

# RAPID ECOLOGICAL ASSESSMENT AGUACALIENTE WILDLIFE SANCTUARY



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This report was prepared for:  
Aguacaliente Management Team  
under grants provided by **PACT**  
with additional assistance from  
Belize Tropical Forest Studies.

December, 2006



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# 1. Introduction<sup>1</sup>

## 1.1. General introduction



**Figure 1. Location within Belize**

Aguacaliente Wildlife Sanctuary is situated in the centre of western Toledo District. The area covered by the designation represents the heart of the extensive wetland formed by a barrier of rolling lands and karst hills that detain the flow of waters from Blue Creek, Mafredi Creek, Black/Piedra Creek and Blue Creek and as they pass to the Moho River.

The entire wetland (i.e. the protected with the unprotected areas), is surrounded by the communities of Laguna, Mafredi, Blue Creek, Jordan, Dump, Yemery Grove, San Marcos, Big Falls, Silver Creek, and San Antonio.

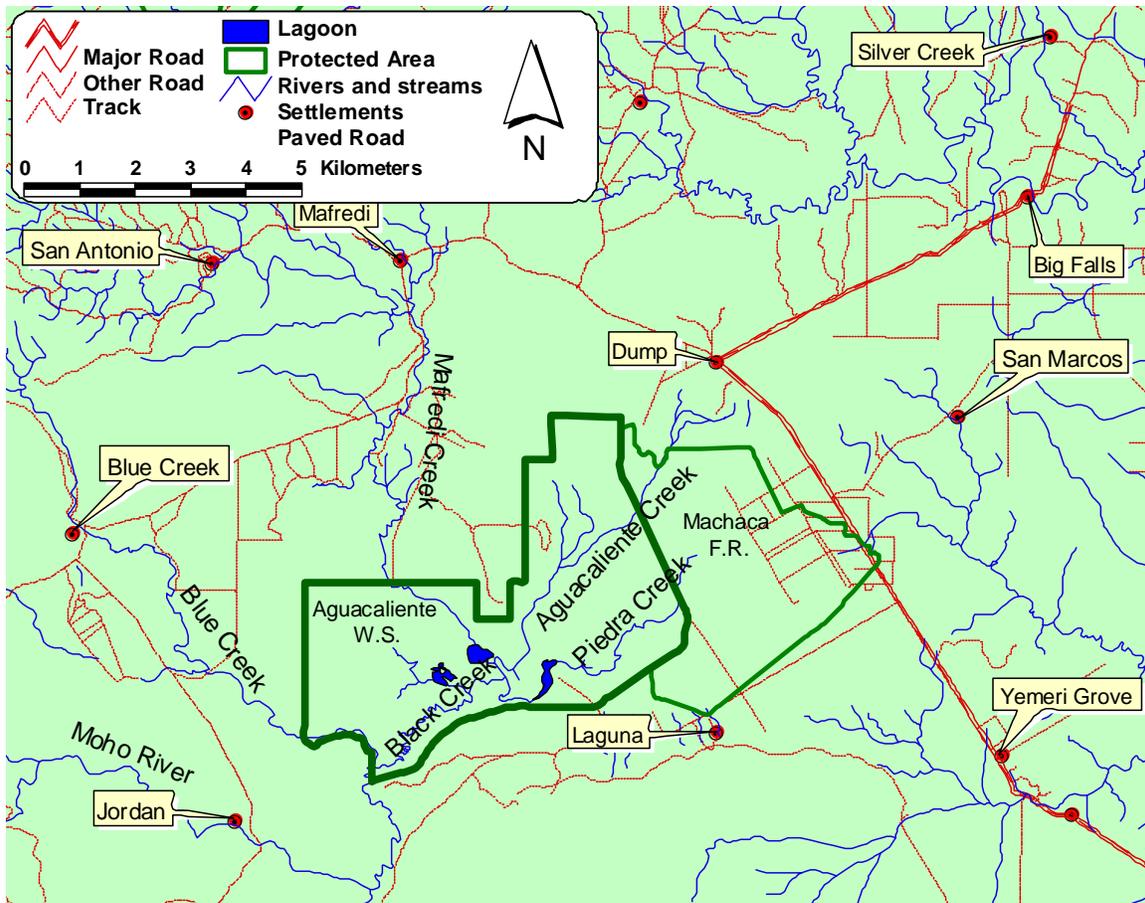
Agricultural lands lie to the north, west and south of the wildlife sanctuary, with the Machaca Forest Reserve to the immediate east. The lands to the north and west are a mix of National land and property, while those to the south are mainly Indian reservation (Black Creek) with some leases and at several properties surveyed out of it. Machaca Forest Reserve was consolidated through statutory instrument 86 of 1998, giving it 3,756 acres.

As declared through statutory instrument No.87 of 1998, the wildlife sanctuary consists of 5,492 acres. Its establishment was largely due to a requirement attached to the Environmental and Social Technical Assistance Project (ESTAP), which was obliged, through its terms of reference, to explore means to have the area given formal protection. The basis of this requirement can be traced back to studies and recommendations made in the early to mid 1990's, such as the Directory of Belizean Protected Areas and Sites of Nature Conservation Interest (Zisman, 1996), which identified the high importance of the area.

The boundaries of the sanctuary were drawn specifically to include the most sensitive parts of the wetlands (i.e. the lagoons and surrounding swamp / savannah, and the small hills where Aguacaliente Creek rises), and exclude all agricultural land, whether surveyed or not. In some places, such as along the western boundary, a buffer area was left between the rice fields and the sanctuary, and it shares a common boundary on the east with Machaca Forest Reserve.

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<sup>1</sup> This section draws heavily from the 2001 report from the Las Cuevas Consulting Team, which remains a relevant document.

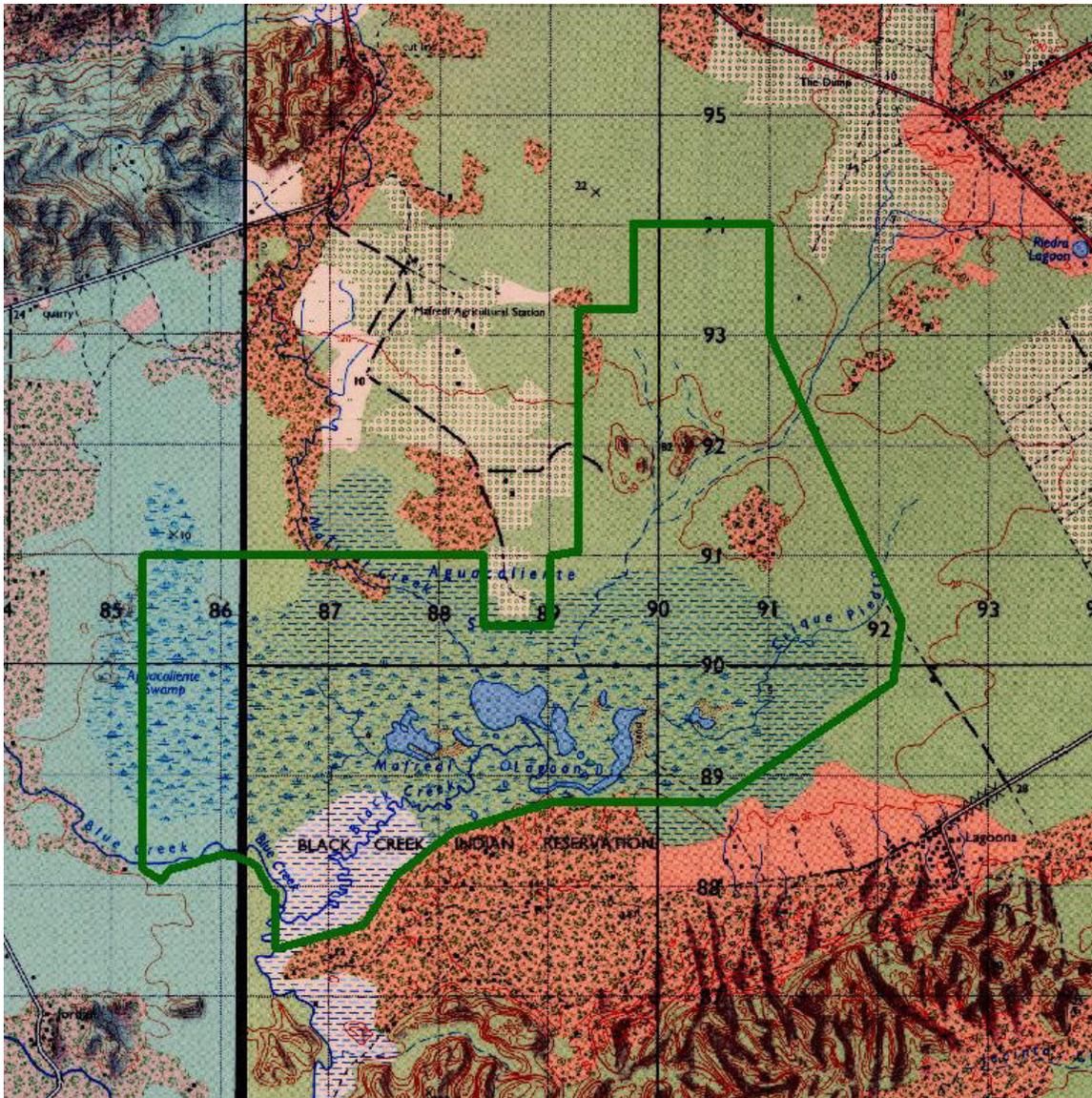


**Figure 2. Map of Aguacaliente Wildlife Sanctuary plus surrounding communities, roads, rivers and streams**

An Aguacaliente Management Team (AMT) was established during the declaration process, with representation from the 10 communities (see above) recognized as having a direct, or even in-direct, interest in the wetland. Although the need for a management plan was acknowledged, none has yet been drafted. Perhaps the most significant activities since declaration have been the maintenance of, and changes in, the management team, and construction by Trekforce of a visitor / management building on the edge of the sanctuary to the immediate north of Laguna with a raised boardwalk leading to it. This boardwalk was in 2006 extended to reach the Piedra Creek.

The AMT team now maintains a small office in Big Falls village. Current funding is supplied through institutions such as PACT and the UNDP Small grants program. A co-management agreement was signed with the Forest Department in 2006.

During the 2005 National Protected Areas Systems Plan (NPAPSP) analysis, the Aguacaliente Wildlife Sanctuary scored very high in the MARXAN gap analysis (Meerman, 2005), in this high score it stood not isolated as most of the Lower Moho River was identified as high conservation priority.



**Figure 3.** DOS map of Aguacaliente Wildlife Sanctuary and surroundings. Each square represents 1 km<sup>2</sup>

The area differs dramatically between dry and wet seasons. Since the area forms a sort of basin, the results of the rainy season quickly inundate much of the entire area of the sanctuary, and the wetland extending beyond its boundaries. This seasonal flooding requires specific adaptations of the flora and fauna, and the resulting ecosystem is to be considered unique in Belize. Moreover the flooded forest provides hugely expanded breeding grounds for the resident fishes. Once the dry season commences, and the water recedes, a multitude of young fish becomes trapped in the lagoons and attracts large numbers of wading birds coming to feed on them. No exact data exist on the fluctuations of the water level.

## 1.2. History of research

The research that led to the declaration of the protected area was carried out by Iremonger and Brokaw, who visited the area in the early 1990's. Their studies led to the recognition and tentative description of (a) 'Seasonal swamp forest of Southern and Central Belize: Aguacaliente variant', and (b) 'Aguacaliente Swamp grassland'. (Iremonger & Brokaw, 1995).

During a district wide vegetation assessment, Meerman and Holst visited the area in 1998 and described some of the ecosystems in the Aguacaliente Wildlife Sanctuary. (Meerman, 1999) in some more detail. Unfortunately, the "Aguacaliente Swamp Grassland" was inundated during this survey.

The Central American Ecosystems mapping initiative used the above studies to produce a 1:250.000 ecosystems map of Belize which includes the Aguacaliente area (Meerman & Sabido 2001). This map was the basis for the much more detailed ecosystems map produced for the current report.

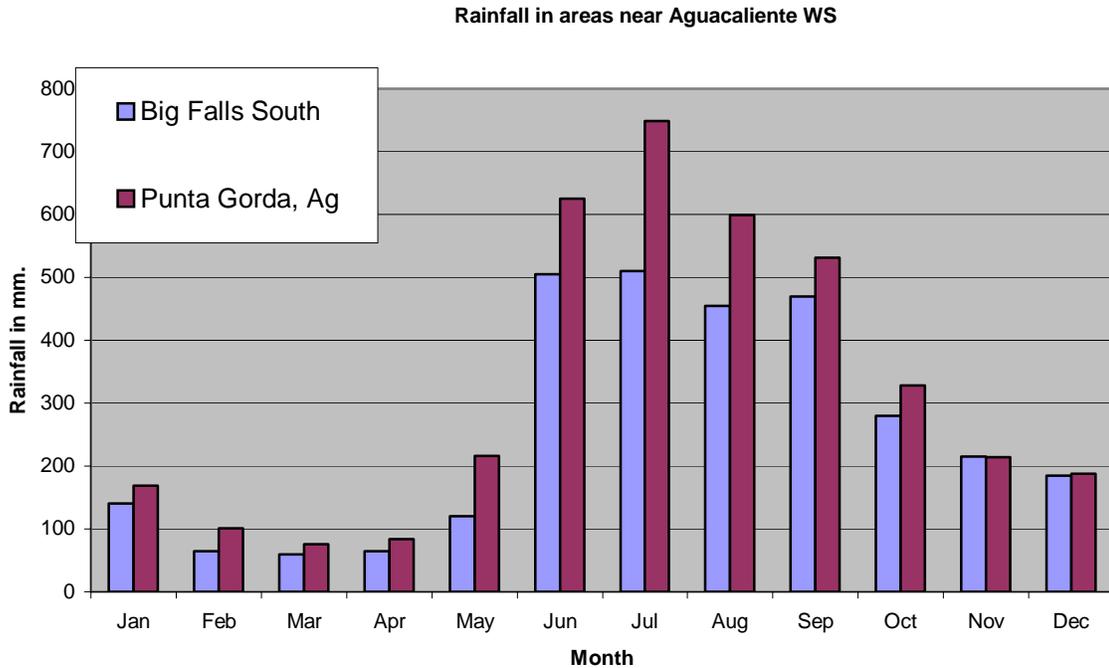
In August 2001, members of the "Las Cuevas Consulting Team", a subsidiary of the Natural History Museum of London, undertook a Rapid Management Assessment (RMA) of the Aguacaliente (Lu Ha) Wildlife Sanctuary. This assessment occurred just weeks before the devastating impact of Hurricane Iris in October 2001. Much of the information gathered in this RMA report has been incorporated into the current report.

Miller & Miller (2006) list Aguacaliente Lagoon as an "Extremely Important" wetland for Waterbirds.

The current REA was carried out in the period February 2006 through October 2006.

### 1.3. Climate

No exact rainfall statistics are known for the area, though, based on data of nearby weather stations, the average annual rainfall lies probably within the 3000 – 4000 mm/year range (120” – 160”) (Table 1).

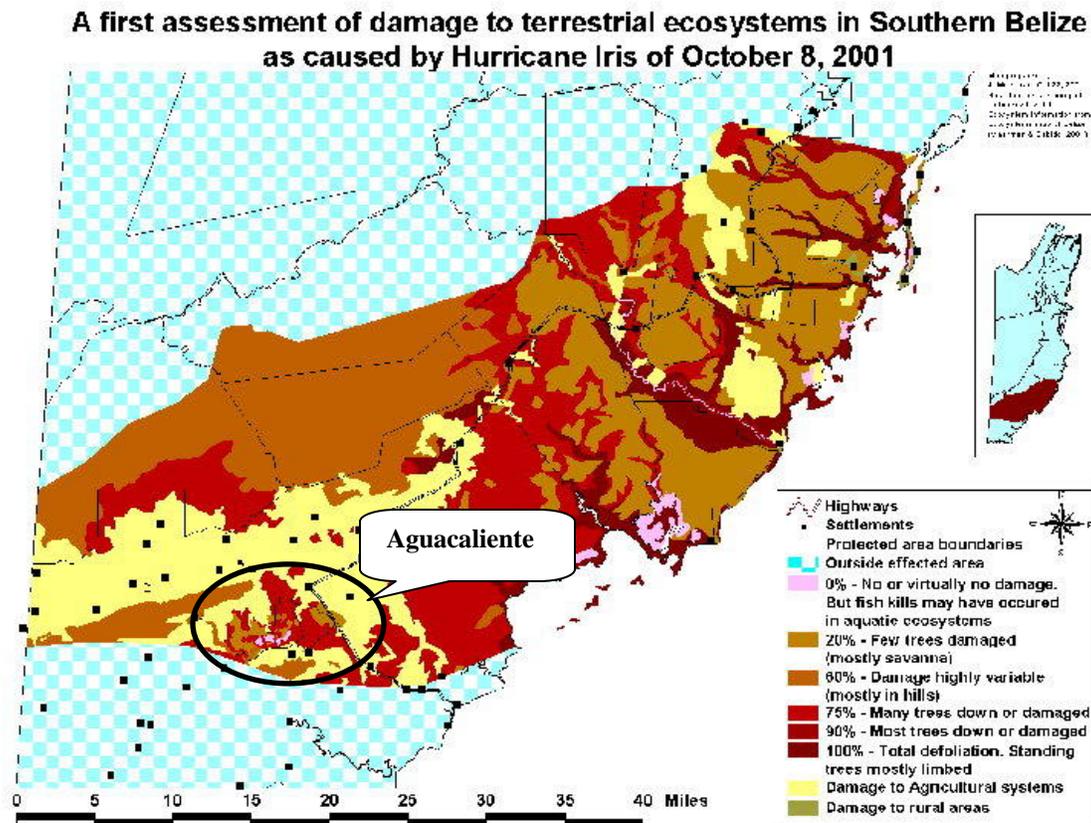


**Figure 4. Rainfall graph for the area**

Another factor in the shaping of the landscape is the frequency of hurricanes. Since 1989, a total of 6 hurricanes have affected the area (table 1).

**Table 1. Hurricanes affecting the Aguacaliente area**

<b>Name</b>	<b>Year</b>	<b>Direction</b>
Not named	1941	Passed north of the area
Not named	1942	Passed east of the area along the coast
Not named	1945	Passed north of the area
Abby	1968	Passed north of the area
Francelia	1969	Directly over the area
Iris	2001	Directly over the area



**Figure 5. Damage by hurricane Iris in 2001.**

On average, a hurricane affects the area every 19 years. Not all of these hurricanes will do extensive damage but there is, at least, an appreciable amount of wind-throw and breakage of crowns. Rainfall is the most obvious factor affecting the project area.

Of the hurricanes listed above, only Iris has been reported of implementing severe damage. The approximate path and damage to terrestrial ecosystems was mapped by Meerman (2001), see figure 5.

The Aguacaliente area lay just inside the southern sector of the hurricane. An overflight on October 21, 2001 revealed severe damage to the entire Aguacaliente Wildlife Sanctuary. Most if not all of the forest had its trees toppled and/or the crowns broken. In the wetland area, most of the larger trees had been blown down as well, and then particularly those that carried heavy epiphyte loads (figure 6).

To make matters worse, the forest felled by the hurricane has since been plagued by fires. These fires have caused more damage to the forest than the hurricane itself.



**Figure 6. Toppled trees in Aguacaliente Wildlife Sanctuary as a result of hurricane Iris as seen on October 21, 2001. Picture by Jan Meerman.**

#### **1.4. Socio-economic Context**

Aguacaliente Wildlife Sanctuary, being a reservoir of lowland wildlife surrounded by agricultural communities, has historically been a focus for hunting and fishing, and dry season grazing. The latter has, apparently, been discontinued though the former two are still relatively widely practised. The surrounding lowlands also present great opportunities for rice cultivation, which extends towards the sanctuary from the north, west and north east.

Of the 10 communities surrounding the area, and represented on the AMT, perhaps those most directly impacting the sanctuary are Laguna, Mafredi, Blue Creek, Jordan, Dump, Yemery Grove, San Marcos, Big Falls, Silver Creek, and San Antonio. They are a very socially, economically and demographically diverse group, with, possibly, their inclusion in the AMT being one of the few factors they have in common.

**Laguna**, lying to the immediate south of the sanctuary, is a predominantly Q'eqchi' community situated within the Black Creek Indian Reservation. The village was established approximately 45 years ago and has a current population in the region of 350-400. There is a demand for additional house lots and agricultural land, which has led to some competition with neighboring communities. Most of the land is still occupied under

customary 'reservation' practices, though several leases have been surveyed along the farmer's road which runs roughly east to west along the southern boundary of the sanctuary, and in other, more isolated, parts at a further distance. Some large blocks, used mainly for pasture, have been surveyed between the village and the sanctuary. The path from the village to the sanctuary visitor / ranger centre runs through this block.

Milpa is the predominant farming type, producing corn, rice and beans. The village has a history of generating new communities through emigration, and many villagers are obliged to seek employment elsewhere in Toledo, if not further afield in Belize. Administration is by village chairman and an alcalde, and there is a community centre and village school. There is also a Toledo Eco-tourism Association guesthouse.

The village has an all weather access road from the San Antonio Road, and 24 hour electricity.

Several Laguna farmers used to farm lands that are now within the sanctuary, and villagers have customarily used the lagoons, savannah and surrounding forest for hunting and fishing.

**Yemery Grove**, situated on the San Antonio Road, is a mainly Creole community, though with seemingly increasing diversification. The community only became a formal 'village' within the last 10 years, and lands are held either as property or lease. Population is small, averaging around 100 to 120, and administration is by village chairman. The community has no concentration of house lots, as such, and occupation is based on medium to large parcels, mainly fronting onto the main road, where 24-hour electricity is available.

Villagers have a probable history of hunting and fishing in the Aguacaliente area prior to declaration.

**San Marcos** is located along an un-paved road leading east off the San Antonio Road, and therefore at some distance (4 miles in a straight line) from the wildlife sanctuary. It is a recent community, probably established about 30 years ago, and is predominantly Q'eqchi', with both a village chairman and an alcalde, and a village school. Population is approximately 450 and is restricted by constraints on land, particularly for agriculture. The land is chiefly National land, though many of the villagers have no formal lease. Furthermore the community is effectively hemmed in by surrounding properties and leases accruing to neighbouring communities, mainly Yemery Grove, Dump, and Big Falls. Crops are mainly corn, rice and beans, though the village does have a reputation for vegetable cultivation.

The village has experienced much consolidation recently, with surveyed lands and the running of a line for 24-hour electricity.

**Dump** is, administratively, part of Big Falls village, though it has significantly different social and economic characteristics. The settlement goes back well over 50 years and is largely composed of East Indians. Indeed, the degree of the community's involvement in the election of the Big Falls village chair and alcalde is not known, but it is most likely minimal. Population is hard to gauge, though it most likely has no more than 10 to 20 households. The Maya population is low. Lands, all surveyed, are held as lease and property, with a high proportion of the latter. The community is located, essentially, at

the junction of the San Antonio Road and the commencement of the Southern Highway, and has 24-hour electricity. The Julian Cho High School and Center for Employment Training is located here.

