species. The herbaceous plants, new weeds, which are found primarily along roadsides and on vacant lots, have come here as involuntary species (adventitious) brought as seeds by villagers or by wind and sea.

Larger shrubs and trees were introduced as ornamentals and fruit trees, many coming from Asia and other continents. Africa, particularly Madagascar, has given us a number of ornamental plants. Except *Sophora tometosa*, these ornamental plants have not become escapees yet.

The Caye Caulker Forest Reserve may turn into a real littoral forest with time, but at this time it is species poor.

Table 1. Origin of Plants Found on Caye Caulker

<u>Native range</u>	<u>Number of Plant Species</u>
Americas ¹	142
Asia + Pacific ²	15
Asia + Africa ³	12
Africa ³	19
Old world tropics + sub-tropics	18
Europe	2
Australia	2
Worldwide	16
Total	226

¹All species growing anywhere in the American hemisphere. Most species grow in Mexico, Central America, South America and the Caribbean. A few grow in the USA only and some come from South America. Most grow in the tropical and subtropical parts of the American hemisphere.

²All species growing from China, India to Hawaii

³Madagascar contributed most of the African species

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