Dump farmers are involved in mechanized rice production, which is cultivated in the surrounding wetlands stretching west towards the wildlife sanctuary. Cattle are also grazed on the same lands in the dry season and they used to be grazed on the savannah inside the sanctuary.

**Big Falls** is centered on the Southern Highway two or three miles east of Dump, and has been experiencing significant economic and demographic growth over the last 10 years. Population is stated as being in the region of 1,200 persons, largely Q'eqchi' Maya, but also Mestizo, Creole and East Indian. Administration is by village chair and alcalde, and lands are held through a mix of leases (almost all surveyed) and property. There is a concentration of house lots, and the village school and health centre, east of the Rio Grande Bridge, and constraints on expansion are being felt, resulting in some competition with surrounding villages over what little un-surveyed National land is left in the area.

Use of the wetlands by Big Falls villages is / was generally restricted to hunting and fishing, with some rice cultivation, both mechanized and milpa.

**Mafredi**, a predominantly East Indian village dating back to the 1940's, is centrally located at the junction of the San Antonio Road and the Blue Creek – Santa Theresa road. Population is small and does not exceed 200. Lands, lying between karst hills to the north and west, and the wetland to the south and south east, are held by a mix of leases and properties, with the majority surveyed. Administration is by village chairman, yet there is no concentration of house lots (except for an underdeveloped block on hilly land to the north). The community has 24-hour electricity and a village school.

Mafredi agriculture is heavily based on mechanized rice production, as is that of the small Mennonite community occupying properties south of the village, along the Blue Creek road. A main block of these rice fields lies across the Mafredi Creek in the wetland (where the now abandoned government-run Mafredi agricultural station was located), and several fields are in close proximity to the sanctuary boundary. It is evident, however, that there appears to have been some reduction in the fields over the last 5 to 10 years.

**San Antonio** (population in excess of 1,500), lying a few miles to the north, can not be considered as bordering the sanctuary. However a group of village farmers, the Matahambre Co-operative, have secured lease lands alongside Mafredi Creek in a block that probably crosses into the northern part of the sanctuary at one point. San Antonio farmers have been using the wetland for farming, hunting and fishing on a long term basis.

**Blue Creek** is a mainly Q'eqchi' village lying alongside Blue Creek to the north west of the sanctuary., population being in the vicinity of 350. Governance is through village chair and alcalde, and the village lies just within the Blue Creek Indian Reservation. A string of agricultural parcels, however, has been surveyed all along the road to Mafredi, and along the road to Aguacate, to the west. 24-hour electricity has now been connected, though the bridge is subject to flooding during heavy rains, and this effectively disconnects all lands and villages to the south (including Jordan) from the main

settlement network and Punta Gorda.

A large block of land lying to the south of the village, which extends into the wetland (though not the sanctuary), was occupied by the Blue Creek agricultural station, the centre of several development projects within the last 10 to 20 years (such as the Toledo Research and Development Project of the mid to late 1980's, and the IFAD project of the early to mid 1990's). Title to the land is still held by the government, preventing its use by village farmers. A proposal is being formulated to establish an agricultural / rural development institution on these lands, though it is still in the draft stage.

Blue Creek farmers are engaged in both milpa corn, beans and rice, and some mechanized rice. Several of their parcels and milpa lands extend into the wetlands, though there is a buffer between sanctuary's western border and the surveyed parcels. Blue Creek villagers are most likely also hunters and fishers within and around the sanctuary.

**Jordan** is a relatively new Q'eqchi' community lying to the immediate north of the Moho bridge leading from Blue Creek west to Santa Theresa. Population is in the region of 120 persons. Administration is through a village chair. The surrounding lands are National lands though some villagers have lease papers. As the only readily fertile lands lie alongside the Moho River and Blue Creek (broken ridge lying to the immediate north) there has been some competition with neighboring villages.

Jordan farmers practice milpa and matahambre alongside the creeks, and may also be responsible for some hunting and fishing within the sanctuary.

## **1.5. Socio-economic characteristics influenced by the site.**

### 1.5.1. Past use.

Although the sanctuary has several major ancient Maya sites in its vicinity (e.g. Nim Li Punit to the east, Lubaantum to the north), as well as many minor sites, there is, as yet, little tangible evidence of ancient use within the sanctuary. No in-depth studies have been undertaken, and ancient hunting and fishing leaves little easily recognized evidence. However it can be safely assumed that the savannah and lagoons have been exploited ever since there have been communities within traveling distance. It is probable that the two hills in the northern extension (the 'Aguacaliente Hills') may reveal some material evidence of ancient use, either temporary or permanent.

As concerns more recent times, accounts of use of the wetland for hunting and fishing go back at least 50 years, and it is probable that the area has been used since San Antonio and Pueblo Viejo were first settled in the nineteenth century. The Old San Antonio Road (running from Punta Gorda to San Antonio and beyond) avoided any unnecessary bridging of, for example, Condemned Branch to the east of Laguna, and passed through the north east part of the wetland.

The Machaca Forest Reserve lies to the immediate east of the wetland. This was planted with pine between 1947 and 1959 as part of a Land Utilization and Development Plan and has been managed by the Forest Department through the Machaca Forest Station situated within the reserve on the main road. The station is the base for all forest

management in southern Belize up to the Las Lomitas area. Machaca Forest Reserve was selectively, though thoroughly, logged in the 1998 / 99 period, and there were concerns that loggers may have passed into the sanctuary, especially as there was no demarcation. However the harvestable pine does not extend far west of the Old San Antonio Road, which indicates the general alignment of the boundary.

Selective logging has also taken place within the last 5 years in the vicinity of Mafredi, Blue Creek and Jordan, though not, as far as can be ascertained, around Laguna. It is estimated that there will be little harvestable timber in the region following hurricane Iris.

Lands to the south east of the sanctuary were laid out in the 1940's for an agricultural project, based, at least partially, on oil palm cultivation. A settlement (Machaca) was established in the San Marcos vicinity. This apparently failed and there is no trace of it beyond the few oil palms near Dump, and the occasional survey pillar indicating previous parcels.

#### 1.5.2. Present use.

It is questionable what would have happened to the area now covered by the sanctuary had it not been declared. As stated in the introduction, actual designation covers what can be considered the heart of the wetland, essentially the area subject to the greatest inundation, apart from the northern extension. An indication of what may have occurred on some of the slightly higher lands can be seen in the fields of mechanised rice cultivation that extend into the wetland from the Blue Creek road, Mafredi and the Dump. Given adequate road infrastructure, these fields may have extended further. Indeed, an approximately 120 acre rice field reaching towards the lagoons had to be specifically excluded from the sanctuary during the declaration process. Field inspection showed the very real possibility of expanded rice cultivation into the sanctuary area from the farmers road leading south from the Blue Creek road, with only the lack of all weather access as an impediment. Yet, due to actual inundation risk, it is most unlikely that rice cultivation would have taken place in the immediate vicinity of the lagoons.

However, the sanctuary is now bounded on the west, north and north east by rice fields, or areas with ready potential for mechanised rice cultivation. Two all-weather farmers' roads are critical to this: one that runs south from the Blue Creek road towards the Moho River and services the parcels that lie west of the sanctuary, and another that crosses Mafredi Creek into the old Mafredi Agricultural Station area where it then branches into a small network servicing the block of parcels directly to the north of the sanctuary.

Although this latter road is occasionally obstructed when the Mafredi Creek bridge is flooded, it does represent the major access route into the sanctuary area from the north, opening up the area for mechanised rice farmers from Mafredi, matahambre farmers from San Antonio, and hunters and fishers from any number of other settlements to the north of the sanctuary.

The large rice fields extending towards the sanctuary from the Dump have no all-weather access roads extending off the main road, and are therefore currently stabilised. Any construction of all-weather access roads in this area, intended, perhaps, to open up the wetland to the north east of the sanctuary (an area of National land which has not been

parcelled out), would exert pressure on the boundary, and possibly on local hydrological flows.

The degree to which herbicides, which are freely used on mechanised rice fields, seep in times of flood across the sanctuary boundaries and into the creeks and lagoons, has not been ascertained. This could, through cumulative effects and / or intensification, exert a particular stress on the water body ecosystems and their associated wildlife.

Rice cultivation in Toledo is subject to periodic assessment and proposal, and the area around the sanctuary, as well as other areas in the district, has often been identified as having the capability for large-scale export-oriented cultivation. The complaint has been made that the sanctuary has 'locked up' some lands with good cultivation potential, especially in the northern extension (Las Cuevas Consulting Team, 2001). However, much of this concern should be regarded in the light of many people's poor perception of the actual land covered by the un-demarcated sanctuary.

Milpa and matahambre has been practiced in and around the wetland for decades. Villagers from Laguna have used the lands along the south side of the sanctuary for several decades under the reservation system, with its attendant insecurity of individual long-term tenures. Over the last ten to fifteen years, however, some lands have been secured as leases of National land. One large parcel lying between the village and the sanctuary has been surveyed, and is now largely fenced for pasture; it is through this pasture that the main access to the sanctuary's ranger station passes. Also a block of around twenty parcels (of between 20 to 30 acres each) has been surveyed along the Laguna farmers' road to the west of the village, along the sanctuary's southern boundary. However, beyond these parcels lies an area much used for matahambre that runs west to the area around the confluence of Blue Creek and Black Creek (which runs out of the lagoons). There are indications from satellite imagery that some matahambre may cross over into the sanctuary from the both the Jordan and the San Antonio side.

Already in 2001 field work (Las Cuevas Consulting Team, 2001) revealed a 2 to 3 acre patch of milpa at the base of the westernmost small hill (the 'Aguacaliente Hills') in the northern extension. In 2006, this area of cultivation was much extended and means were being sought to expel this particular farmer. Burning activities associated with this farming activity have meanwhile caused massive damage to the hill vegetation.

The only other area of milpa/matahambre is alongside Blue Creek in the vicinity of Jordan. It is established that there is cultivation on the west side of the creek, and again, satellite imagery suggest that it also takes place on the east-side i.e. within the sanctuary.

The other main area of matahambre cultivation is the large block, estimated at around 200 acres, alongside Mafredi Creek accessed by the Mafredi Creek bridge which leads to the mechanised rice fields north of the sanctuary. This area is being worked by the Matahambre Co-operative of San Antonio (San Antonio farmers have been working here for decades). The area was inspected in 2001 by the Las Cuevas Consulting Team, and it was noticed that it was at that stage in the process of being surveyed into several parcels, running roughly parallel to the creek, and that at least one of the survey pillars appeared to be within the sanctuary, though the boundary had not been demarcated. As one member of the co-operative is also a member of the AMT it can be assumed that this irregularity can be resolved.

It should also be recognized that occasional fields of milpa rice are also cultivated around the mechanized rice fields east of the farmers' road running south off the Blue Creek Road. As milpa farmers are willing to travel further by foot than mechanized rice farmers, there is a possibility that, at some time in the future, there may be more incursions.

Laguna is a growing community which appears to be expanding beyond the physical and customary confines of the traditional reservation system. Recently demand has been expressed for house lots to accommodate this growth (Laguna never used to have surveyed house lots).

The other evident uses in the sanctuary are hunting and fishing. In fact the AMT has adopted a policy of incremental enforcement of statutory sanctuary regulations on these activities in acknowledgement of their historic and widespread practice. While hunting is actively discouraged, the policy allows, for the time being, low level fishing on certain conditions: no commercial fishing, no nets, no poison, and no fire.

The actual fish fauna remains largely unstudied and there is need to establish whether tilapia is present, as claimed, and ascertain its potential impact.

As is the case in other protected areas, over-fishing would most probably have a direct negative impact on other wildlife dependant on this resource, particularly the many birds that feed on the trapped fish in the beginning of the dry season. This would impact the appreciation, and rationale, of the area as a sanctuary.

Many of the surrounding communities exert a degree of pressure on the sanctuary through the harvesting of non-timber forest extracts. However, as there is forested land, to a greater or lesser extent, throughout the region, and often in a far readier location, it can be assumed that this pressure is minimal.

At present there is little tourism activity in the sanctuary. Laguna has a guesthouse operated by the Toledo Ecotourism Association. Out of the other surrounding communities, Punta Gorda, Blue Creek and Big Falls have an increasing amount of lodges that attracts a steady flow of visitors, generating spin-off tour guiding and craft sales.

It is quite probable that the sanctuary will act as a destination for tour guiding from throughout the region (possibly being included into Placencia based tour packages now that the Southern Highway has been largely improved). However, at present it is generally restricted to occasional visits, mainly by ornithologists.

## 2. Geology

Geologically, the core area of the Aguacaliente Wildlife Sanctuary can be characterised as alluvial deposits overlying Eocene-Paleocene-limestone-Toledo bed formations. Only at one isolated location in the north of the sanctuary is there is small karstic cretaceous limestone outcropping. Presumably, a fault line traverses the area along which there is a seepage of warm, sulphuric water. The 'hot springs', which give the area its name, are found where this water surfaces. Other 'hot springs', presumably along the same fault line, can be found in the Big Falls and Silver Creek vicinity.

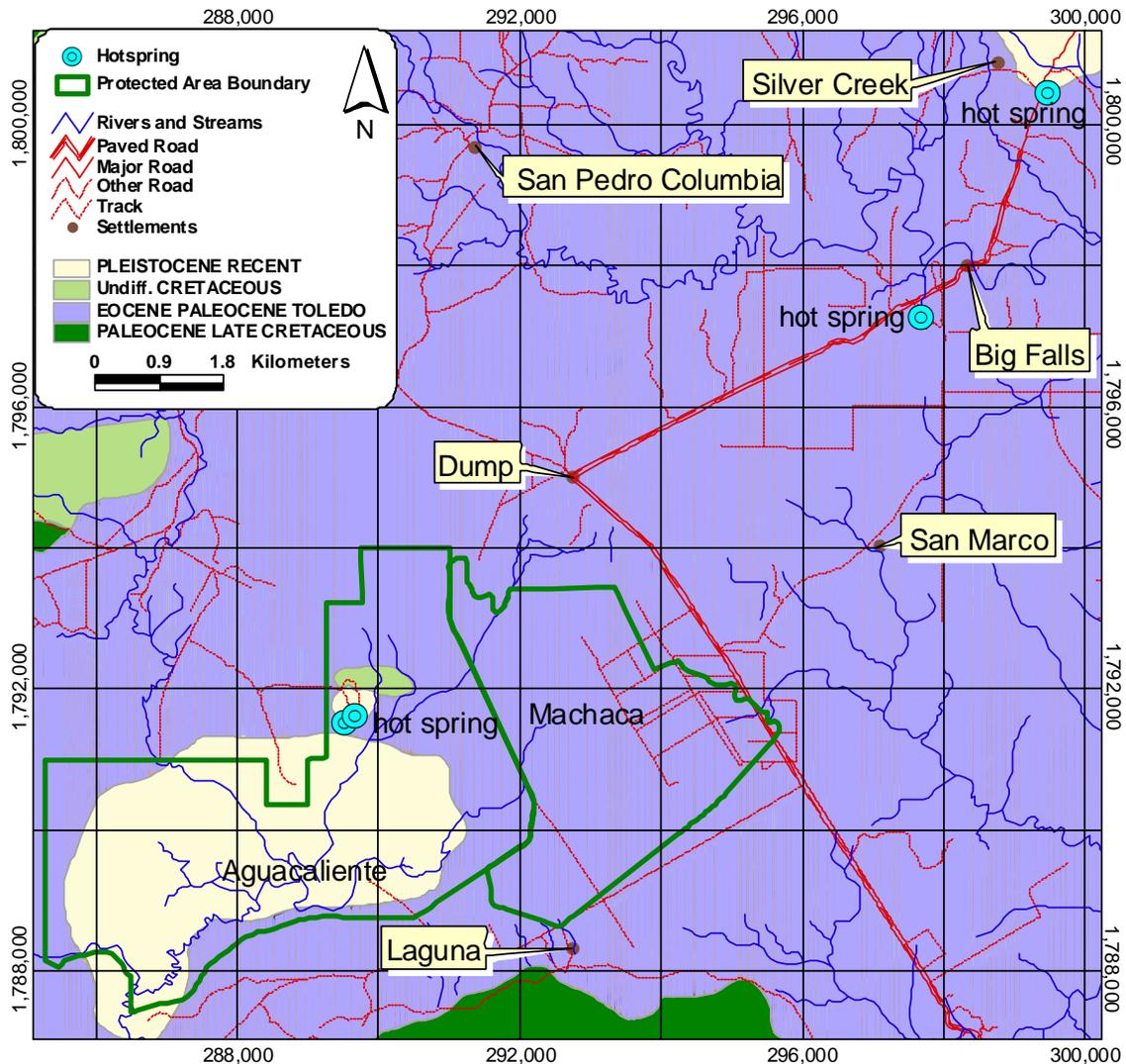


Figure 7. Geology of the greater Aguacaliente Area. Source: Corneic (undated)

### 3. Hydrology

Aguacaliente Wildlife Sanctuary, located in central western Toledo District, occupies the central part of a large bajo-like feature that has become an extensive wetland acting as a drain for the waters of Blue Creek, Mafredi Creek, Aguacaliente Creek and Piedra Creek. The rolling lands to the east (east of the San Antonio Road and south of the Southern Highway), and the steep karst hills on the south (immediately south of Laguna) contain the waters, with the only outlet being Blue Creek to the immediate west of the Laguna hills, which in its turn drains into the Moho River. Regular seasonal floods increase the waters with contributions from both the Blue Creek and the Moho River themselves. The dumping of the road between Mafredi and The Dump (hence the name) cuts across the wetland and disrupts the drainage from east to west. The sanctuary occupies the core of the wetland the lagoons and savannahs lying to the north of Laguna and the south of Mafredi.

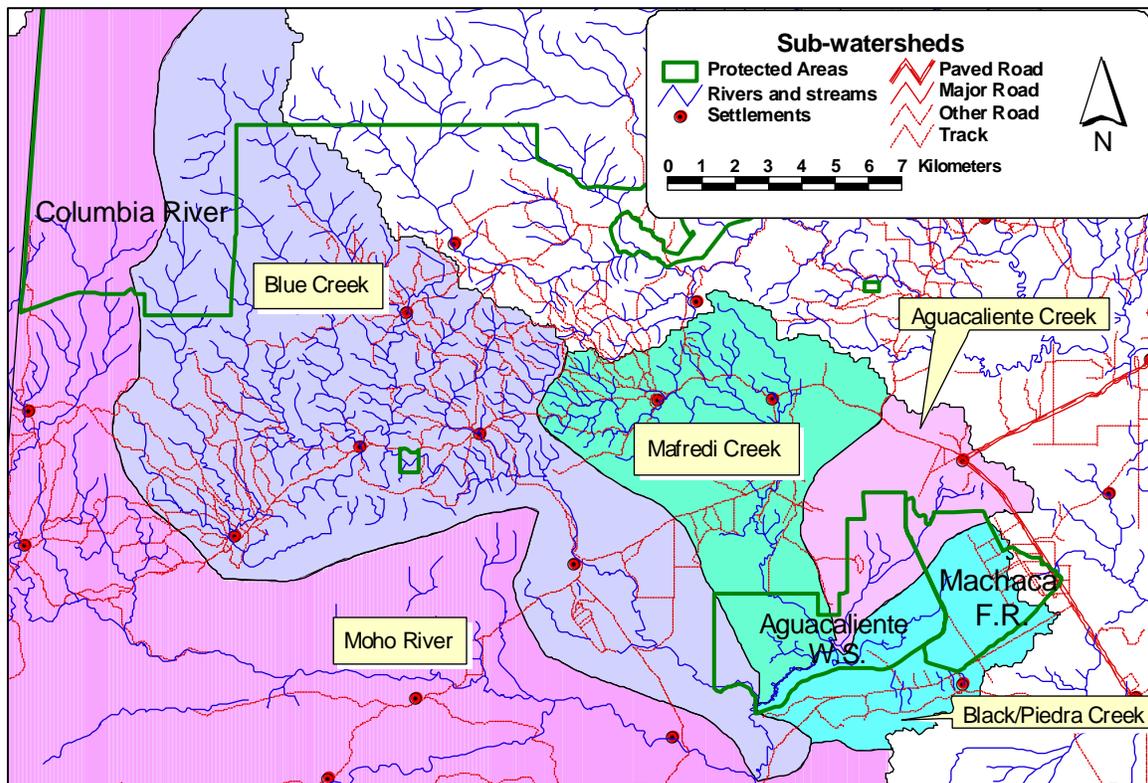


Figure 8. (Sub-) Watersheds

All of the Aguacaliente Wildlife Sanctuary is part of the Moho watershed. The Moho watershed is a fairly large watershed of approximately 312,000 acres, reaching well into Guatemala. Important is the subdivision into sub-watersheds which are units within the Moho watershed. It turns out that there are 4 main sub-watersheds affecting the Aguacaliente Wildlife Sanctuary (table 2).

**Table 2. Sub watersheds**

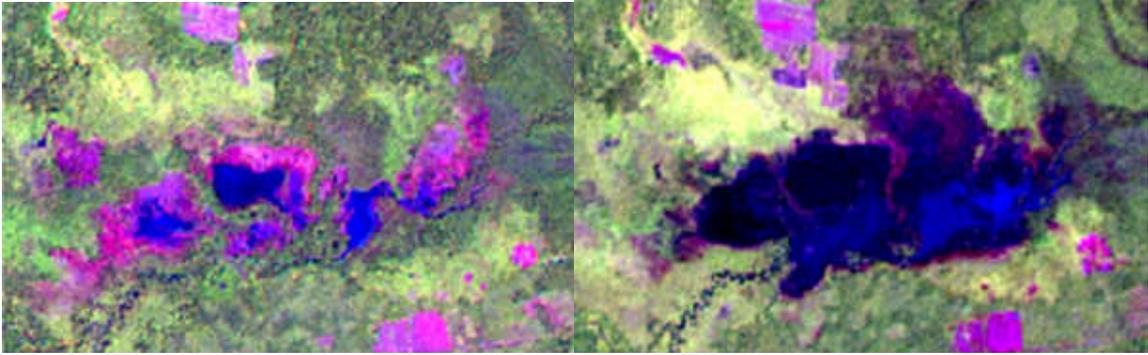
<b>Sub-watershed</b>	<b>Acreage</b>	<b>Villages</b>	<b>Agriculture</b>	<b>Mechanized Agriculture</b>
<b>Blue Creek</b>	44,600 acres	San Jose Hawaii Santa Cruz Santa Elena Pueblo Viejo Blue Creek	Yes	Yes
<b>Mafredi Creek</b>	14,600 acres	Mafredi San Antonio	Yes	Yes
<b>Aguacaliente Creek</b>	6,500 acres	Dump	Yes	Yes
<b>Black/Piedra Creek</b>	7,000 acres	Laguna	Yes	No
<b>Moho (Total)</b>	312,000 acres	Total	Yes	Yes

These sub-watersheds are not necessarily well defined. In lowlands the boundaries between (sub)watersheds can be very diffuse and even flexible depending on local rainfall conditions. It is important to keep this in mind when discussing watershed details.

The most obvious hydrological effect noticeable to even the most casual observer is the tremendous change in water level. These water level changes are what make Aguacaliente Wildlife Sanctuary what it is.

These dramatic changes are caused by the hydrology of the streams discussed above. While the Aguacaliente Wildlife Sanctuary directly draws water from the Mafredi Creek, the Aguacaliente Creek and the Piedra Creek, these are in themselves probably not sufficient to cause the tremendous changes in water level experienced. Together the watersheds of these creeks cover approximately 28,100 acres. However, if the Blue Creek swells and tries to drain into the Moho River, it gets stopped by the Moho River itself which is (typically) also swelled at the same time. The result is that the 44,600 acre Blue Creek watershed cannot drain quickly and backs up into the Aguacaliente Wildlife Sanctuary. In other words, the Aguacaliente Wildlife Sanctuary acts as storage buffer for the Blue Creek drainage.

From a hydrological point of view this is interesting and it explains the extended periods of high water levels. But practically it also indicates the tremendous area from which the Aguacaliente Wildlife Sanctuary receives water, a large area with no less than 9 villages with associated agriculture (including mechanized agriculture) activities. This should cause concern for the long-term water quality of the lagoons in the Aguacaliente Wildlife Sanctuary.



**Figure 9. Differences in water level as shown by these two landsat images. Both were taken during the wet season (left: Nov 1999, right: Jan 2004). Blue is water. Pink represents low vegetation, bare soil or cleared fields.**

## 4. Vegetation/Ecosystems

### 4.1. Ecosystems

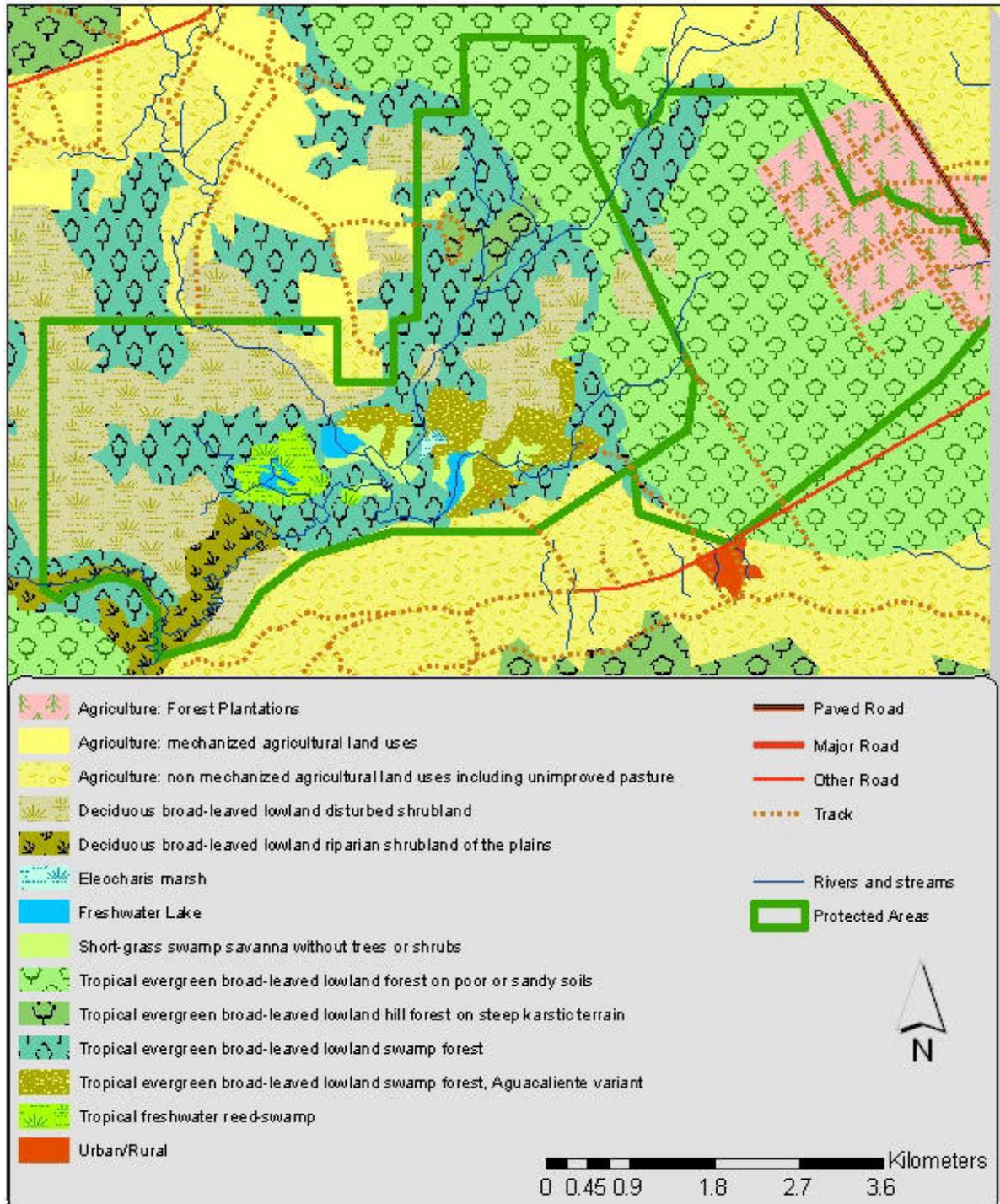
Aguacaliente Wildlife Sanctuary is a complex mosaic of ecosystems. No less than 10 ecosystems have been recognized, not counting agricultural systems (table 3).

Of these ten, two (Swamp grassland without trees or shrubs, Tropical evergreen broad-leaved lowland swamp forest, Aguacaliente variant) are unique to Aguacaliente Wildlife Sanctuary. In other words, the conservation of these ecosystems depends on the management of the Aguacaliente Wildlife Sanctuary.

**Table 3. Ecosystems found in Aguacaliente Wildlife Sanctuary. Ecosystems in Bold represent ecosystems found ONLY in the Aguacaliente Wildlife Sanctuary.**

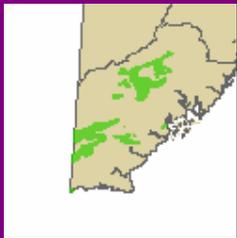
<b>ECOSYSTEM</b>	<b>ACRES</b>	<b>HECTARES</b>
Agriculture: mechanized agricultural land uses	18	7
Agriculture: non mechanized agricultural land uses including unimproved pasture	226	91
Deciduous broad-leaved lowland disturbed shrubland	1584	641
Deciduous broad-leaved lowland riparian shrubland of the plains	259	105
Eleocharis marsh	12	5
Freshwater Lake (normal low water levels)	70	28
<b>Swamp grassland without trees or shrubs</b>	123	50
Tropical evergreen broad-leaved lowland forest on poor or sandy soils	867	351
Tropical evergreen broad-leaved lowland hill forest on steep calcareous hills	119	48
Tropical evergreen broad-leaved lowland swamp forest	1738	703
<b>Tropical evergreen broad-leaved lowland swamp forest, Aguacaliente variant</b>	328	133
Tropical lowland reed-swamp	125	51

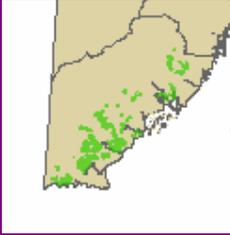
Descriptions of these ecosystems will be given on the following pages. These descriptions are based on the Central American Ecosystems Map (Meerman & Sabido, 2001) but updated using the findings of this year's fieldwork. The descriptions given here apply to the national coverage. The species accounts for each ecosystem will be presented in the species list in the appendix.

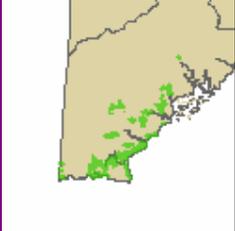


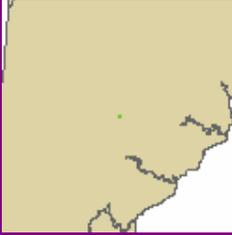
**Figure 10. Ecosystems of Aguacaliente and surroundings**

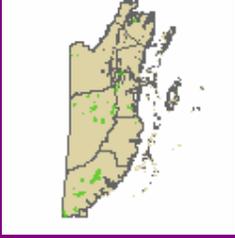
**Table 4. Ecosystem Descriptions (Based on Meerman & Sabido, 2001)**

<b>UNESCO code</b>	<b>I.A.1.a.(1).(a).K-s</b>
<b>Name</b>	<b><u>Tropical evergreen broadleaf lowland forest over steep calcareous hills</u></b>
<b>Location</b>	< 500 m. Found in the 2500 - 4000 mm annual rainfall areas of southern Belize with a dry season from February through May.
	
<b>Geology and soil</b>	Found in steep terrain over Cretaceous – Early Tertiary calcareous rocks, often where there is more non-vegetated ground surface, particularly bare rock. Soils may be extremely organic due to the leaching of the mineral soil and the build-up of organic matter in the limestone cracks and fissures.
<b>Water regime</b>	Mostly well drained
<b>Fire exposure</b>	Fires can do tremendous damage to this ecosystem. The soil at the base of steep limestone hills is often quite fertile and sought after for slash and burn agriculture. Agricultural fires associated with this practice frequently escape and creep up the hills, commonly doing relatively minor damage at the lower elevations but completely destroying the tops of the hills. The vegetation of such hilltops is then replaced by vines such as <i>Bidens squarrosa</i> and <i>Calea</i> sp. or more commonly with the fern <i>Pteridium caudatum</i> .
<b>Description</b>	Altitude is less important than steepness and the vegetation cover is dictated by the seasonal droughtyness. But because of the high rainfall figures in southern Belize, deciduousness is not a conspicuous feature even on these steep hills. Normally the valleys between these steep hills have an ecosystem that should be termed IA1a(1)(a)K-r but the current mapping effort does not allow this type of detail. The canopy tends to reach 25-30 m.
	
<b>Frequent plant species</b>	Distinctive species include: <i>Acalypha diversifolia</i> , <i>Achimenes erecta</i> , <i>Alseis yucatenensis</i> , <i>Ampelocera hottlei</i> , <i>Aphelandra scabra</i> , <i>Astronium graveolens</i> , <i>Bauhinia divaricata</i> , <i>Begonia sericoneura</i> , <i>Bernoullia flammea</i> , <i>Brosimum alicastrum</i> , <i>Bursera simaruba</i> , <i>Carludovica palmata</i> , <i>Cecropia obtusifolia</i> , <i>Ceiba pentandra</i> , <i>Cestrum nocturnum</i> , <i>Chamaedorea tepejilote</i> , <i>Crysophila stauracantha</i> , <i>Cupania belizensis</i> , <i>Deherainia smaragdina</i> , <i>Dendropanax arboreus</i> , <i>Desmoncus orthacanthos</i> , <i>Dracaena americana</i> , <i>Drypetes brownei</i> , <i>Forchhammeria trifoliata</i> , <i>Louteridium donnell-smithii</i> , <i>Malmea depressa</i> , <i>Manilkara chicle</i> , <i>Manilkara zapota</i> , <i>Metopium brownei</i> , <i>Myriocarpa obovata</i> , <i>Oreopanax obtusifolius</i> , <i>Pimenta dioica</i> , <i>Piper aduncum</i> , <i>Piper jacquemontianum</i> , <i>Pouteria campechiana</i> , <i>Pouteria reticulata</i> , <i>Protium copal</i> , <i>Pseudobombax ellipticum</i> , <i>Sabal mauritiiformis</i> , <i>Sapindus saponaria</i> , <i>Sebastiania tuerckheimiana</i> , <i>Trema micrantha</i> , <i>Trichilia minutiflora</i> , <i>Trichilia pallida</i> , <i>Vitex gaumeri</i> and <i>Zamia variegata</i> .
<b>Faunistic comments</b>	The limestone hills in the Toledo district are still poorly documented. Certainly they are inhabited by Mexican Black Howler Monkeys and are reputed to be areas with high bird diversity.
<b>References</b>	Brokaw & Lloyd-Evans 1987, Iremonger & Sayre 1994, Meerman 1998b, 1999a, 1999c, Hawkins et al. 1998, Schultze and Whitacre 1999, Wright et al. 1959: 2d, 2e (where on hills)  Picture: Blue Creek, Toledo district. J. Meerman

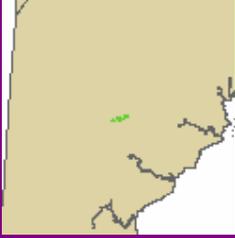
<b>UNESCO code</b>	<b>I.A.1.a.(1).(b).P</b>
<b>Name</b>	<b>Tropical evergreen broadleaf lowland forest over poor or sandy soils</b>
<b>Description</b>	Generally dense forests with a broken canopy. Abundant Melastomataceae, Yemeri ( <i>Vochysia hondurensis</i> ), Polewood ( <i>Xylopia frutescens</i> ) and Cutting grass ( <i>Scleria bracteata</i> ). Essentially a wetter extension of <a href="#">I.A.2.a.(1).(b).S</a> .
<b>Location</b>	Widespread throughout the lowlands of the Toledo District at altitudes below 50 m. Found in the 2500 - 4000 mm annual rainfall areas of southern Belize with a dry season from February through May.
	
<b>Geology and soil</b>	Over Late Cretaceous – Early Tertiary and Pleistocene deposits. Corresponding to where they occur in lowland areas, soils are acidic and may be dull reddish-brown, brown or gray clays, often mottled and/or stony.
<b>Water regime</b>	Drainage varies. Often ill drained.
<b>Fire exposure</b>	Where fires have penetrated this system, small patches of scrubby “savanna” occur with associated species such as <i>Byrsonima crassifolia</i> and <i>Pinus caribaea</i> appearing. High rainfall figures in these areas prevent major expansion of these savannas but under a regime of recurring droughts and increased human pressure, these forests may well degenerate towards savanna.
<b>Frequent plant species</b>	Distinctive species include <i>Acoelorrhaphe wrightii</i> , <i>Attalea cohune</i> , <i>Bactris mexicana</i> , <i>Cryosophila stauracantha</i> , <i>Pinus caribaea</i> , <i>Dracaena americana</i> , <i>Heliconia vaginalis</i> , <i>Gynerium sagittatum</i> , <i>Scleria bracteata</i> , <i>Xylopia frutescens</i> , <i>Amphitecna latifolia</i> , <i>Hirtella americana</i> , <i>Hirtella racemosa</i> , <i>Licania hypoleuca</i> , <i>Calophyllum brasiliense</i> , <i>Chrysobalanus icaco</i> , <i>Combretum laxum</i> , <i>Terminalia amazonia</i> , <i>Erythroxylum guatemalense</i> , <i>Acosmium panamense</i> , <i>Dialium guianense</i> , <i>Senna papillosa</i> , <i>Calliandra houstoniana</i> , <i>Lonchocarpus rugosus</i> , <i>Casearia sylvestris</i> , <i>Laetia thamnia</i> , <i>Zuelania guidonia</i> , <i>Lacistema aggregatum</i> , <i>Miconia impetiolaris</i> , <i>Mouriri exilis</i> , <i>Tococca</i> sp., <i>Siparuna thecaphora</i> , <i>Compsoeura sprucei</i> , <i>Heisteria media</i> , <i>Passiflora pittieri</i> , <i>Bredemeyera lucida</i> , <i>Tetracera volubilis</i> , <i>Cassipourea guianensis</i> , <i>Geophila repens</i> , <i>Gonzalagunia panamensis</i> , <i>Guettarda combsii</i> , <i>Hamelia rovirosae</i> , <i>Morinda panamensis</i> , <i>Psychotria poeppigiana</i> , <i>Simarouba glauca</i> , <i>Vitex kuylenii</i> , <i>Vitex gaumeri</i> , <i>Virola koschnyi</i> , <i>Vismia ferruginea</i> and <i>Vochysia hondurensis</i> .
	
<b>Faunistic comments</b>	Mammals using this ecosystem include White-tailed Deer, Red Brocket Deer, Mexican Black Howler Monkey, Nine banded Armadillo, Jaguar, Puma, Raccoon, Baird’s Tapir, and Collared Peccary.  Birds commonly listed for this ecosystem include Gray Hawk, Roadside Hawk, Laughing Falcon, Black-faced Grosbeak, Blue-black Grosbeak, Blue Ground Dove, Short-billed Pigeon, Brown Jay, Chachalaca, Ivory-billed Woodcreeper, Black-faced Antrush, Yellow-billed Cacique, Montezuma Oropendola, Pale-billed Woodpecker, Red-lored Parrot, Olive-throated Parakeet, Keel-billed Toucan, Red-throated Ant Tanager, Little Tinamou, Spot-breasted Wren, Black-headed Trogon, Northern Bentbill and Lesser Greenlet.
<b>References</b>	Meerman 1999a, Wright et al. 1959: 8, 8a, 8b, 8c, Iremonger and Brokaw 1995: I.2.1.4.  Picture: <i>Vochysia hondurensis</i> : J. Meerman

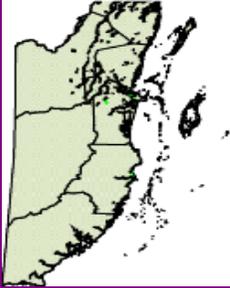
<b>UNESCO code</b>	<b><u>I.A.1.g.(1).(a)</u></b>
<b>Name</b>	<b><u>Tropical evergreen broadleaf lowland swamp forest</u></b>
<b>Location</b>	Restricted to low lying areas in the Toledo District at altitudes below 50 m. Found in the 2500 - 4000 mm annual rainfall areas of southern Belize with a dry season from February through May.
	
<b>Geology and soil</b>	Late Cretaceous – Early Tertiary Toledo Beds and Recent Alluvium. Mostly calcium poor.
<b>Water regime</b>	Ill drained, often waterlogged for part of the year.
<b>Fire exposure</b>	Uncommon
<b>Description</b>	Swampy thickets of thin stemmed trees and shrubs without emergents in the high rainfall areas of southern Belize. Some hog-wallow micro-relief exists.
	
<b>Frequent plant species</b>	Frequently encountered plants in these forests are <i>Attalea cohune</i> , <i>Bactris major</i> , <i>Bactris mexicana</i> , <i>Calyptrogyne ghiesbreghtiana</i> , <i>Vriesea gladioliflora</i> , <i>Vriesea heliconioides</i> , <i>Scleria bracteata</i> , <i>Heliconia vaginalis</i> , <i>Bravaisia integerrima</i> , <i>Lacmellea standleyi</i> , <i>Malouetia guatemalensis</i> , <i>Thevetia ahouai</i> , <i>Aristolochia belizensis</i> , <i>Pachira aquatica</i> , <i>Chrysobalanus icaco</i> , <i>Hirtella racemosa</i> , <i>Licania hypoleuca</i> , <i>Licania platypus</i> , <i>Calophyllum brasiliense</i> , <i>Garcinia intermedia</i> , <i>Symphonia globulifera</i> , <i>Terminalia amazonia</i> , <i>Amanoa guianensis</i> , <i>Dialium guianense</i> , <i>Hymenaea courbaril</i> , <i>Cojoba graciliflora</i> , <i>Inga cocleensis</i> , <i>Acosmium panamense</i> , <i>Andira inermis</i> , <i>Dalbergia cubilquitzensis</i> , <i>Dalbergia stevensonii</i> , <i>Lonchocarpus hondurensis</i> , <i>Lonchocarpus guatemalensis</i> , <i>Platymiscium dimorphandrum</i> , <i>Pterocarpus officinalis</i> , <i>Salacia impressifolia</i> , <i>Lacistema aggregatum</i> , <i>Grias cauliflora</i> , <i>Miconia impetolaris</i> , <i>Mouriri exilis</i> , <i>Mouriri myrtilloides</i> , <i>Tococa guianensis</i> , <i>Carapa guianensis</i> , <i>Swietenia macrophylla</i> , <i>Eugenia aeruginea</i> , <i>Passiflora pittieri</i> , <i>Cassipourea guianensis</i> , <i>Amaioua corymbosa</i> , <i>Guettarda combsii</i> , <i>Hamelia rovirosae</i> , <i>Psychotria poeppigiana</i> , <i>Randia aculeata</i> , <i>Randia genipifolia</i> , <i>Pouteria campechiana</i> , <i>Sterculia mexicana</i> , <i>Vitex kuylenii</i> , <i>Vochysia hondurensis</i> .  In the Sartsoon Temash National Park, species also include: <i>Euterpe precatoria</i> and <i>Manicaria saccifera</i> . In Aguacaliente Wildlife Sanctuary, <i>Amanoa guianensis</i> is dominant.
	
<b>Faunistic comments</b>	Mammals recorded from this ecosystem include: Mexican Black Howler Monkey, Paca, Agouti, White-tailed Deer, Baird's Tapir, Collared Peccary, and Jaguar.  Some birds include: Roadside Hawk, Bat Falcon, American Pigmy Kingfisher, Limpkin, Blue-black Grossbeak, Brown Jay, Chachalaca, Squirrel Cuckoo, Ivory-billed Woodcreeper, Variable Seedeater, Yellow-billed Cacique, Montezuma Oropendola, White-collared Manakin, Red-lored Parrot, Great Antshrike, Barred Antshrike, Yellow-throated Euphonia, White-breasted Wood Wren, Spot-breasted Wren, Black-headed Trogon, Great Kiskadee, Slate-headed Tody Flycatcher, Yellow-olive Flycatcher,
<b>References</b>	Meerman 1999a, Meerman 2004, Meerman 2006, Wright et al. 1959: 14,14a, 14b, 14c; Iremonger and Brokaw 1995: 1.1.1.1.2.1.  Picture top: Punta Gorda, Toledo district. J. Meerman Bottom: <i>Heliconia vaginalis</i> . J. Meerman

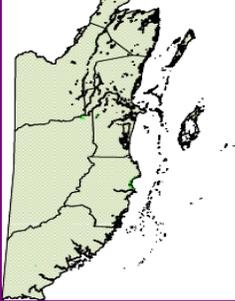
<b>UNESCO code</b>	<b><u>I.A.2.g.(1).(a).AC</u></b>
<b>Name</b>	<b><u>Tropical evergreen seasonal broadleaf lowland swamp forest: Aguacaliente variant.</u></b>
<b>Location</b>	<p>Restricted to the Aguacaliente Wildlife Sanctuary in the Toledo District. The elevation is barely above sealevel.</p> <p>Located in a high average rainfall zone of near 4000 mm per year with a dry season from February through May.</p>
	
<b>Geology and soil</b>	Recent sediments
<b>Water regime</b>	Seasonally inundated. Partial or even total flooding can last up to 7 months in a year.
<b>Fire exposure</b>	Normally not affected but severely damaged by fires following hurricane Iris in 2001. Currently probably less than half of its original extend is still in good shape.
<b>Location</b>	Restricted to the Aguacaliente Wildlife Sanctuary in the Toledo District.
<b>Description</b>	<p>This variant is found around the Lu Ha or Aguacaliente lagoon in the Toledo district. The forest is low of stature (&lt;10 m) with a very open under story. Flooding is frequent and occasionally the water in the forest can be up to 2 m deep. The Myrtaceae <i>Eugenia aeruginea</i> can achieve monospecific stands.</p>
	
<b>Frequent plant species</b>	<p>Dominated by the Myrtaceae <i>Eugenia aeruginea</i>. With secondary species such as <i>Lonchocarpus hondurensis</i>, <i>Dalbergia glabra</i>, <i>Pachira aquatica</i> and <i>Chrysobalanus icaco</i>. Species less commonly encountered include <i>Acoelorrhaphe wrightii</i>, <i>Alibertia edulis</i>, <i>Bactris</i> spp., <i>Calyptanthes chytraculia</i>, <i>Clidemia</i> sp., <i>Conarus lambertii</i>, <i>Guadua longifolia</i>, <i>Lonchocarpus castilloi</i>, <i>Lonchocarpus rugosus</i>, <i>Randia</i> sp. and <i>Zygia</i> sp. The field layer is mainly composed of graminoids including <i>Scleria</i> spp. Epiphytes such as <i>Aechmea tillandsioides</i>, <i>Anthurium scandens</i>, <i>Epidendrum nocturnum</i>, <i>Epiphyllum</i> sp., <i>Tillandsia balbisiana</i>, <i>T. limbata</i>, <i>T. streptophylla</i>, <i>T. utriculata</i>, <i>Vittaria</i> sp. and <i>Vriesea</i> sp. are abundant.</p>
	
<b>Faunistic comments</b>	This ecosystem has a low biodiversity. Black-headed Trogon, Great Kiskadee and Yellow-bellied Tyranulet are common bird species. The butterfly <i>Hamadryas feronia</i> can nearly always be seen here.
<b>References</b>	<p>Meerman 1999a, Meerman, 2006, Iremonger and Brokaw 1995: I.1.1.1.2.2.</p> <p>Picture top: Aguacaliente Lagoon. Toledo district. J. Meerman</p> <p>Bottom. <i>Eugenia aeruginea</i> in fruit. Aguacaliente Lagoon. Toledo district. J.Meerman</p>

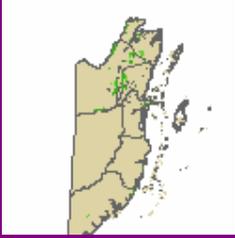
<b>UNESCO code</b>	<b><u>III.B.1.b.(a).2.</u></b>
<b>Name</b>	<b><u>Deciduous broad-leaved lowland disturbed shrubland</u></b>
<b>Location</b>	Found countrywide in various rainfall regimes, but lower than 500 m.
	
<b>Geology and soil</b>	Variable
<b>Water regime</b>	Variable but mostly well drained
<b>Fire exposure</b>	Frequently exposed to human induced fires.
<b>Description</b>	This community varies much according to its topographic position and. Disturbance may be natural, such as the displacement by a river after flooding, or, more commonly, it may be anthropogenic as when land is cleared and left fallow or disturbed by fire or land affected by "escaped" agricultural fires.
<b>Frequent plant species</b>	Variable. Mostly "weedy" species including many grasses. Typical components are: <i>Blechnum pyramidatum</i> , <i>Astronium graveolens</i> , <i>Spondias radlkoferi</i> , <i>Stemmadenia donnell-smithii</i> , <i>Thevetia ahouai</i> , <i>Dendropanax arboreus</i> , <i>Attalea cohune</i> , <i>Bactris mexicana</i> , <i>Cryosophila stauracantha</i> , <i>Desmoncus orthacanthos</i> , <i>Asclepias curassavica</i> , <i>Bidens pilosa</i> , <i>Critonia morifolia</i> , <i>Koanophyllon albicaule</i> , <i>Lasianthaea fruticosa</i> , <i>Ochroma pyramidale</i> , <i>Bursera simaruba</i> , <i>Cecropia peltata</i> , <i>Cecropia obtusifolia</i> , <i>Momordica charantia</i> , <i>Cnidioscolus multilobus</i> , <i>Dalechampia scandens</i> , <i>Schizolobium parahyba</i> , <i>Mimosa pudica</i> , <i>Mimosa hondurana</i> , <i>Lonchocarpus guatemalensis</i> , <i>Platymiscium dimorphandrum</i> , <i>Heliconia latispatha</i> , <i>Byrsonima crassifolia</i> , <i>Hampea trilobata</i> , <i>Sida acuta</i> , <i>Cedrela odorata</i> , <i>Psidium guajava</i> , <i>Catsetum integerrimum</i> , <i>Passiflora biflora</i> , <i>Passiflora serratifolia</i> , <i>Piper auritum</i> , <i>Guadua longifolia</i> , <i>Gynerium sagittatum</i> , <i>Rottboellia cochinchinensis</i> , <i>Hamelia patens</i> , <i>Allophylus cominia</i> , <i>Chrysophyllum mexicanum</i> , <i>Guazuma ulmifolia</i> , <i>Trichospermum grewiifolium</i> , <i>Vitex gaumeri</i> and <i>Zamia polymorpha</i> ,
<b>Faunistic comments</b>	The fauna in this ecosystem can be extremely varied and to some degree depends on surrounding ecosystems. Typical butterflies include: <i>Anartia fatima</i> , <i>Caligo memnon</i> , <i>Chlosyne spp.</i> , <i>Heliconius charithonia</i> and <i>Phoebis spp.</i> . Typical birds include: Rufous-tailed Hummingbird, Blue Ground Dove, Roadside Hawk, Plain Chachalaca, Brown Jay, Red-throated Ant Tanager, Black-headed Saltator and Black-headed Trogon. And typical mammals include herbivores with a preference of disturbed habitats such as the White-tailed Deer and Baird's Tapir.
<b>References</b>	Iremonger and Brokaw 1995: II.2.3.

<b>UNESCO code</b>	<b><u>III.B.1.b.(f).P</u></b>
<b>Name</b>	<b><u>Deciduous broadleaf lowland riparian shrubland of the plains</u></b>
<b>Location</b>	Nearly countrywide along the main rivers and generally below 50 m in altitude. Raifall regime varies per location.
	
<b>Geology and soil</b>	On recent alluvial deposits. Outcrops of calcareous rock occur, but generally the alluvial deposits are deep and there is no bedrock visible.
<b>Water regime</b>	Variable but mostly well drained
<b>Fire exposure</b>	Frequently exposed to human induced fires.
<b>Description</b>	Found along riversides where disturbance may be natural, such as the displacement by a river after flooding, or it may be anthropogenic as when land is cleared and left fallow.
<b>Frequent plant species</b>	Tall graminoids (reeds, rushes, and sedges) mix with shrubs, and many types of ruderal communities. Typical species include: <i>Aristolochia grandiflora</i> , <i>Attalea cohune</i> , <i>Bactris mexicana</i> , <i>Bactris major Jacq.</i> , <i>Bambusa vulgaris</i> , <i>Bauhinia divaricata</i> , <i>Bauhinia herrerae</i> , <i>Cassia grandis</i> , <i>Cecropia obtusifolia</i> , <i>Cecropia peltata</i> , <i>Cestrum nocturnum</i> , <i>Enterolobium cyclocarpum</i> , <i>Ficus insipida</i> , <i>Guadua longifolia</i> , <i>Guazuma ulmifolia</i> , <i>Gynerium sagittatum</i> , <i>Heliconia latispatha</i> , <i>Inga vera</i> , <i>Lonchocarpus guatemalensis</i> , <i>Mimosa pudica</i> , <i>Mimosa pellita</i> , <i>Momordica charantia</i> , <i>Passiflora biflora</i> , <i>Schizolobium parahyba</i> , <i>Scleria bracteata</i> , <i>Spondias radlkoferi</i> , <i>Tabebuia rosea</i> and <i>Trichospermum grewiifolium</i> .
<b>Faunistic comments</b>	The fauna in this ecosystem can be extremely varied and to some degree depends on surrounding ecosystems. Typical butterflies include: <i>Anartia fatima</i> , <i>Caligo memnon</i> , <i>Chlosyne spp.</i> , <i>Heliconius charithonia</i> and <i>Phoebis spp.</i>  Typical birds include: Kingfishers, Black-headed Saltator, Grayish Saltator, Blue Ground Dove, Tawny-winged woodcreeper, Ivory-billed Woodcreeper, Green-backed Sparrow, Rufous-breasted Spinytail, Yellow-billed Cacique, Montezuma Oropenola, Gray Catbird, Ovenbird, White-collared Manakin, Red-capped Manakin, Dusky Antbird, Barred-Antshrike, Gray-headed Tanager, Red-throated Ant Tanager, Spot-breasted Wren and Wood Thrush.  Mammals include Mexican Black Howler Monkey, Opossums, Raccoons, Nine-banded Armadillo, River Otter, White-tailed Deer and Baird's Tapir,
<b>References</b>	Iremonger and Brokaw 1995: II.2.3.

<b>UNESCO code</b>	<u>V.A.2.c.(g)</u>
<b>Name</b>	<u>Swamp grassland without trees or shrubs</u>
<b>Location</b>	<p>Restricted to the Aguacaliente Wildlife Sanctuary in the Toledo District where it occurs barely above sealevel.</p> <p>Occurs in a high average rainfall zone of near 4000 mm per year with a dry season from February through May.</p>
	
<b>Geology and soil</b>	On recent alluvial deposits
<b>Water regime</b>	Seasonally inundated. The area is flooded up to 8 months each year.
<b>Fire exposure</b>	Normally unaffected but fires along the fringes were common following the destruction of the surrounding forest by hurricane Iris in 2001
<b>Description</b>	Annual grassland developing during a 4-5 month dry season. It has only been observed in the Aguacaliente Swamp (Aguacaliente Wildlife Sanctuary) in the Toledo District. The area is a seasonally flooded basin bordered by forest (I.A.2.g.(1).(a).AC: Tropical evergreen seasonal broadleaf lowland swamp forest: Aguacaliente variant).
	
<b>Frequent plant species</b>	Dominated by the grass <i>Neeragrostis contrerasii</i> , which forms a sward at about 15-20 cm, with occasional other herbaceous vegetation such as <i>Ludwigia octovalvis</i> , <i>Cyperus articulatus</i> , <i>Lippia stoechadifolia</i> , <i>Solanum campechiense</i> and <i>Spigelia polystachya</i> .
	
<b>Faunistic comments</b>	<p>This ecosystem surrounds the Aguacaliente Lagoon system which is an important wintering site for Herons, Egrets, Sandpipers, Ducks, Cormorants and others. This is one of the few locations where the Buff breasted Sandpiper can be seen on occasion.</p> <p>Interestingly, this ecosystem appears to be affected to some extent by Tilapia. During high water, Tilapia breeds in the submerged wetlands and digs large nesting craters. Several Chiclid fishes do this, but the Tilapia nests may be up to 3 ft in diameter. During low water, this ring of soil is slightly elevated and supports a different vegetation than just the grass. Typically, old Tilapia nests can thus be recognized by a ring of <i>Mimosa</i> or other shrubs and herbs.</p>
	
<b>References</b>	<p>Meerman, 2006. Iremonger and Brokaw 1995: III.1.1.2.2</p> <p>Pictures top to bottom: Ecosystem overview, Flowering <i>Neeragrostis contrerasii</i> and Buff-breasted Sandpipers. All pictures: Jan Meerman</p>

<b>UNESCO code</b>	<b><u>V.D.1.a.(1)</u></b>
<b>Name</b>	<b><u>Eleocharis marsh</u></b>
<b>Location</b>	Found throughout the lowlands at elevation of less than 50 m. Ranfall regimes are variable
	
<b>Geology and soil</b>	On alluvial deposits. Soils often peaty over clay.
<b>Water regime</b>	Mostly inundated, frequently with water of a somewhat higher salinity
<b>Fire exposure</b>	In savanna areas potentially exposed to fires.
<b>Description</b>	These almost monospecific marshes may be found in waterlogged plains, fringed with shrubs. The height of the herb layer is about 50 cm. Common in small patches in short-grass savannas but mostly too small to be mapped. A good example of this ecosystem can be found along the Hopkins road in the Stann Creek district.
	
<b>Frequent plant species</b>	The dominant species is an <i>Eleocharis</i> sp. Additional plant species commonly found here include <i>Blechnum serrulatum</i> , <i>Centrosema</i> sp., <i>Crinum erubescens</i> , <i>Hyptis</i> sp., <i>Ludwigia</i> spp., <i>Mimosa peltita</i> , <i>Sagittaria lancifolia</i> and <i>Thalia geniculata</i> .
<b>Faunistic comments</b>	The ecosystem is a habitat for wading birds. A notable component is also the large apple snail : <i>Pomacea flagellata</i> .
<b>References</b>	Meerman 1999a, Meerman and Boomsma 1995a, Rejmánková et al. 1996, Iremonger & Brokaw III.1.1.2.1.  Picture: Hopkins, Stann Creek District. J. Meerman

<b>UNESCO code</b>	<b><u>VII.B.1.a.</u></b>
<b>Name</b>	<b><u>Tropical lowland reed-swamp</u></b>
<b>Location</b>	Nearly countrywide at elevations geneally lower than 50 m irrespective of rainfall regime.
	
<b>Geology and soil</b>	Over recent alluvium, soils usually peaty.
<b>Water regime</b>	Inundated through much of the year, increasing salinity will favor the development of <i>Cladium jamaicense</i> , while increasing nutrient availability will favor the development of <i>Typha domingensis</i> .
<b>Fire exposure</b>	Fire is of at least occasional occurrence in this ecosystem
<b>Description</b>	An open terrain dominated by tall graminoids. Level of inundation may vary. Good examples are found near Hopkins village.
	
<b>Frequent plant species</b>	Graminoid species such as <i>Typha domingensis</i> , <i>Phragmites australis</i> and/or <i>Cladium jamaicense</i> dominate with addition of semi-aquatic shrubs such as <i>Mimosa pellita</i> . In the Stann Creek district, the sedge <i>Cyperus giganteus</i> is common. In the Aguacaliente Lagoon area the grass <i>Hymenachne amplexicaulis</i> dominates. Locally the Maranthaceae <i>Thalia geniculata</i> is a dominant species. The latter probably indicates a transition to Predominantly tall herbaceous reedland.
<b>Faunistic comments</b>	These wetlands form a habitat for many of the smaller wading birds such as Least Bittern, Green Heron, Pinated Bittern and Limpkin. Raccoons are typical mammals for this ecosystem.
<b>References</b>	Picture: Commerce Bight Lagoon, Stann Creek District. J. Meerman

<b>UNESCO code</b>	<b><u>S.A.1.b (4)(b).</u></b>
<b>Name</b>	<b><u>Fresh Water Lake</u></b>
<b>Location</b>	Countrywide at lowland (< 50 m) elevations. Particularly prevalent in Northern Belize. Rainfall regimes vary.
	
<b>Geology and soil</b>	Variable
<b>Water regime</b>	Standing or slowly flowing fresh water but water level may fluctuate strongly. Some lakes may occasionally dry up during the dry season.
<b>Fire exposure</b>	NA
<b>Description</b>	Belizean lakes can vary from very small and shallow to very large such as the New River Lagoon which is up to 30 m deep. Most have a limestone influence. Vegetation in the deeper lakes is restricted to the outer fringes where average depth does not exceed 2m.
	
<b>Frequent plant species</b>	Typical species include <i>Nymphaea ampla</i> , free floating <i>Utricularia</i> spp., <i>Cabomba palaeformis</i> , <i>Vallisneria americana</i> and blue green algae The shores are often rimmed with <i>Eleocharis</i> spp.  See also VIIC1 (Rooted floating leaf communities of fresh water lakes) and VIID2 (Rooted underwater communities of flowing water).
<b>Faunistic comments</b>	Species this zone include the Apple Snail ( <i>Pomacea flagellata</i> ) which is probably a keystone species in the lagoon. Animals that hunt this snail in this zone include the Snail Kite and the Morelet's Crocodile ( <i>Crocodylus moreletii</i> ). Northern Jacana's walk over the Water Lily leaves on the hunt for insects. Many dragonflies and damselflies use this zone for oviposition. Mammals in this zone include Neotropical River Otter and Where there is easy access to the sea: Manatee ( <i>Trichechus manatus</i> ). The deeper water zones is the element for fish species such as Tarpon: <i>Megsalops atlanticus</i> and Threadfin Shad: <i>Dorasoma petenense</i> .
<b>References</b>	Cabrera & Sanchez, 1994.  Rejmánková et al. 1996.  Meerman, J. C. 2006. Ecological Characterization of the New River Lagoon, Orange Walk District. Belize. Report to Programme for Belize. 31. pp.  Picture: New River Lagoon, Orange Walk District. J. Meerman

## 4.2. Flora

Within the actual confines of the AWS, 213 plant species were identified belonging to 70 families (Appendix).

There are some plants that appear characteristic for Aguacaliente Wildlife Sanctuary. These include:



*Neeragrostis contrerasii*, Poaceae. Aguacaliente Lagoon, Toledo District, Belize.

This is the dominant species in the “Swamp Grassland Without Trees or Shrubs”

This grass sprouts immediately after the water goes down in February, grows very quickly to a height of about 10”, flowers and sets seed before the area gets flooded again in late May or June.



ID by Gerrit Davidse, Missouri Botanical Gardens and Steven Brewer, University of North Carolina at Wilmington.

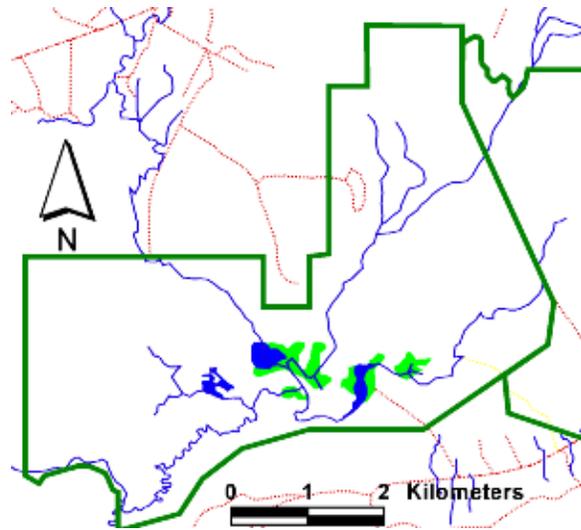


Figure 11. Pictures and distribution map of *Neeragrostis contrerasii*



*Hymenachne amplexicaulis*. This grass is a dominating feature in the “Tropical Lowland Reed Swamp” between the 2nd and 3rd lagoon. It floats in large masses in water up to 1 m deep. This is a wetland species, inhabiting margins of swamps, river floodplains, and drainage canals, throughout the American tropics, mostly in water to about 2 m deep, occasionally extending into water 3-4 m deep. It can be grown for pasture in natural or artificially inundated pondage areas. On seasonally flooded floodplains, it needs over 1 m of water during the wet season to persist. It has low drought tolerance, not spreading beyond the wet zone, and low salt tolerance, not surviving even occasional tidal impact.

ID by Gerrit Davidse, Missouri Botanical Gardens

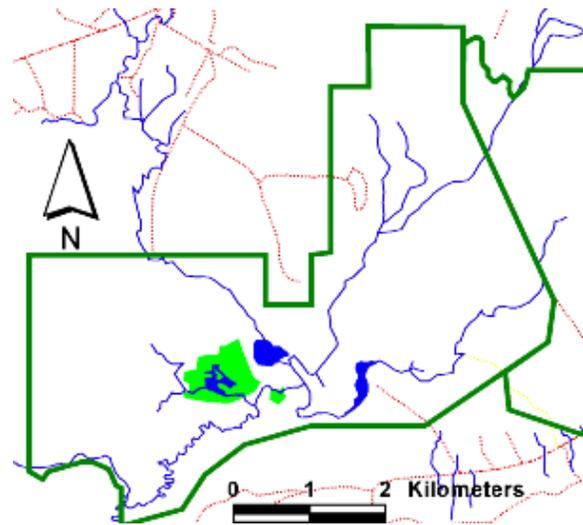


Figure 12. Pictures and distribution map of *Hymenachne amplexicaulis*

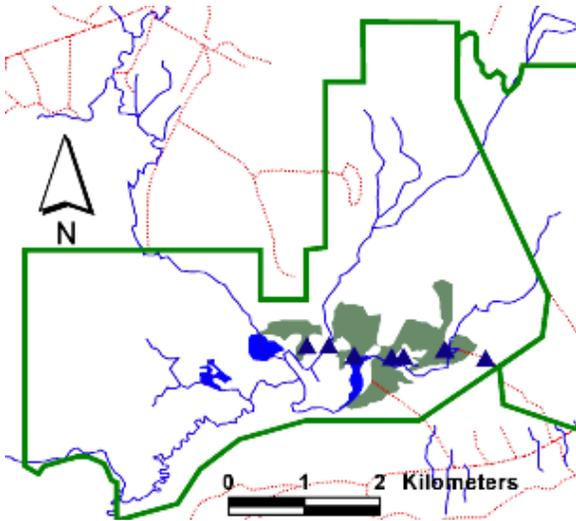


*Eugenia aeruginea*. Myrtaceae. This is the characteristic species in the “Tropical evergreen broad-leaved lowland swamp forest, Aguacaliente variant”. The species is not unique to Aguacaliente Wildlife Sanctuary but it occurs country wide in swampy conditions. Nearly pure stands however, are only known from AWS. Interestingly the pure *Eugenia* stands of this forest type seem to have survived the effects of hurricane Iris better than the other forest ecosystems.



The flowers from this *Eugenia* are white, the cylindrical fruit turn orange when ripe. ID by Bruce Holst. Mary Selby Botanical Gardens.

**Figure 13. Pictures and distribution/specimen map of *Eugenia aeruginea*.**





*Lonchocarpus hondurensis*. Fabaceae: Papilionoideae. This is another species found in the “Tropical evergreen broad-leaved lowland swamp forest, Aguacaliente variant”. It often grows mixed with *Eugenia aeruginea*, but it is more typical for stream-sides and edges.

The species flowers in March-April and the paired “coin” shaped fruits (legumes) appear soon after.

This species has suffered heavily from the effects of Hurricane Iris and subsequent fires.

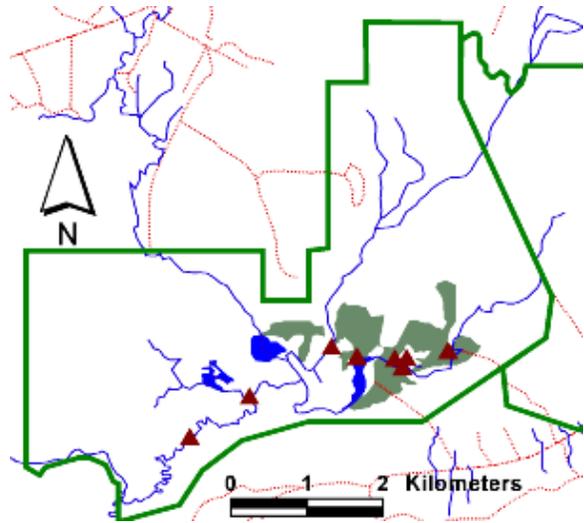


Figure 14. Pictures and distribution/specimen map of *Lonchocarpus hondurensis*



*Amanoa guianensis*. Euphorbiaceae. This can be a dominant tree species in the “Tropical evergreen broadleaf lowland swamp forest” The tree is difficult to recognize when not in flower or fruit, but the base of the tree can be helpful in identification. Especially older specimens have stilted roots, a bit like Red Mangrove (*Rhizophora mangle*), clearly an adaptation for the often inundated conditions in which the species grows.

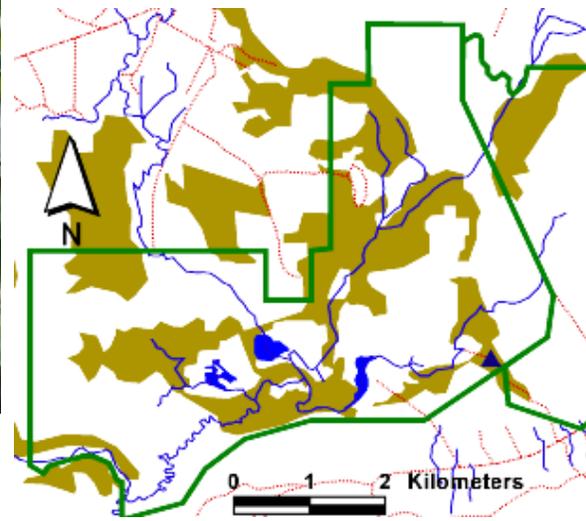


Figure 15. Pictures and distribution/specimen map of *Amanoa guianensis*

There are two plant species found within the Aguacaliente Wildlife Sanctuary that are listed in the list of Critical Species (Meerman, 2005).

These species are:

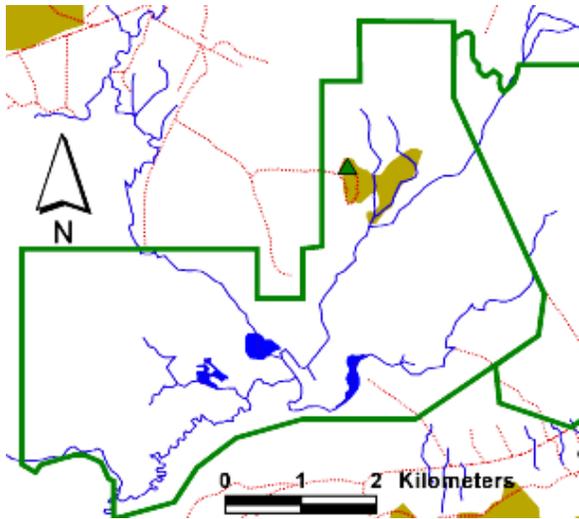


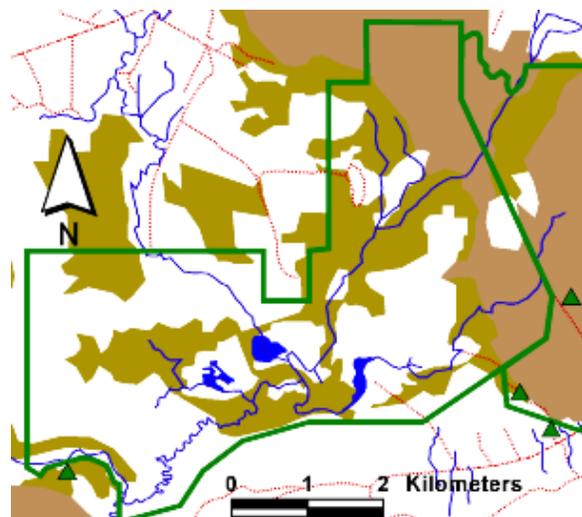
Figure 16. Distribution map of Mahogany

**Mahogany** (*Swietenia macrophylla*) is listed as vulnerable. This is an important timber species and heavily over-harvested. Within the Aguacaliente Wildlife Sanctuary this species was only encountered around the karst hills in the northern extension. The Aguacaliente Wildlife Sanctuary stands are not nationally important for the survival of the species.



Figure 17. *Zamia variegata* plant + distribution/specimen map

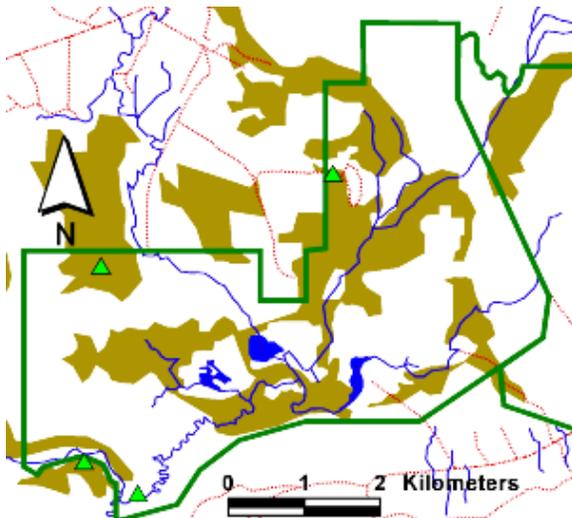
**Variegated Zamia** (*Zamia variegata*). This unusual herb (figure 10) is listed as endangered (EN) by the IUCN but listed as vulnerable (VU) in the 2005 Belize List of Critical Species. Within Aguacaliente Wildlife Sanctuary this species has been found only within the “Tropical evergreen broadleaf lowland forest over poor or sandy soils”, which covers the area between the village and the Visitors Centre. The Aguacaliente Wildlife Sanctuary has some importance for maintaining healthy stands of this species.



Other than these species of conservation interest, a fairly large number of plants was discovered which appear to be first records for Belize.



***Bravaisia integerrima***. Acanthaceae. This is a dominant tree species in the “Tropical evergreen broadleaf lowland swamp forest” in the northern section of the Aguacaliente Wildlife Sanctuary. The trees are easy to recognize, even when not in flower or fruit, since they have many thin stilt roots, a bit like Red Mangrove (*Rhizophora mangle*), clearly an adaptation for the often inundated conditions in which the species grows.



**Figure 18.** Picture of *Bravaisia integerrima* and specimen/possible distribution map.



**Figure 19.** *Ceratopteris thalictroides*. This is a semi-aquatic fern which occurs throughout the tropics. The plant is popular in aquariums and therefore well documented. The plant grows usually rooted in the mud, but it can also be found floating. The sterile leaves are broad and can act as flotation devices for the plant. The fertile leaves look very different and are very finely divided. Fertile leaves usually stick out of the water. Plants have been found in rice fields at the northern boundary of the Aguacaliente Wildlife Sanctuary.



**Figure 20** *Marsilea* sp.

Another semi-aquatic fern. The genus is very distinctive with its “four-leaf clover” leaves. The plant always grows rooted in the mud. The specimen was found in a rice field at the northern boundary of the Aguacaliente Wildlife Sanctuary. Unfortunately, the plant was in a sterile phase and it can not be identified to species until fertile leaves are available.



**Figure 21.** *Sagittaria guyanensis*.

Alismataceae. This species looks a bit like a water lily but the flowers are very different. It typically grows in very shallow water and mud. It is very common on the muddy access trail from Laguna village to the sanctuary. It was also found in rice fields at the northern boundary of the Aguacaliente Wildlife Sanctuary and can certainly be expected to occur within the sanctuary itself.



**Figure 22.**

*Trichostigma octandrum* Phytolaccaceae. Shrubby vine along the trail to the karst hills along the NW boundary.

In addition there are some **exotic** species in the Aguacaliente Wildlife Sanctuary. The most noticeable exotic is the “Devils-grass” *Rottboellia cochinchinensis*. This South-east Asian species was probably brought in with rice seeds and it is now a major pest in cleared areas and in patches with illegal agriculture. Within the Aguacaliente Wildlife Sanctuary it is relatively scarce, but has small stands in recently burned areas. It is very prevalent in adjacent ricefields.

## 5. Fauna

### 5.1. Invertebrates

The invertebrate fauna was not the main focus of the REA. Nevertheless, data was collected in an opportunistic way. The species attended to were mainly Lepidoptera or butterflies. In total 23 butterfly species belonging to 5 families, were recorded. This number reflects the low effort. For a place like Aguacaliente, the ultimate species list can be expected to exceed 300-400.



Figure 23. *Hylephyla phyleus*. Common butterfly in the Swamp Grassland

## 5.2. Fish

The fish fauna of Aguacaliente was not a focus of this REA. The fish fauna was supposed to be assessed by a Tilapia study project funded by IABIN. Unfortunately, this survey never took place. Instead we managed to record fishes on an opportunistic basis and reach a species list of 11 species belonging to 5 families (Appendix). A key species, if not in numbers, but at least in economic impact is the Tilapia (*Oreochromis nilotica*),

The fact that this study failed to materialize is regrettable as the fish fauna plays a critical role in the ecological functioning of the area.

The lagoons are a very productive area. The massive flooding that occurs annually increases the fish habitat tremendously, increasing both breeding and feeding sites. Once the dry season starts, the water level drops and all the fish are forced into an increasingly diminishing amount of water.

It is this high productivity combined with the extremely low water levels during the dry season, which makes the area so attractive and important for water birds.

The high productivity also makes the area attractive to people. For generations people from the surrounding communities have used the lagoons for fishing. Typically this fishing would be carried out using seine nets. Nowadays the AMT is trying to discourage the use of seine nets but allows hand-line fishing.

Over-fishing would most probably have a direct negative impact on other wildlife dependant on this resource, particularly the many birds that feed on the trapped fish in the beginning of the dry season. This over-fishing and resulting bird population decline would impact the appreciation, and rationale, of the area as a sanctuary.

Nevertheless, moderate impact line fishing would probably be quite compatible with the objectives of the sanctuary. Seine fishing is to be halted completely since it removes too much of the reproductive class of virtually every economically interesting species. The best solution would be to create a zonation with a section where fishing is allowed and a larger section where any form of fishing is prohibited.



**Figure 24. Old Tilapia nest in dry swamp grassland**

### 5.3. Amphibians

Amphibians are a group of organisms that is difficult to survey outside the very restricted breeding season. As it is, the Aguacaliente Wildlife Sanctuary is probably not a key area for amphibians. Most amphibians (notably frogs and toads) rely on temporary pools that do not contain predators such as fish for their reproduction. During the rainy season, the Aguacaliente Wildlife Sanctuary is essentially one large pool filled with predatory fish. As a result, there are probably very few temporary pools that make good breeding sites. The low number of amphibians encountered (4 amphibians belonging to 3 families), reflects this. None of the species encountered are considered threatened.



Figure 25. *Rana vaillanti*. A frog found along Piedra Creek

## 5.4. Reptiles

In total 8 reptiles species belonging to 6 families were recorded (appendix). This is a fairly low number and especially the number of snakes can be expected to be much larger than what was encountered.

Interestingly only one crocodile was encountered. The Aguacaliente Wildlife Sanctuary habitat may appear highly suitable for crocodiles, yet they are next to absent. This situation is true throughout the Toledo district. Nationwide, crocodile numbers were severely depleted only a few decades ago, when commercial crocodile hunting (for their skin) was legal in Belize. Numbers actually dropped so low that for a while the once common **Morelet's Crocodile** (*Crocodylus moreletii*) was feared to be extinct. However, the Morelet's Crocodile survived and has made a surprising come-back in much of Belize's lowlands. Currently the status of the Morelet's Crocodile is listed as conservation dependent, meaning that populations are not immediately threatened, but depend on the success of conservation measures.

However, this success did not translate itself to the Toledo district. In the 1990s there were even no reliable records from the Toledo district. Currently we know that they occur (in low numbers) at least in the Temash River. And with the record in the AWS, we now also know they occur in the Moho drainage. Strangely, their numbers are surprisingly low, in spite of abundant apparently suitable habitat.

The key to this is probably the attitude of the local population. Many of the local inhabitants of the Toledo district live a self-sustaining lifestyle which includes fishing even in the more remote rivers, streams and other water bodies. What is more, these same water bodies are used for bathing and washing of clothes. As a result, crocodiles are widely seen as not only a competitor for food, but also as a potential threat for bathing children and laundering women. As a matter of course any known crocodiles are relentlessly being persecuted. This intolerant attitude has prevented crocodiles from recovering in the Toledo district.

Two other reptiles of conservation interest were recorded. One is the **Green Iguana** (*Iguana iguana*), which occurs in modest numbers along the streams. The strongly fluctuating water levels and clayey soils are probably not favorable for the reproduction of this species which prefers sand banks along rivers for laying its eggs.

Another reptile of conservation interest occurring in the Aguacaliente Wildlife Sanctuary is the Near Threatened **Common Slider Turtle** (*Trachemys scripta*) in Belize commonly known as "Bocatora". Again this species may be suppressed by the lack of suitable nesting beaches. Also it may be a victim of indiscriminate seine netting during the dry season. Many turtles are a favorite food item for many people.

Reptiles of conservation interest that are expected to occur in AWS, but could not be confirmed are the Endangered Central American River Turtle or Hickatee (*Dermatemys mawii*) and the Near Threatened Mexican Musk Turtle or Loggerhead (*Staurotypus triporcatus*).

## 5.5. Birds

Birds are the heart of Aguacaliente Wildlife Sanctuary. The wetlands attract a large number of very visible birds forming the principal attraction for visitors to the sanctuary. Miller & Miller (2006) list Aguacaliente Lagoon as an “Extremely Important” wetland for Water birds.

Based on field work carried out during this survey plus some literature records, 146 bird species belonging to 48 families have so far been recorded for the Aguacaliente Wildlife Sanctuary. This number can be expected to rise as more data gets added to the database.

Not only is there is a large number of species occurring in the AWS, but some of them occur in large numbers. Additionally, a number of birds that occur in Aguacaliente Wildlife Sanctuary have been listed as vulnerable (VU) in the List of Critical Species for Belize (Meerman, 2005). These include:

- Agami Heron: *Agamia agami* (not confirmed but extremely likely it has been known to breed along the Moho River)
- Roseate Spoonbill: *Ajaia ajaja*
- Great Blue Heron: *Ardea herodias*
- Muscovy Duck: *Cairina moschata*
- Black-Bellied Whistling Duck: *Dendrocygna autumnalis*
- Snowy Egret: *Egretta thula*
- Tricolored Heron: *Egretta tricolor*
- Jabiru: *Jabiru mycteria*
- Wood Stork: *Mycteria americana*
- Black-crowned Night-Heron: *Nycticorax nycticorax*
- Neotropic Cormorant: *Phalacrocorax brasilianus*

Miller and Miller (2006) produced list a “watch list” of species that should be “watched” as sensitive species of conservation concern. This list is considerably larger than the list of Critical Species and includes the following species that have been recorded for AWS:

Anhinga	Muscovy Duck
Black-crowned Night Heron	Black-bellied Whistling Duck.
Cattle Egret	Neotropic Cormorant
Gray-necked Woodrail	Northern Jacana
Great Blue Heron	Roseate Spoonbill
Jabiru	Snowy Egret
Green Heron	Tricolored Heron
Great Egret	American Wood Stork
Little Blue Heron	

To establish the relative importance of Aguacaliente Wildlife Sanctuary for these species and the seasonal fluctuations for these species, a monitoring program was established. The premise of this monitoring program was quite simple. Fixed monitoring points were established and monthly visits to these monitoring sites were scheduled. Monitoring was carried out by the Aguacaliente Wildlife Sanctuary team of voluntary rangers: Elam

Choc, Adriano Ack, Santos Kok and Alberto Muku. They were assisted by BTFS team member Steven Choco from Big Falls.

To begin the monitoring 2 training sessions were held, focusing on species recognition, GPS readings and data recording. During the first training session, it was decided to monitor only a subset of species, focusing on species of conservation concern that were easy to recognize and observe. Effectively, this meant the water birds that are so important for the Aguacaliente Wildlife Sanctuary.

A total of 9 fixed monitoring sites were established; 6 terrestrial sites in different forest types and 3 in the lagoons. The 6 terrestrial sites depended much on the expertise of Steven Choco who is an experienced birder. The lagoon monitoring sites with their easily recognizable species were the responsibility of the Aguacaliente Wildlife Sanctuary rangers.

Based on the training and establishment of sites and species, a monitoring protocol was prepared (Appendix).

As it turned out, monitoring was a little more complicated than it would seem. Specifically, weather conditions resulting in extensive flooding made some of the monitoring sites difficult to access. Once the AMT acquired canoes, it was easier to access the lagoon locations, but even that was troublesome at times. During extreme low water, it was possible to access the lagoon sites on foot, and during extreme high water it was very easy to access the sites by canoe, effectively navigating over much of the terrestrial vegetation. But at medium water levels, canoe access was more complex with vegetation in and around the waterways blocking easy access. This led to some months having missing data for lagoon 2, for example.

To analyze the monitoring data, all were entered in the **BERDS** (<http://www.biodiversity.bz>) monitoring database. Using that database it becomes very easy to extract monitoring results.

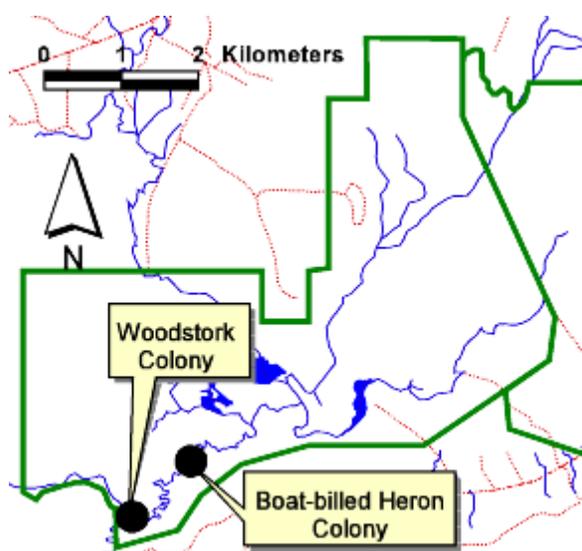


Figure 26. Location of Breeding Colonies

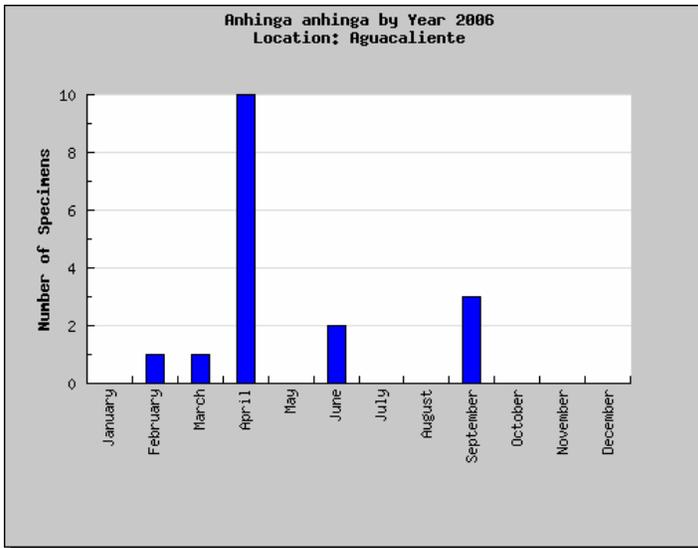
One outcome of the monitoring was the recording of some important bird breeding colonies. The presence of an American Woodstork Colony in Aguacaliente Wildlife Sanctuary has been rumored for years, but the exact location was never established. This colony is located in the extreme south western corner of the Aguacaliente Wildlife Sanctuary near the confluence of the Black Creek with the Blue Creek. In 2006, approximately 200 pair of American Woodstorks were breeding here in large trees (*Ceiba*, *Ficus*) together with a few dozen Neotropic Cormorants and Montezuma Oropendolas. A little more to the north east, along the black Creek, a colony of Boat-Billed

Heron was discovered. In August 2006, there were approximately 50 nests, many of them with eggs.

Some of the more interesting outcomes are discussed on the following pages using the graphs generated by the **BERDS** monitoring database. The data discussed here only apply for the period February through September 2006. More monitoring is taking place but the combined results of this will be published separately.

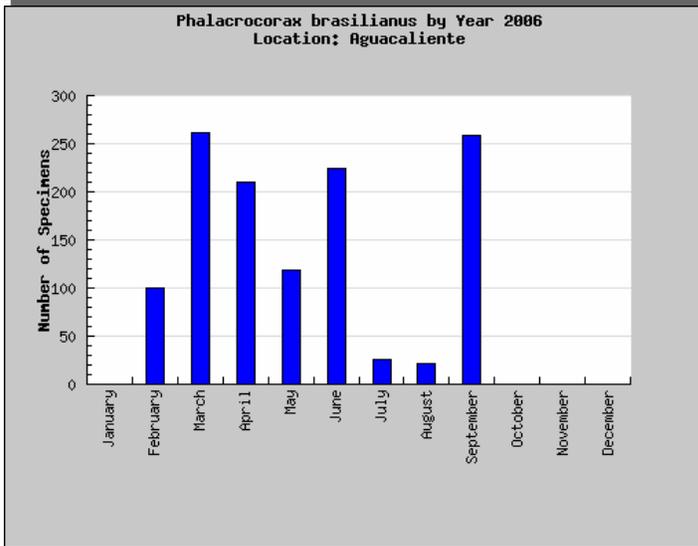


**Figure 27. American Woodstork Colony**



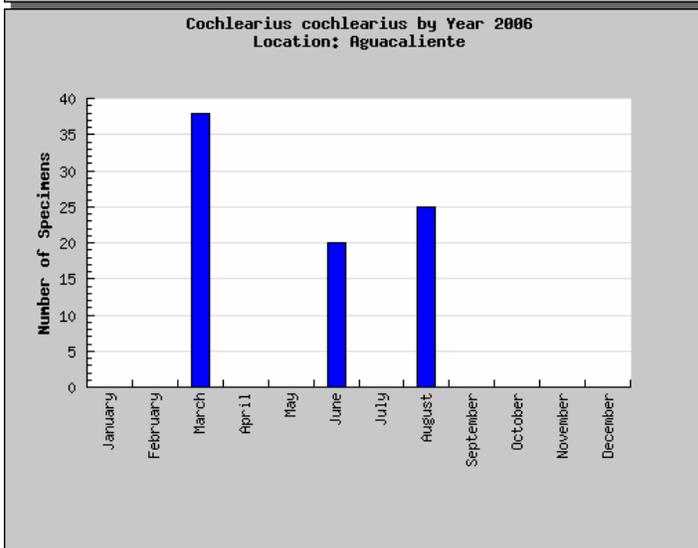
### Anhinga

Although not always noted, this appears to be a resident species in the Aguacaliente Wildlife Sanctuary in fairly low numbers. It is possible that the numbers should be higher because of potential confusion with Neotropic Cormorants.



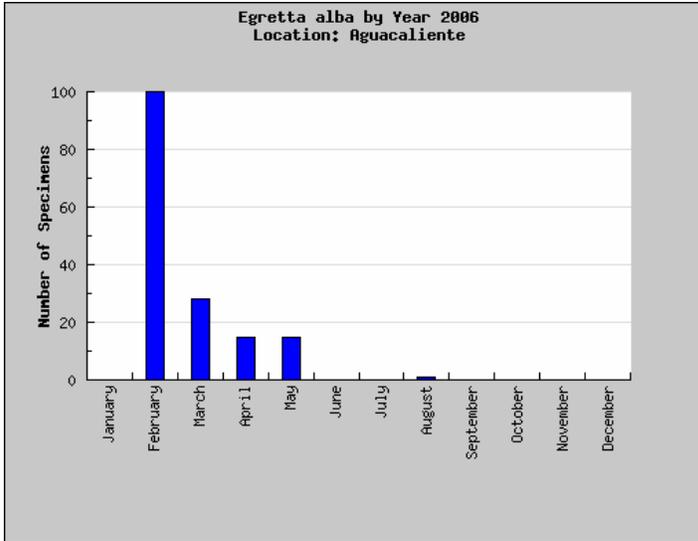
### Neotropic Cormorant

A resident and very abundant species in the Aguacaliente Wildlife Sanctuary. The species is also known to breed in the Aguacaliente Wildlife Sanctuary and nests were seen in the Woodstork Colony.



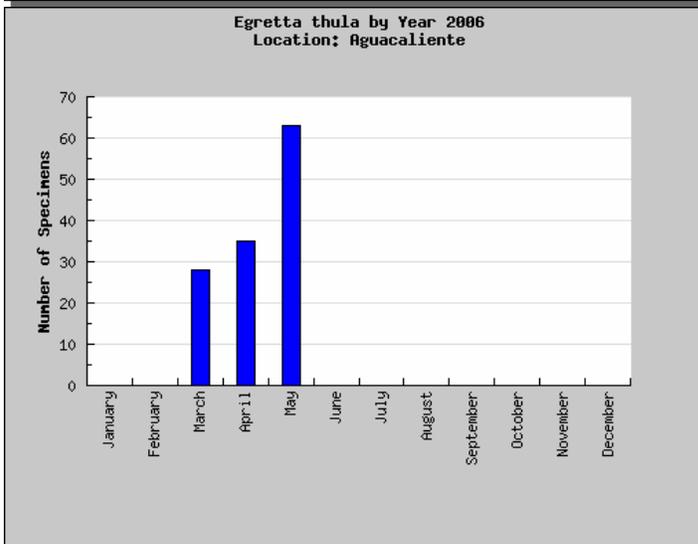
### Boat-billed Heron

Largely a nocturnal species which probably explains the erratic sighting records. The species is not only resident but also breeds in the Area.



### Great Egret

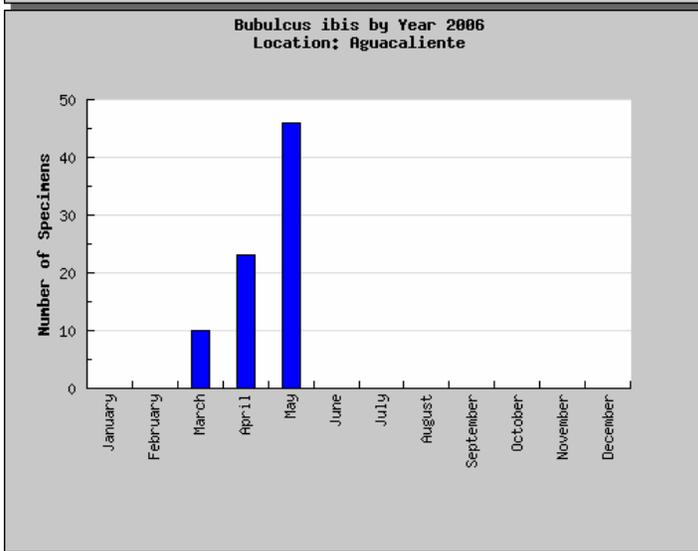
A migratory species in the Aguacaliente Wildlife Sanctuary.



### Snowy Egret

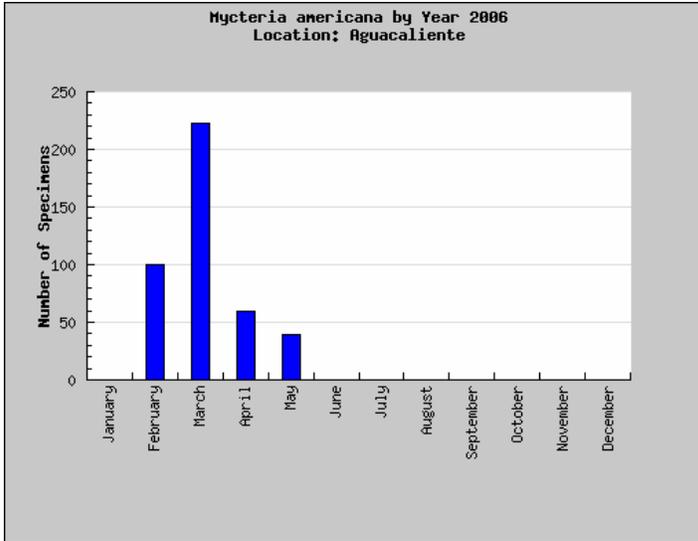
A migratory species in the Aguacaliente Wildlife Sanctuary.

Note how the numbers of Snowy Egrets increase as the number of Great Egrets decrease!



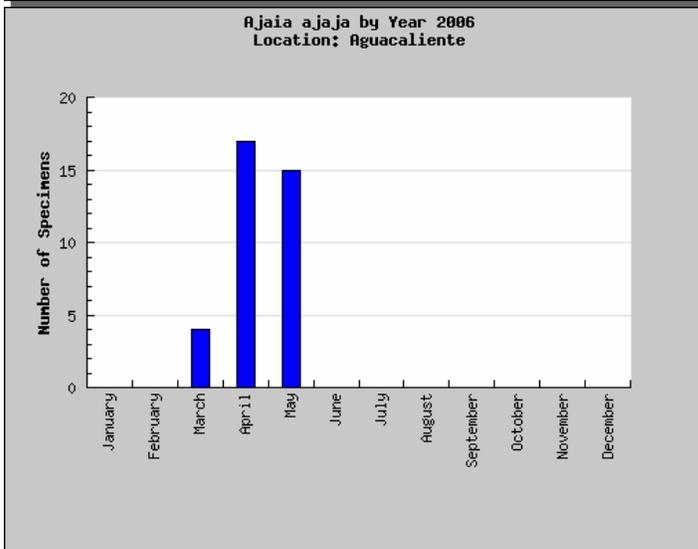
### Cattle Egret

Also a migratory species in the Aguacaliente Wildlife Sanctuary. The pattern of abundance follows that of the Snowy Egret, probably indicating a transient migratory pattern.



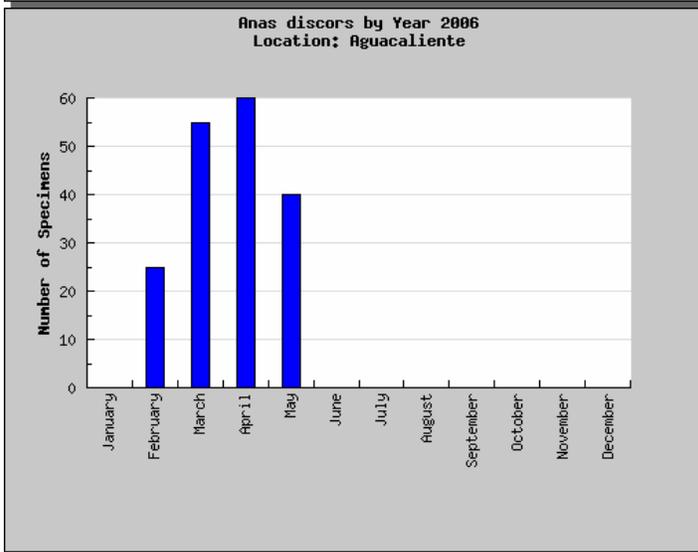
### American Woodstork

Based on the number of records, this species appears migratory. To a degree it is. Only it does breed in the area (see figure) and actually has an important colony inside the AWS, but clearly leaves its breeding grounds when the rainy season starts.



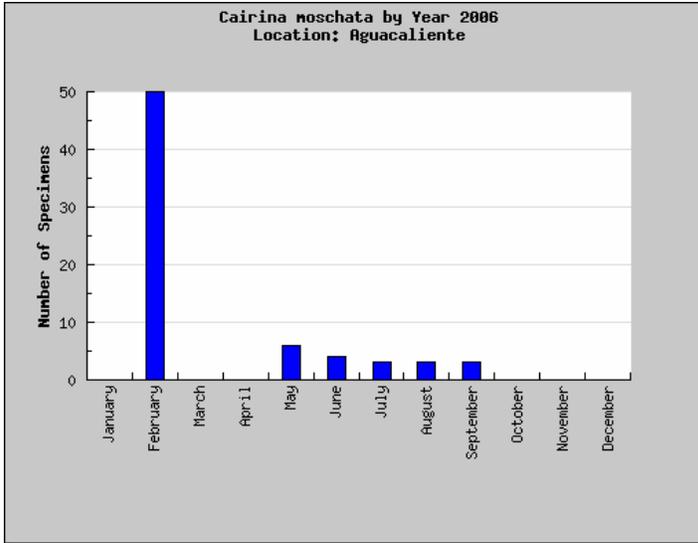
### Roseate Spoonbill

This is another species that uses the Aguacaliente Wildlife Sanctuary during the dry season. No nesting is known in the area.



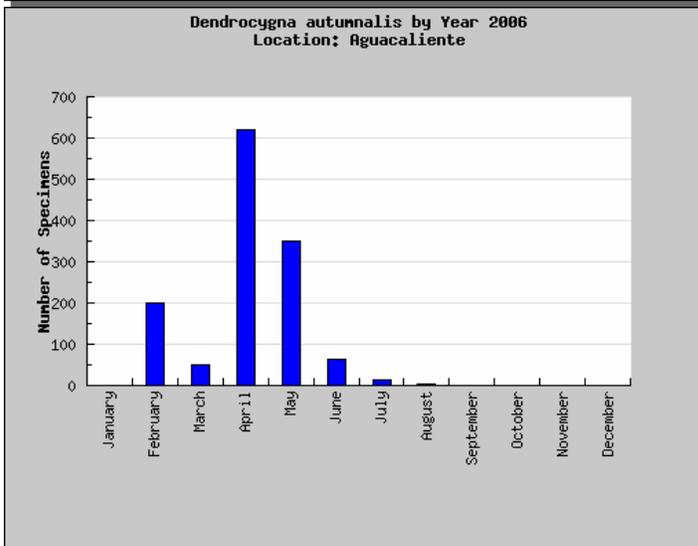
### Blue-winged Teal

A classical migratory species, present only in the “winter” months.



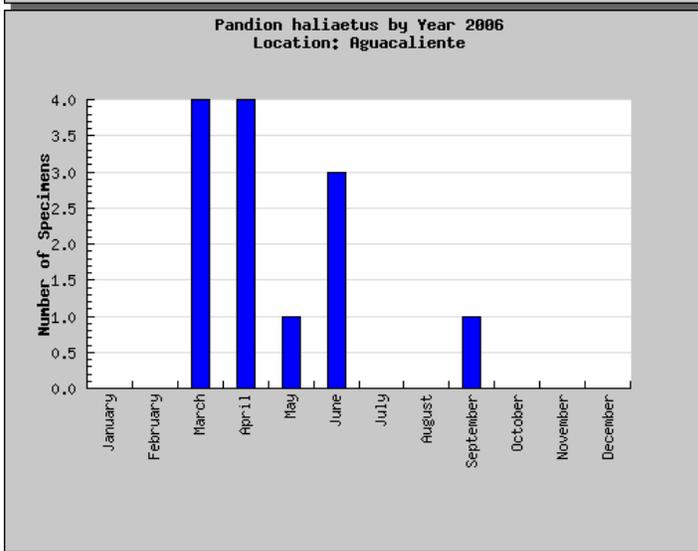
### Muscovy Duck

A resident species that could be expected to breed inside the Aguacaliente Wildlife Sanctuary. Based on the numbers recorded in February 2006, the Aguacaliente Wildlife Sanctuary could additionally be an important foraging area outside the breeding season. Nationally, the numbers of this species are very low as a result of heavy hunting pressure.



### Black-bellied Whistling Duck

These birds use the lagoons in occasionally large numbers. While this is a “resident” species, the numbers appear highest outside the breeding season, suggesting the Aguacaliente Wildlife Sanctuary as an important foraging area. Breeding, although not exactly confirmed is highly likely as birds were seen that presented defensive behaviour.



### Osprey

This bird of prey is commonly seen over the lagoons in low numbers. Figures are erratic suggesting that the area is used by transient and wandering individuals. Breeding in the Aguacaliente Wildlife Sanctuary has not been confirmed but is possible.

While most of the monitoring data is still awaiting full analysis, there is one species that warrants some attention. The Gray-throated Chat (*Granatellus sallaei*): has been reported from the “Tropical evergreen seasonal broadleaf lowland swamp forest: Aguacaliente variant” by Lee Jones (2003) prior to hurricane Iris in 2001. This local endemic species has been recorded in very few other places in Toledo District. In the north of Belize, it is typically associated with ‘bajo’ forest, but in southern Belize it is very sparsely distributed. It is interesting to note that this bird was not recorded during the 2006 REA.



**Figure 28. Buff Breasted Sandpiper, rare migrant seen near the second lagoon**

## 5.6. Mammals

In total 13 mammal species belonging to 10 families were documented for the Aguacaliente Wildlife Sanctuary (Appendix). The normally inundated conditions of much of Aguacaliente Wildlife Sanctuary may not be attractive for many mammal species. With the high land being increasingly affected by agriculture, there is less and less land available for animals to retreat to in time of flood. This may explain the low number of species recorded. Also the high hunting level may be responsible for the scarcity of mammals.

On occasion tracks of **Puma** and/or **Jaguar** were found. These signs are encouraging because they indicate that the area is still not isolated from larger areas of undisturbed habitat which act as reservoirs for these wide-ranging species.

**Black Howler Monkeys** were frequently heard, but their numbers appear low probably this is a species that suffered heavily from the impact of hurricane Iris in 2001. Possibly it is only just starting to make a come-back into the area.

There are several mammals that occur in the AWS, which are listed as species of conservation concern (Meerman, 2005). These are:

- Mexican Black Howler Monkey; *Alouatta pigra*; (Globally endangered, vulnerable in Belize.
- Ocelot; *Leopardus pardalis* (Globally and nationally vulnerable)
- Margay; *Leopardus wiedii* (Not confirmed in AWS, but likely. Globally and nationally vulnerable)
- Neotropical River Otter; *Lontra longicaudis* (Nationally vulnerable)
- Jaguar; *Panthera onca* (Globally and nationally Near Threatened)
- Puma; *Puma concolor* (Globally and nationally Near Threatened)
- Jaguarundi; *Puma yaguarondi* (Not confirmed in AWS, but likely. Globally vulnerable)
- Central American Tapir; *Tapirus bairdii* (Globally endangered, nationally vulnerable)

For each of these species counts that the area of Aguacaliente Wildlife Sanctuary is too small to make it of national importance. Particularly for the large carnivores such as Puma and Jaguar, Aguacaliente Wildlife Sanctuary is much too small to present sufficient habitat for a viable population. Jaguars in Belize have been shown to need between 900 and 1,500 hectares per individual in areas with good to reasonable prey availability (Meerman, 2005). Within the Aguacaliente Wildlife Sanctuary there is barely 1,800 hectares of marginally suitable habitat available and most of this is inundated much of the year and has low prey availability.

## 6. Threats

As concerns external threats through **agricultural** or other incursion, three particular areas were considered as having the potential to exert possible pressure:

1. on the north and west (the Blue Creek to Mafredi area), where rice fields approach the boundary,
2. The northern section around the limestone hills, where farming is already being practiced.
3. the south (Laguna area), where milpa and matahambre is practiced adjacent to the boundary.

These potential threats were considered as being particularly worrisome due to the national park's boundary not being demarcated on the ground. The integrity of the eastern boundary is currently considered as protected by being contiguous with the forest reserve.

One important threat that is related to the above is **fire**. Since hurricane Iris in 2001, fires have swept through the reserve on an annual basis, destroying more than the hurricane itself. Figure 25 depicts the key areas from which fires can be expected to originate. Vigilance from these sites should be key in preventing further fire damage.

Other issues of concern are **fishing** in the lagoons and water courses, and **hunting** throughout the protected area. It is popularly recognised that these activities have a long local history, and that there remains a residual level of both being carried out by individuals from several nearby communities. Hunting is also of concern due to the probability of occasional fires being set to draw out wildlife feeding on subsequent fresh re-growth. The other historic land use contradictory to the objectives of wildlife sanctuary designation (though not necessarily to the biological integrity of the area) used to be the driving of cattle onto the grassland in dry weather, though it appears to have now been discontinued.

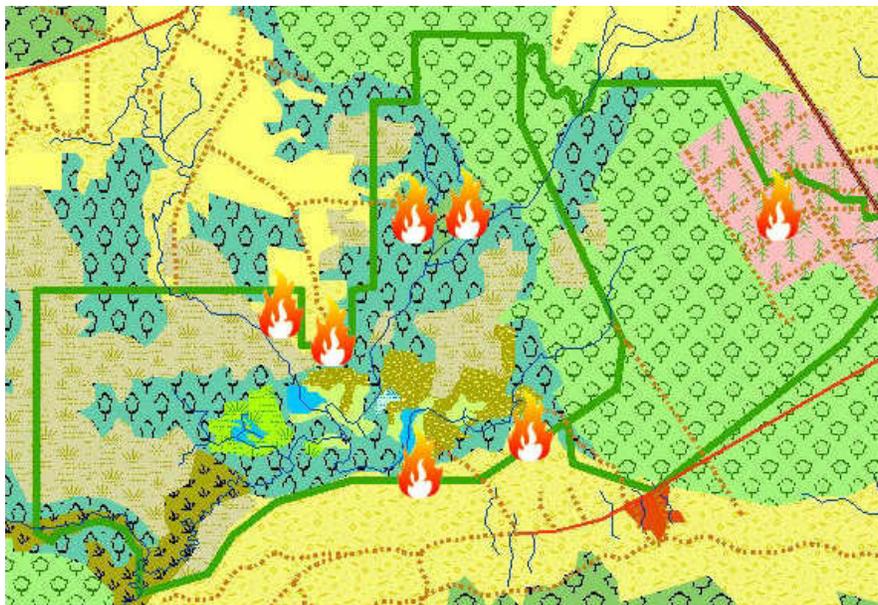


Figure 29. Fire threats. Flames indicate areas from which fires may become a problem

## 7. Zonation

While zonation of a protected area is a matter for a management plan, some comments should be made here. Based on considerations of practicality, conservation priority and tourism potential, a broad zonation scheme can be proposed.

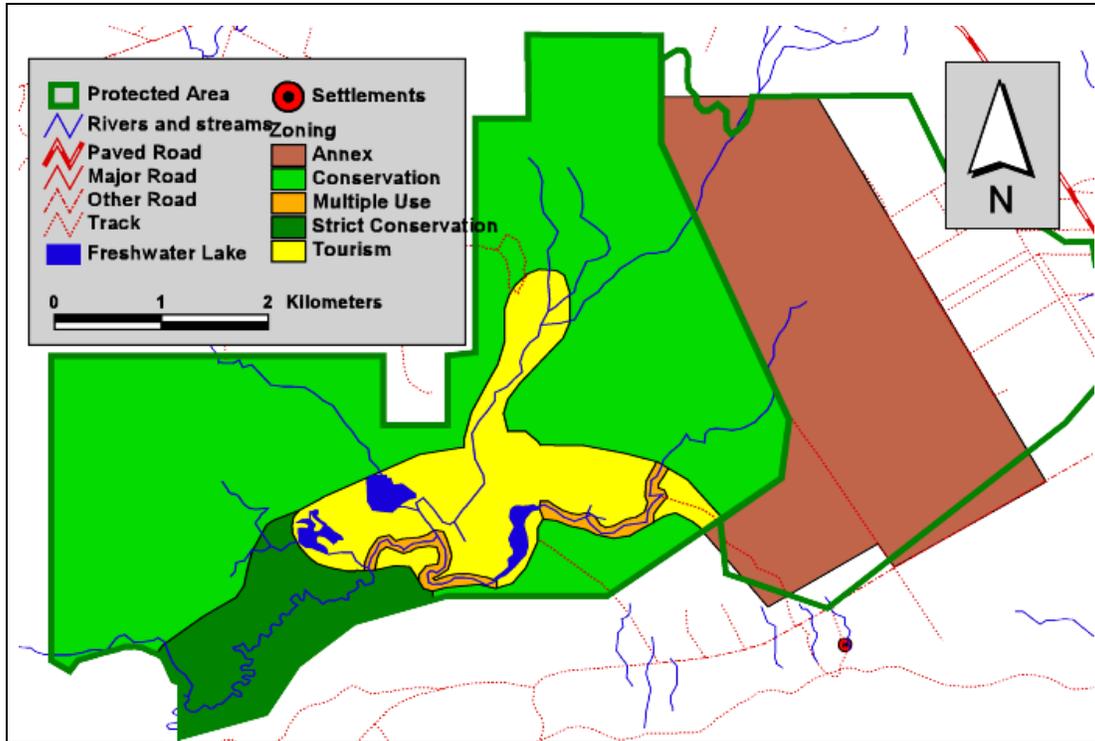


Figure 30, Proposed zonation

In this proposal 5 zones can be recognized. The approximate location of these zones is depicted in figure 26. A description of the proposed zones follows:

- **Multiple use zone:** This zone is specifically meant for traditional local use. In this case line fishing. This zone overlaps with the tourism zone.
- **Tourism zone:** This area allows visitors to access the prime bird watching areas. The hot-spring area in the north has tentatively been included in this even though there is no easy access to this area and the hot-springs themselves are at this stage not much of an attraction.
- **Conservation zone:** The remainder of the protected area. Essentially all those areas without tourism potential.
- **Strict conservation zone:** This is effectively a zone within the previous zone. It contains the major bird nesting colonies along the Black Creek. This zone should be for study and monitoring only. Tourism visits to the colonies are deemed to be too much of a risk, considering the disturbance they might cause.
- **Annex:** With the low profile of the Machaca Forest Reserve, and the need for watershed protection, a case can be made to annex part of the current Machaca Forest Reserve onto the Aguacaliente Wildlife Sanctuary.

## 8. Next steps

### 8.1. Conservation Targets

Next steps include the preparation of a management plan. This management plan should include the identification of conservation targets. Based on the current study, these conservation targets should at least include:

- The water bodies. These features have four essential components: lagoons, creeks, and ‘hot’ springs. There are seven or so lagoons, lying in the ‘heart’ of the sanctuary, which are discernable as discrete water bodies during the average dry season. In the wet season the lagoons become indistinguishable as the waters spread over the surrounding savannahs.

Three main creeks feed the lagoons: Mafredi Creek, Aguacaliente Creek, and Crique Piedra. The Blue Creek and the Moho River are also of importance but lie outside the Aguacaliente Wildlife Sanctuary. Nevertheless, these two rivers are important for the health of the Aguacaliente Wildlife Sanctuary.

‘Hot’ springs (more sulphuric than actually hot) are found at the base of the Aguacaliente Hills, where they flow into Aguacaliente Creek.

- Bird Colonies. The known bird colonies (American Woodstork, Cormorant, Oropendola and Boat-billed Heron along the Black Creek).
- Broadleaf forest. Four lowland forest vegetation classifications are included into this ecosystem: Tropical evergreen broad-leaved lowland forest on poor or sandy soils, Tropical evergreen broad-leaved lowland hill forest on steep calcareous hills, Tropical evergreen broad-leaved lowland swamp forest and the area unique **Tropical evergreen broad-leaved lowland swamp forest, Aguacaliente variant**. They form the ‘outer ring’ of the sanctuary, circling the lagoon / grass land heart of the area. Most is subject to temporary or permanent inundation; the only forest which may be free of such conditions is found solely on and around the Aguacaliente Hills. The ‘Aguacaliente variant’ is unique to the area. Much of the forest has suffered from Hurricane Iris, but especially from subsequent fires. Prevention of fires should be a prime management consideration for these forests.
- Swamp Grass land. This consists of swamp grass land without trees or shrubs, and describes the grass land / savannah found around the lagoons in the heart of the sanctuary. This, too, is unique to the sanctuary, and, in the dry season, is an attraction to visitors.

### 8.2. Compatible uses:

The management plan should include sections on compatible uses. For example, the temporary grasslands have traditionally been used for dry season grazing. This use has meanwhile been discontinued without pressure from the side of conservation. Nevertheless, the grasslands along the lagoons may be suitable for temporary grazing.

Equally, the lagoons are a very productive area. The massive floodings that occur annually increase the fish habitat tremendously, increasing breeding and feeding sites. Consequently, (hand-line) fishing could very well be tolerable within a sustainable

management plan. Anyway the fishing focuses mainly on the introduced Tilapia. Typically fishing is carried out with seine nets and hand-lines. The seine netting is extremely destructive and removes all species and size classes. As a result seine netting should not be allowed.

A tourism management plan should be worked out. This should identify the tourist attractions and decide how tourism could be developed within the Aguacaliente Wildlife Sanctuary without affecting its conservation goals.

### **8.3. Monitoring**

The monitoring program that was initiated under the REA should be continued at least for the waterbirds in the lagoons. The monitoring in the forest has proven to show less direct results and is more dependant on expert input.

Waterbird Monitoring experience gained during the 2006 season showed that accessibility during the rainy season can be problematic. When the water level is low, the monitoring sites can be accessed on foot, when the water level is extremely high; the monitoring sites are easily access by canoe. But during intermediate water levels, access can be problematic. Some of this can be resolved by clearing branches and shrubs and maintaining a free passage for the canoes at all times. However, this is laborious and time consuming.

Probably the most viable option for a monitoring program is to restrict waterbird monitoring to the dry season (February through May). This is also the most important season for the waterbirds and monitoring results should continue to yield important information.

The monitoring protocol (Appendix) remains valid even after this REA. All the species listed in this protocol as priorities should be monitored in the future, even if only at a low level. Even if no formal transects are maintained, mammals and forest birds that are listed as priorities should be recorded whenever they are encountered. Particularly the bird colonies are to be monitored on a yearly basis. These results will not only be important measures to ascertain the health of the populations concerned but also act as an important measure of management effectiveness.

All records and monitoring results should be forwarded to the Biodiversity and Environmental Resource Data System of Belize (**BERDS**: <http://www.biodiversity.bz> ) and entered into that system. This system allows for easy access and analysis of all biodiversity data.

Monitoring results involving ducks should be shared with organizations such as Ducks Unlimited. This organization recognizes the value of the Aguacaliente Wetlands for waterbirds. Also, this organization might provide assistance and training in the future.

## 9. Literature

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## 10. Appendices

<b>Transect data Swamp forest: Aguacaliente Variant</b>	<b>0</b>
<b>Species list: Plants</b>	<b>1</b>
<b>Species list: Butterflies</b>	<b>12</b>
<b>Species list: Fishes</b>	<b>14</b>
<b>Species list: Amphibians and Reptiles</b>	<b>15</b>
<b>Species list: Birds</b>	<b>16</b>
<b>Species list: Mammals</b>	<b>24</b>

Transect data from the Tropical Evergreen Lowland Swamp Forest: Aguacaliente Variant

Species	Eugeneia aeruginosa	Lonchocarpus hondurensis
0-10	12, 13, 14, 15, 14	
10-20	11, 12, 15, 12, 11	
20-30	14, 12, 11, 13, 24	
30-40	22, 13	15
40-50	14, 16, 14	
50-60	10, 29	
60-70	16, 13, 20, 11	
70-80	15, 20	
80-90	17, 10, 14	
90-100	11, 12, 13, 16, 12, 11, 16, 13	
100-110	12, 15, 16, 11, 23	
110-120	11, 15	
120-130	11, 12, 11, 14	
130-140	15, 14, 11, 14	
140-150		14
150-160		
160-170		
170-180		
180-190		
190-200		

Species	Eugeneia aeruginosa	Pachyra aquatica	Dead	Chrysobalanus icaco	
0-10	12, 17				
10-20	10, 14				
20-30	13, 14				
30-40	12, 18				
40-50	10, 10				
50-60		14	23		
60-70					
70-80					
80-90	12, 13				
90-100		18			
100-110		11			
110-120	14, 10				
120-130		11			
130-140	11, 15, 14				
140-150			35	15	
150-160	11, 11				
160-170		11		19, 19	
170-180	10, 13				
180-190		12		19	20
190-200	13, 14, 10				20

Count and dbh measurement of trees > 10 cm dbh within each 10 meter segment of the transect

	Species	<i>Amanoa guianensis</i>	<i>Calophyllum brasiliense</i>	<i>Casipourea guianensis</i>	<i>Coccoloba belizensis</i>	Dead, fallen	Dead, standing	<i>Eugenia aeruginea</i>	<i>Grias cauliflora</i>	<i>Inga cocleensis</i>	<i>Licania hypoleuca</i>	<i>Maytenus schippii</i>	<i>Pachira aquatica</i>	<i>Pterocarpus officinalis</i>	<i>Salacia impressifolia</i>	<i>Symphonia globulifera</i>	<i>Terminalia amazonia</i>	<i>Zygia</i> sp.
0-10	21				30	16												
10-20	22, 15				29							51						16
20-30					21											26		
30-40	19														16			
40-50	16											55						
50-60				15			13	11										
60-70								23										
70-80									11									
80-90										19		50	14					
90-100	17											36						
100-110	22		13						13			36, 19						
110-120	10, 12	15																
120-130	20					36						12						
130-140	21, 21, 13					17												
140-150	18, 16																	
150-160						25												26
160-170	16, 12, 22																	
170-180	15, 21																	
180-190						22							26					
190-200	19, 19	55																

Plant Species along 800 sq meter transect in Aguacaliente Wildlife Sanctuary

Measurement in cm dbh.

Date 21 April 2006.

Transect 3. Central Northing 1789568, Central Easting 291371

Note: Low diversity and dominance of *Amanoa guianensis* and *Pachira aquatica*

Note: ALL measured trees showed storm damage.

Note: High number of dead trees still present 5 years after hurricane Iris. Original must have been higher.

## Aguacaliente Wildlife Sanctuary Species Lists

Kingdom: Plantae	
Division: Magnoliophyta	
Class: Liliopsida (Monocot Plants)	
Order - Apiales (Asterids)	
Family - Araliaceae (Spikenard Family)	
Genus species	Common Name [Local Names]:
Dendropanax arboreus ((L.) Decne. & Planch.)	-
Oreopanax obtusifolius (L. O. Williams)	-
Order - Arales (Aroids)	
Family - Araceae ()	
Anthurium schlechtendalii (Kunth subsp. schlechtendalii)	-
Philodendron radiatum var. radiatum (Schott var. radiatum)	-
Order - Arales (Aroids)	
Family - Araceae ()	
Anthurium schlechtendalii (Kunth subsp. schlechtendalii)	-
Philodendron radiatum var. radiatum (Schott var. radiatum)	-
Order - Arecales (Palms)	
Family - Arecaceae (Palms)	
Asterogyne martiana ((H. Wendl.) H. Wendl. ex Hemsl.)	-
Astrocaryum mexicanum (Liebm. ex Mart.)	-
Attalea cohune var. (Mart.)	Cohune Palm [Corozo, Manaka.]
Bactris major Jacq. var. major	-
Bactris mexicana (Mart.)	-
Calyptrogyne ghiesbreghtiana ((Linden & H. Wendl.) H. Wendl.)	-
Chamaedorea ernesti-augustii var. (H. Wendl.)	Fish tail palm [Xate]
Chamaedorea neurochlamys Burret var. ((Jacq.) Oerst.)	False Jade [Monkey tail]
Chamaedorea tepejilote var. (Liebm.)	Pacaya []
Cryosophila stauracantha ((Heynold) R. Evans)	-
Sabal mauritiformis var. ((H. Karst.) Griseb. Ex. H. Wendl.)	Bayleaf [Guanu, Botan.]
Order - Aristolochiales (Birthworts)	
Family - Aristolochiaceae (Dutchman's Pipes)	
Aristolochia grandiflora (Sw.)	Pelicanflower [Flor de Pato, Contribo, Guaco]

**Aguacaliente Wildlife Sanctuary  
Species Lists**

Order - Asparagales (Agaves, Aloes, Onions)	
Family - Dracaenaceae (Dragon Tree Family)	
Dracaena americana (Donn. Sm.)	-
Order - Bromeliales (Bromeliads)	
Family - Bromeliaceae (Bromeliads)	
Aechmea bracteata ((Sw.) Griseb.)	-
Aechmea tillandsioides ((Mart. ex Schult. & Schult. f.) Baker)	-
Androlepis skinneri (Brongn. ex Houlllet)	-
Bromelia pinguin var. (L.)	□
Catopsis berteroniana ((Schult. f.) Mez)	-
Guzmania scherzeriana (Mez)	-
Tillandsia juncea ((Ruiz & Pav.) Poir.)	-
Tillandsia streptophylla (Scheidw. ex E. Morren)	-
Tillandsia utriculata (L.)	-
Tillandsia valenzuelana var. (A. Rich.)	□
Vriesea gladioliflora ((H. Wendl.) Antoine)	-
Order - Campanulales (Bellflowers)	
Family - Campanulaceae (Bellflower Family)	
Hippobroma longiflora ((L.) G. Don)	-
Order - Campanulales (Bellflowers)	
Family - Sphenocleaceae (Chickenspike Family)	
Sphenoclea zeylanica var. (Gaertn.)	Gooseweed [Chickenspike]
Order - Caryophyllales (Caryophyllids)	
Family - Cactaceae (Cactus Family)	
Epiphyllum phyllanthus var. strictum ((L.) Haw. var. strictum (Lem.) Kimnach)	-
Rhipsalis baccifera ((J. S. Muell.) Stearn)	-
Selenicereus testudo ((Karw.) Buxb.)	-
Order - Caryophyllales (Caryophyllids)	
Family - Phytolaccaceae (Pokeweed Family)	
Phytolacca rivinoides var. (Kunth & C. D. Bouché)	[Pigeon Berry (Cr), Poke (Cr), Jak (Q), Telcox, Coch-oton]
Trichostigma octandrum (L.) H. Walt.	-

## Aguacaliente Wildlife Sanctuary Species Lists

Order - Celastrales (Celastralids)	
Family - Celastraceae (Bittersweet Family)	
Maytenus schippii (Lundell)	-
Order - Celastrales (Celastralids)	
Family - Hippocrateaceae (Tape-grass Family)	
Salacia impressifolia var. ((Miers) AR Sm.)	□
Order - Commelinales (Commelinalids)	
Family - Commelinaceae (Spiderwort Family)	
Tradescantia zanonina ((L.) Sw.)	-
Order - Cyperales (Sedges)	
Family - Cyperaceae (Sedge Family)	
Cyperus articulatus var. articulatus (L. var. articulatus)	□
Eleocharis interstincta var. ((Vahl) Roem. & Schult.)	□
Scleria bracteata (Cav.)	-
Order - Ebenales (Ebendalids)	
Family - Sapotaceae (Sapote Family)	
Chrysophyllum mexicanum var. (Brandegge ex Standl.)	□
Pouteria campechiana ((H.B.K.) Baehni)	-
Order - Euphorbiales (Euphorbias)	
Family - Euphorbiaceae (Euphorb Family)	
Acalypha diversifolia (Jacq.)	-
Amanoa guianensis (Aubl.)	-
Croton billbergianus (Müll. Arg. subsp. pyramidalis (Donn. Sm.) G. L. Webster)	-
Order - Fabales (Legumes)	
Family - Fabaceae: Caesalpinioideae (Legume Family)	
Dialium guianense var. ((Aubl.) Steud.)	Ironwood [Tambran (Cr), Qua'ch'il (Q)]
Hymenaea courbaril (L.)	-
Schizolobium parahyba var. ((Vell.) S. F. Blake)	[Quamwood]
Senna undulata ((Benth.) H. S. Irwin & Barneby)	-
Order - Fabales (Legumes)	
Family - Fabaceae: Mimosoideae (Mimosa Family)	
Cojoba graciliflora ((S. F. Blake) Britton & Rose)	-
Inga cocleensis var. cocleensis	-

## Aguacaliente Wildlife Sanctuary Species Lists

(Pittier subsp. cocleensis)	
Inga vera (Willd.)	-
Mimosa peltita var. peltita (Humb. & Bonpl. ex Willd. var. peltita)	-
Order - Fabales (Legumes) Family - Fabaceae: Papilionoideae (Legume Family)	
Acosmium panamense var. ((Benth.) Yakovlev)	[Billy Webb]
Andira inermis ((W. Wright) DC.)	-
Dalbergia cubilquitzensis ((Donn. Sm.) Pittier)	-
Dalbergia glabra ((Mill.) Standl.)	-
Lonchocarpus guatemalensis (Benth.)	-
Lonchocarpus hondurensis var. (Benth.)	Swamp Cabbage Bark [Turtlebone, Waterside, Swamp Dogwood, Jabin del Agua]
Machaerium cirrhiferum (Pittier)	-
Platymiscium dimorphandrum (Donn. Sm.)	-
Pterocarpus officinalis (Jacq.)	-
Vatairea lundellii ((Standl.) Killip ex Record)	-
Order - Gentianales (Gentians) Family - Apocynaceae (Dogbane Family)	
Odontadenia macrantha ((Roem. & Schult.) Markgr.)	-
Stemmadenia donnell-smithii ((Rose) Woodson)	-
Thevetia ahouai ((L.) A. DC.)	-
Thevetia gaumeri (Hemsl.)	-
Order - Gentianales (Gentians) Family - Loganiaceae (Butterfly-bush Family)	
Spigelia polystachya var. (Klotzsch ex Progel)	[]
Order - Lamiales (Mints and Snapdragons) Family - Boraginaceae (Borage Family)	
Cordia stellifera var. (I. M. Johnst.)	[]
Heliotropium procumbens (Mill.)	-
Order - Lamiales (Mints and Snapdragons) Family - Verbenaceae (Verbena Family)	

## Aguacaliente Wildlife Sanctuary Species Lists

Citharexylum caudatum (L.)	-
Citharexylum hirtellum (Standl.)	-
Lippia stoechadifolia ((L.) H.B.K.)	-
Vitex kuylenii (Standl.)	-
Order - Lecythidales (Brazil Nut Trees) Family - Lecythidaceae (Brazil Nut Family)	
Grias cauliflora (L.)	-
Order - Malvales (Malvalids) Family - Bombacaceae (Kapok-tree Family)	
Ceiba pentandra var. ((L.) Gaertn.)	Kapok [Ceiba, Cotton Tree]
Pachira aquatica var. (Aubl.)	Provision Tree [Provision Bark, Santo domingo, Zapote bobo, Zapotón, Cuy-che,Uacut ]
Quararibea funebris var. ((La Llave) Vischer)	[Batidor, Sapotillo]
Order - Malvales (Malvalids) Family - Sterculiaceae (Cacao Family)	
Guazuma ulmifolia var. (Lam.)	Bay Cedar [Pixoi, Tapaculo]
Order - Myrtales (Myrtalids) Family - Combretaceae (Combretum Family)	
Bucida buceras (L.)	-
Terminalia amazonia var. ((J. F. Gmel.) Exell)	Nargusta [Kanchan (Q), Bullywood (Q), ]
Order - Myrtales (Myrtalids) Family - Melastomataceae (Melastoma Family)	
Clidemia dentata (D. Don)	-
Miconia impetioilaris ((Sw.) D. Don ex DC.)	-
Mouriri exilis var. (Gleason)	[Puruch'ahin (Q)]
Mouriri myrtilloides var. parvifolia ((Sw.) Poir. subsp. parvifolia (Benth.) Morley)	-
Order - Myrtales (Myrtalids) Family - Myrtaceae (Eucalyptus, Guava Family)	
Calyptranthes chytraculia var. americana ((L.) Sw. var. americana McVaugh)	-
Eugenia aeruginea (DC.)	-
Eugenia capuli ((Schltdl. & Cham.) O. Berg)	-
Psidium guajava	-

**Aguacaliente Wildlife Sanctuary  
Species Lists**

(L.)	
Order - Myrtales (Myrtalids)	
Family - Myrtaceae (Eucalyptus, Guava Family)	
Calyptranthes chytraculia var. americana ((L.) Sw. var. americana McVaugh)	-
Eugenia aeruginea (DC.)	-
Eugenia capuli ((Schltdl. & Cham.) O. Berg)	-
Psidium guajava (L.)	-
Order - Myrtales (Myrtalids)	
Family - Onagraceae (Fuschia Family)	
Ludwigia octovalvis var. ((Jacq.) P. H. Raven)	Mexican primrose willow. []
Order - Nymphaeales (Waterlillies and Pond Weeds)	
Family - Cabombaceae (Water-shield Family)	
Cabomba palaeformis (Fassett)	-
Order - Nymphaeales (Waterlillies and Pond Weeds)	
Family - Nymphaeaceae (Water-lily Family)	
Nymphaea ampla ((Salisb.) DC.)	-
Order - Orchidales (Orchids)	
Family - Orchidaceae (Orchid Family)	
Epidendrum imatophyllum (Lindl.)	-
Epidendrum nocturnum (Jacq.)	-
Epidendrum rigidum (Jacq.)	-
Lepanthes disticha ((A. Rich. & Galeotti) Garay & R. E. Schult.)	-
Nidema boothii ((Lindl.) Schltr.)	-
Order - Piperales (Piperals)	
Family - Piperaceae (Pepper Family)	
Piper amalago (L.)	-
Order - Poales (Grasses)	
Family - Poaceae (Grass Family)	
Eragrostis contrerasii (R. W. Pohl)	-
Echinochloa crus-pavonis (Kunth) Schult.	-
Guadua longifolia ((E. Fourn.) R. W. Pohl)	-
Gynerium sagittatum var. ((Aubl.) P. Beauv.)	Wild Cane [Dumb Cane]
Hymenachne amplexicaulis	-

## Aguacaliente Wildlife Sanctuary Species Lists

((Rudge) Nees)	
Rottboellia cochinchinensis var. ((Lour.) Clayton)	[Devil Grass]
Order - Polygalales (Milkworts) Family - Polygalaceae (Milkwort Family)	
Securidaca diversifolia var. ((L.) S. F. Blake)	[Man vine, Guingeo]
Order - Polygalales (Milkworts) Family - Vochysiaceae ( )	
Vochysia hondurensis var. (Sprague)	Yemeri [Emeri, San Juan, White Mahogany]
Order - Polygonales (Buckwheats) Family - Polygonaceae (Rhubarb Family)	
Coccoloba belizensis (Standl.)	-
Coccoloba hirtella (Lundell)	-
Polygonum acuminatum (H.B.K.)	-
Order - Polypodiales (Ferns) Family - Davalliaceae (Oleandrid Fern Family)	
Nephrolepis cordifolia ((L.) C. Presl)	-
Order - Polypodiales (Ferns) Family - Schizaeaceae (Curly Grass Family)	
Lygodium venustum (Sw.)	-
Order - Primulales (Primulalids) Family - Theophrastaceae (Theophrasta Family)	
Jacquinia paludicola (Standl.)	-
Order - Rosales (Roses and allies) Family - Chrysobalanaceae (Cocoa-plum Family)	
Hirtella racemosa var. hexandra (Lam. var. hexandra (Willd. ex Roem. & Schult.) Prance)	-
Licania hypoleuca var. hypoleuca (Benth. var. hypoleuca)	-
Order - Rubiales (Gardenias, Coffees and Quinines) Family - Rubiaceae (Gardenia, coffee and quinine family)	
Alibertia edulis ((Rich.) DC.)	-
Chiococca alba ((L.) Hitchc.)	-
Faramea occidentalis var. ((L.) A. Rich.)	[Kape'che (Q)]
Guettarda combsii (Urb.)	-
Hamelia rovirosae (Wernham)	-

## Aguacaliente Wildlife Sanctuary Species Lists

Morinda panamensis (Seem.)	-
Palicourea crocea ((Sw.) Roem. & Schult.)	-
Psychotria glomerulata ((Donn. Sm.) Steyerm.)	-
Psychotria poeppigiana (Müll. Arg.)	-
Randia aculeata var. aculeata (L. var. aculeata)	-
Simira salvadorensis ((Standl.) Steyerm.)	-
Uncaria tomentosa ((Willd. ex Roem. & Schult.) DC.)	-
Order - Salviniales (Ferns)	
Family - Salviniaceae (Floating Fern or Water Spangle Family)	
Salvinia minima (Baker)	-
Order - Santales (Santalids)	
Family - Loranthaceae (Catkin-mistletoe Family)	
Psittacanthus rhynchanthus ((Benth.) Kuijt)	-
Order - Santales (Santalids)	
Family - Olacaceae (Olax Family)	
Heisteria media (S. F. Blake)	-
Order - Sapindales (Sapindalids)	
Family - Anacardiaceae (Sumac Family)	
Spondias mombin (L.)	-
Spondias radlkoferi (Donn. Sm.)	-
Order - Sapindales (Sapindalids)	
Family - Meliaceae (Mahogany Family)	
Guarea glabra (Vahl)	-
Swietenia macrophylla var. (King)	Large-leaved Mahogany □
Order - Sapindales (Sapindalids)	
Family - Simaroubaceae (Quassia-Wood Family)	
Picramnia antidesma antidesma (Sw. subsp. antidesma)	-
Order - Scrophulariales (Bladderworts and Trumpet Creepers)	
Family - Acanthaceae (Black-eyed Susan Family)	
Aphelandra aurantiaca ((Scheidw.) Lindl.)	-
Aphelandra scabra (Vahl) Sm.)	-
Bravaisia integerrima var. (Spreng. (Standl).)	□

## Aguacaliente Wildlife Sanctuary Species Lists

Odontonema callistachyum ((Schltdl. & Cham.) Kuntze)	-
Order - Scrophulariales (Bladderworts and Trumpet Creepers)	
Family - Bignoniaceae (Bignonia Family)	
Tabebuia chrysantha chrysantha var. ((Jacq.) G. Nicholson subsp. chrysantha)	Yellow Mayflower [Cortez]
Mussatia hyacinthina (Standl.) Sandwith	-
Tabebuia rosea ((Bertol.) DC.)	-
Order - Scrophulariales (Bladderworts and Trumpet Creepers)	
Family - Gesneriaceae (African Violets, etc)	
Codonanthe macradenia var. (Donn. Sm.)	[]
Columnea sulfurea (Donn. Sm.)	-
Order - Scrophulariales (Bladderworts and Trumpet Creepers)	
Family - Lentibulariaceae (Bladderwort Family)	
Utricularia foliosa (L.)	-
Order - Solanales (Gentians, Potatoes, Dodders, and Jimsonweed)	
Family - Solanaceae (Potato Family)	
Cestrum nocturnum (L.)	-
Solanum campechiense (L.)	-
Order - Theales (Thealids)	
Family - Clusiaceae (St John's Wort Family)	
Calophyllum brasiliense var. rekoi (Cambess. var. rekoi)	-
Garcinia intermedia var. ((Pittier) Hammel)	[Carakel (Q)]
Symphonia globulifera var. (L. f.)	[Leche amarillo, Waika Chewstick, Can-i-lech, Lech, k'han-lech]
Order - Urticales (Urticalids)	
Family - Cecropiaceae (Cecropia Family)	
Cecropia obtusifolia var. (Bertol.)	Cecropia [Trumpet Tree, Guarumu]
Order - Urticales (Urticalids)	
Family - Moraceae (Fig, Mulberry Family)	
Castilla elastica elastica (Sessé subsp. elastica)	-
Ficus insipida (Willd.)	-
Ficus nymphaeifolia var. (Mill.)	[]
Poulsenia armata ((Miq.) Standl.)	-
Pseudolmedia spuria var. ((Sw.) Griseb.)	[Cherry (Cr), Aax (Q)]

## Aguacaliente Wildlife Sanctuary Species Lists

Order - Urticales (Urticalids)	
Family - Ulmaceae (Elm Family)	
Ampelocera hottlei ((Standl.) Standl.)	-
Trema micrantha var. micrantha ((L.) Blume var. micrantha)	-
Order - Urticales (Urticalids)	
Family - Urticaceae (Nettle Family)	
Urera baccifera ((L.) Gaudich.)	-
Order - Violales (Violets, etc)	
Family - Begoniaceae (Begonias)	
Begonia sericoneura var. (Liebm.)	□
Order - Violales (Violets, etc)	
Family - Caricaceae (Papaya Family)	
Carica papaya (L.)	-
Order - Violales (Violets, etc)	
Family - Cucurbitaceae (Gourds)	
Gurania makoyana ((Lem.) Cogn.)	-
Order - Violales (Violets, etc)	
Family - Flacourtiaceae (Kei-apples)	
Casearia aculeata (Jacq.)	-
Order - Violales (Violets, etc)	
Family - Passifloraceae (Passionflowers)	
Passiflora biflora (Lam.)	-
Passiflora choconiana ((S. Watson) Killip)	-
Passiflora ciliata (Dryand.)	-
Order - Violales (Violets, etc)	
Family - Violaceae (Violet Family)	
Corynostylis arborea ((L.) S. F. Blake)	-
Order - Zingiberales (Cannales)	
Family - Heliconiaceae (Lobster Claws)	
Heliconia aurantiaca (Ghiesbr.)	-
Heliconia bourgaeana (Petersen in C. Martius)	-
Heliconia latispatha (Benth)	-
Heliconia vaginalis mathiasiae (Daniels & Stiles) L. Anderson)	Pacal
Heliconia wagneriana (Petersen)	-

**Aguacaliente Wildlife Sanctuary  
Species Lists**

Order - Zingiberales (Cannales)	
Family - Marantaceae ()	
Calathea inocephala ((Kuntze) H. A. Kenn. & Nicolson)	-
Order - Zingiberales (Cannales)	
Family - Marantaceae ()	
Calathea inocephala ((Kuntze) H. A. Kenn. & Nicolson)	-

## Aguacaliente Wildlife Sanctuary Species Lists

Kingdom: Animalia	
Phylum: Arthropoda	
Class: Insecta (Insects)	
Order - Lepidoptera (Butterflies)	
Family - Hesperidae (Skippers)	
Genus species	Common Name [Local Names]:
Hylephila phyleus (Drury, [1773])	Fiery Skipper
Order - Lepidoptera (Butterflies)	
Family - Nymphalidae (Danais & Browns)	
Actinote pellenea guatemalena	-
Aeria eurimedia pacifica (Godman & Salvin 1879)	-
Archaeoprepona demophon centralis (Fruhstorfer [1905])	-
Caligo eurilochus sulanus (Fruhstorfer 1904)	-
Caligo memnon memnon (C. & R. Felder 1866)	-
Danaus eresimus montezuma (Talbot 1943)	-
Dryas iulia moderata (Stichel [1908])	-
Hamadryas feronia farinulenta ((Fruhstorfer 1916))	-
Heliconius erato petiverana var. (Doubleday 1847)	□
Heliconius ismenius telchinia (Doubleday 1847)	-
Heliconius sapho leuce var. (Doubleday 1847)	□
Hypothyris lycaste dionaea var. ((Hewitson 1854))	□
Laparus doris transiens ((Staudinger 1896))	-
Marpesia chiron marius ((Cramer [1779]))	Banded Daggerwing
Mechanitis polymnia lycidice (Bates 1864)	-
Megeuptychia antonoe	-
Morpho peleides montezuma var. (Guenée)	Blue Morpho □
Pierella luna heracles ((Boisduval))	-
Order - Lepidoptera (Butterflies)	
Family - Papilionidae (Swallowtails)	
Battus polydamas polydamas ((Linnaeus) 1758)	Polydamas Swallowtail
Parides sesostris zestos	-

**Aguacaliente Wildlife Sanctuary  
Species Lists**

Order - Lepidoptera (Butterflies)	
Family - Riodinidae (Metalmarks)	
Emesis lucinda aurimna (Boisduval)	Lucinda Metalmark
Order - Lepidoptera (Butterflies)	
Family - Lycaenidae (Blues)	
Eumaeus toxea	Zamia butterfly

## Aguacaliente Wildlife Sanctuary Species Lists

Kingdom: Animalia	
Phylum: Chordata (Craniata)	
Class: Actinopterygii (Ray-finned Fishes)	
Order - Characiformes (Characins, f/w Hatchetfishes)	
Family - Characidae (Characids/Tetra Fishes)	
Genus species	Common Name [Local Names]:
Astyanax fasciatus (Cuvier 1819)	Banded Astyanax (Billum)
Brycon guatemalensis (Regan 1908)	Machaca Macabil
Order - Cyprinodontiformes (Killifishes, Mosquitofishes)	
Family - Poeciliidae (Live Bearers)	
Belonesox belizanus var. (Kner 1860)	Topminnow Pike killifish
Gambusia luma (Rosen and Bailey 1963)	Sleek Mosquitofish
Heterandria bimaculata (Heckel 1848)	Twospot Livebearer
Poecilia mexicana (Steindachner 1863)	Shortfin Molly
Order - Elopiformes (Tarpons, Ladyfishes, etc)	
Family - Megalopidae (Tarpons)	
Megalops atlanticus (Valenciennes 1847)	Tarpon
Order - Perciformes (Perch-like Fishes)	
Family - Cichlidae (Cichlids)	
Oreochromis niloticus var. (Linnaeus 1758)	Tilapia []
Thorichthys aureus (Günther 1862)	Blue Flash Golden Firemouth Cichlid
Vieja maculicauda (Regan 1905)	Blackbelt Cichlid
Order - Synbranchiformes (Spiny Eels)	
Family - Synbranchidae (Swamp Eels)	
Ophisternon aenigmaticum (Rosen and Greenwood 1976)	Obscure Swamp Eel

## Aguacaliente Wildlife Sanctuary Species Lists

Kingdom: Animalia	
Phylum: Chordata (Craniata)	
Class: Amphibia (Amphibians)	
Order - Anura (Frogs and Toads)	
Family - Bufonidae (Toads)	
Genus species	Common Name [Local Names]:
Bufo marinus var. (Linnaeus 1758)	Cane Toad []
Bufo valliceps (Wiegman 1833)	Gulf Coast Toad
Order - Anura (Frogs and Toads)	
Family - Leptodactylidae (Rain Frogs)	
Leptodactylus melanonotus var. (Hallowell 1861)	Sabinal Frog []
Order - Anura (Frogs and Toads)	
Family - Ranidae (True Frogs)	
Rana vaillanti var. (Brocchi 1877)	Vaillant's Frog []

Order - Crocodylia (Caimans and Crocodiles)	
Family - Crocodylidae (Crocodiles)	
Genus species	Common Name [Local Names]:
Crocodylus moreletii var. (DumÉril and Bibron 1851)	Morelet's Crocodile [Alligator, Lagarto, Cocodrilo de morelet]
Order - Squamata (Amphisbaenians, Lizards and Snakes)	
Family - Colubridae (Typical Snakes)	
Dryobius margaritiferus var. (Schlegel 1837)	Speckled Racer []
Imantodes cenchoa (Linnaeus 1758)	Blunthead Tree Snake
Order - Squamata (Amphisbaenians, Lizards and Snakes)	
Family - Iguanidae (Iguanas)	
Iguana iguana var. (Linnaeus 1758)	Green Iguana (Bamboo Chicken, Gorobo)
Order - Squamata (Amphisbaenians, Lizards and Snakes)	
Family - Polychrotidae (Anoles)	
Norops lemurinus var. (Cope 1861)	Ghost Anole []
Norops pentapryon var. (Cope 1862)	Lichen Anole []
Order - Squamata (Amphisbaenians, Lizards and Snakes)	
Family - Viperidae (Pit Vipers and Rattlesnakes)	
Bothrops asper var. (Garman 1884)	Tommy Goff (Terciopelo)
Order - Testudines (Tortoises and Turtles)	
Family - Emydidae (Wood Turtles and Sliders)	
Trachemys scripta var. (Schoepf 1792)	Slider []

## Aguacaliente Wildlife Sanctuary Species Lists

Kingdom: Animalia	
Phylum: Chordata (Craniata)	
Class: Aves (Birds)	
Order - Anseriformes (Ducks)	
Family - Anatidae (Waterfowl)	
Genus species	Common Name [Local Names]:
Anas clypeata (Linnaeus 1758)	Northern Shoveler
Anas discors (Linnaeus 1766)	Blue-winged Teal
Cairina moschata var. ((Linnaeus 1758))	Muscovy Duck []
Dendrocygna autumnalis var. ((Linnaeus 1758))	Black Bellied Whistling Duck []
Order - Apodiformes (Hummingbirds & Swifts)	
Family - Trochilidae (Hummingbirds)	
Amazilia candida var. ((Bourcier & Mulsant 1846))	White-bellied Emerald []
Amazilia tzacatl var. ( )	Rufous-tailed Hummingbird []
Anthracothorax prevosti ((Lesson 1832))	Green-breasted Mango
Phaethornis longirostris var. ((Lesson 1832))	Long-billed Hermit [Long-tailed Hermit]
Phaethornis striigularis var. ((Linnaeus 1766))	Stripe-throated Hermit [Little Hermit]
Order - Charadriiformes (Shorebirds & Relatives)	
Family - Charadriidae (Plovers)	
Charadrius semipalmatus (Bonapart 1825)	Semipalmated Plover
Charadrius vociferus (Linnaeus 1758)	Killdeer
Order - Charadriiformes (Shorebirds & Relatives)	
Family - Jacanidae (Jacanas)	
Jacana spinosa ((Linnaeus 1758))	Northern Jacana [Georgie Bull]
Order - Charadriiformes (Shorebirds & Relatives)	
Family - Recurvirostridae (Stilts & Avocets)	
Himantopus mexicanus ((Muller 1776))	Black-necked Stilt
Order - Charadriiformes (Shorebirds & Relatives)	
Family - Scolopacidae (Sandpipers & Allies)	
Actitis macularia ((Linnaeus 1766))	Spotted Sandpiper [Shaky Batty]
Calidris himantopus ((Bonaparte 1826))	Stilt Sandpiper
Calidris mauri ((Cabanis 1857))	Western Sandpiper

## Aguacaliente Wildlife Sanctuary Species Lists

Calidris melanotos ((Vieillot 1819))	Pectoral Sandpiper
Tringa melanoleuca ((Gmelin 1789))	Greater Yellowlegs
Tringa solitaria (Wilson 1813)	Solitary Sandpiper
Tryngites subruficollis var. ((Vieillot 1819))	Buff-breasted Sandpiper []
Order - Ciconiiformes (Stork & Relatives) Family - Ardeidae (Bitterns, Herons & Egrets)	
Ardea herodias var. (Linnaeus 1758)	Great Blue Heron [Full pott, Garza morene]
Bubulcus ibis var. ((Linnaeus 1758))	Cattle Egret [Gaulin, Garza blanca]
Butorides virescens ((Linnaeus 1758))	Green Heron [Green-backed Heron, Poor Joe]
Cochlearius cochlearius ((Linnaeus 1766))	Boat-billed Heron [Spoon-billed Carpenter]
Egretta alba ((Linnaeus 1758))	Great Egret [Gaulin, Garza blanca]
Egretta caerulea ((Linnaeus 1758))	Little Blue Heron [Blue Gaulin, Garza morene]
Egretta thula var. ((Molina 1782))	Snowy Egret [White Gaulin, Garza blanca]
Egretta tricolor var. ((Muller 1776))	Tricolored Heron [Crabcatcher, Garza morene]
Nycticorax nycticorax var. ((Linnaeus 1758))	Black-crowned Night Heron []
Tigrisoma mexicanum (Swainson 1834)	Bare-throated Tiger Heron [Barking Gaulin]
Order - Ciconiiformes (Stork & Relatives) Family - Cathartidae (American Vultures)	
Cathartes burrovianus (Cassin 1845)	Lesser Yellow-Headed Vulture [John Crow]
Coragyps atratus var. ((Bechstein 1793))	Black Vulture [John Crow, Sope]
Order - Ciconiiformes (Stork & Relatives) Family - Ciconiidae (Storks)	
Jabiru mycteria var. ((Lichtenstein 1819))	Jabiru [Turk, Fillymingo]
Mycteria americana var. (Linnaeus 1758)	Wood Stork [John Crow Curlew, Galletan]
Order - Ciconiiformes (Stork & Relatives) Family - Threskiornithidae (Ibises & Spoonbills)	
Ajaia ajaja var. ((Linnaeus 1758))	Roseate Spoonbill [Cuchara]

## Aguacaliente Wildlife Sanctuary Species Lists

Order - Columbiformes (Pigeons & Doves)	
Family - Columbidae (Pigeons & Doves)	
Claravis pretiosa ((Ferrari-Perez 1886))	Blue Ground-Dove
Columba cayennensis (Bonnaterre 1792)	Pale-vented Pigeon [Red Mangrove Pigeon]
Columbina talpacoti ((Temminck 1810))	Ruddy Ground-Dove [Turtle Dove]
Patagioenas nigrirostris var. (Sclater 1860)	Short-billed Pigeon []
Order - Coraciiformes (Kingfishers & Allies)	
Family - Alcedinidae (Kingfishers)	
Ceryle alcyon ((Linnaeus 1758))	Belted Kingfisher
Ceryle torquata ((Linnaeus 1766))	Ringed Kingfisher
Chloroceryle aenea ((Pallas 1764))	Pygmy Kingfisher
Chloroceryle amazona ((Latham 1790))	Amazon Kingfisher
Chloroceryle americana ((Gmelin 1788))	Green Kingfisher
Order - Coraciiformes (Kingfishers & Allies)	
Family - Motmotidae (Motmots)	
Momotus momota var. ((Linnaeus 1766))	Blue-crowned Motmot [Good Cook]
Order - Cuculiformes (Cuckoos, Hoatzins, Turacos and Relatives)	
Family - Cuculidae (Cuckoos & Anis)	
Crotophaga ani (Linnaeus 1758)	Smooth-billed Ani [Cowboy Blackbird]
Crotophaga sulcirostris (Swainson 1827)	Groove-billed Ani [Cowboy Blackbird, Chel]
Piaya cayana var. ((Linnaeus 1766))	Squirrel Cuckoo [Pe-quam]
Tapera naevia ((Linnaeus 1766))	Striped Cuckoo
Order - Falconiformes (Falcons & Allies)	
Family - Accipitridae (Kites, Hawks, Eagles & Allies)	
Asturina nitida var. ( )	Gray Hawk []
Buteo magnirostris var. ((Gmelin 1788))	Roadside Hawk [Chicken Hawk]
Ictinia plumbea var. ((Gmelin 1788))	Plumbeous Kite []
Leptodon cayanensis ((Latham 1790))	Gray-headed Kite
Pandion haliaetus ((Linnaeus 1758))	Osprey [Billy Hawk, Jincho]
Spizaetus tyrannus ((Wied-Neuwied 1820))	Black Hawk-Eagle

## Aguacaliente Wildlife Sanctuary Species Lists

Order - Falconiformes (Falcons & Allies)	
Family - Falconidae (Falcons & Allies)	
Falco ruficularis (Daudin 1800)	Bat Falcon [Lion Hawk]
Herpetotheres cachinnans var. ((Linnaeus 1758))	Laughing Falcon [Guaco]
Order - Galliformes (Chicken-like Birds)	
Family - Cracidae (Guans and Curassows)	
Ortalis vetula var. ((Wagler 1830))	Plain Chachalaca [Cockycrow, Cocrico]
Order - Gruiformes (Coots, Cranes and Rails)	
Family - Aramididae (Limpkins)	
Aramus guarauna ((Linnaeus 1766))	Limpkin [Clucking Hen]
Order - Gruiformes (Coots, Cranes and Rails)	
Family - Rallidae (Rails, Gallinules and Allies)	
Aramidides cajanea ((Muller 1776))	Gray-necked Wood Rail [Top-na-chick, Gallinola]
Laterallus ruber ((Sclater & Salvin 1860))	Ruddy Crake [Dodging Bull]
Order - Passeriformes (Perching Birds)	
Family - Cardinalidae (Saltators, Grosbeaks & Buntings)	
Cyanocompsa cyanoides ((Lafresnaye 1847))	Blue-back Grosbeak
Order - Passeriformes (Perching Birds)	
Family - Corvidae (Jays & Crows)	
Cyanocorax morio ((Wagler 1829))	Brown Jay [Piam-piam]
Order - Passeriformes (Perching Birds)	
Family - Dendrocolaptidae (Woodcreepers)	
Glyphorhynchus spirurus ((Vieillot 1810))	Wedge-billed Woodcreeper
Lepidocolaptes souleyetii ((DesMurs 1849))	Streak-headed Woodcreeper
Xiphorhynchus flavigaster (Swainson 1827)	Ivory-billed Woodcreeper
Order - Passeriformes (Perching Birds)	
Family - Emberizidae (Seedeaters & Allies)	
Sporophila americana ((Gmelin 1789))	Variable Seedeater
Order - Passeriformes (Perching Birds)	
Family - Formicariidae (Antthrushes & Antpittas)	
Formicarius analis ((d'Orbigny & Lafresnaye 1837))	Black-faced Antthrush
Order - Passeriformes (Perching Birds)	
Family - Furnariidae (Ovenbirds)	
Synallaxis erythrothorax (Sclater 1855)	Rufous-breasted Spinetail

## Aguacaliente Wildlife Sanctuary Species Lists

Order - Passeriformes (Perching Birds)	
Family - Hirundinidae (Swallows)	
Tachycineta albineata ((Lawrence 1863))	Mangrove Swallow
Order - Passeriformes (Perching Birds)	
Family - Icteridae (Blackbirds & Allies)	
Amblycercus holosericeus ((Deppe 1830))	Yellow-billed Cacique [Bamboo Cracker]
Dives dives ((Deppe 1830))	Melodius Blackbird
Icterus spurius ((Linnaeus 1766))	Orchard Oriole [Banana Bird]
Molothrus aeneus ((Wagler 1829))	Bronzed Cowbird
Molothrus oryzivorus	Giant Cowbird [Tick Bird]
Psarocolius montezuma ((Lesson))	Montezuma Oropendola [Yellow Tail]
Quiscalus mexicanus ((Gmelin 1788))	Great-tailed Grackle [Blackbird]
Order - Passeriformes (Perching Birds)	
Family - Incerta Sedis (Uncertain Affinities)	
Schiffornis turdinus ((Weid-Neuweid 1831))	Thrushlike Schiffornis [(Thrushlike Manakin)]
Tityra semifasciata ((Spix 1825))	Masked Tityra
Order - Passeriformes (Perching Birds)	
Family - Mimidae (Mockingbirds)	
Dumetella carolinensis ((Linnaeus 1766))	Gray Catbird
Order - Passeriformes (Perching Birds)	
Family - Parulidae (Wood Warblers)	
Dendroica dominica ((Linnaeus 1766))	Yellow-throated Warbler
Dendroica magnolia ((Wilson 1811))	Magnolia Warbler
Dendroica petechia ((Linnaeus 1766))	Yellow Warbler
Dendroica virens ((Gmelin 1789))	Black-throated Green Warbler
Geothlypis trichas ((Linnaeus 1766))	Common Yellowthroat
Helmitheros vermivorus ((Gmelin 1789))	Worm-eating Warbler
Icteria virens ((Linnaeus 1758))	Yellow-breasted Chat
Mniotilta varia ((Linnaeus 1766))	Black-and-White Warbler
Oporornis formosus var. ((Wilson 1811))	Kentucky Warbler □

## Aguacaliente Wildlife Sanctuary Species Lists

Protonotaria citrea ((Boddaert 1783))	Prothonotary Warbler
Seiurus aurocapillus ((Linnaeus 1766))	Ovenbird
Seiurus noveboracensis ((Gmelin 1789))	Northern Waterthrush
Setophaga ruticilla ((Linnaeus 1758))	American Redstart
Wilsonia citrina ((Boddaert 1783))	Hooded Warbler
Order - Passeriformes (Perching Birds)	
Family - Pipridae (Manakins)	
Manacus candei ((Parzudaki 1841))	White-collared Manakin
Pipra mentalis (Scalder 1857)	Red-capped Manakin
Order - Passeriformes (Perching Birds)	
Family - Sylviidae (Gnatcatchers)	
Poliptila caerulea ((Linnaeus 1766))	Blue-gray Gnatcatcher
Ramphocaenus melanurus (Vieillot 1819)	Long-billed Gnatwren
Order - Passeriformes (Perching Birds)	
Family - Thamnophilidae (Typical Antbirds)	
Microrhopias quixensis ((Cornalia 1849))	Dot-winged Antwren
Taraba major ((Vieillot 1816))	Great Antshrike
Thamnophilus doliatus ((Linnaeus 1764))	Barred Antshrike
Order - Passeriformes (Perching Birds)	
Family - Thraupidae (Tanagers)	
Euphonia affinis ((Lesson 1842))	Scrub Euphonia
Euphonia gouldi (Sclater 1857)	Olive-backed Euphonia
Euphonia hirundinacea var. (Bonaparte 1838)	Yellow-throated Euphonia □
Habia fuscicauda var. ((Cabanis 1861))	Red Throated Ant Tanager □
Piranga rubra var. ((Linnaeus 1758))	Summer Tanager □

**Aguacaliente Wildlife Sanctuary  
Species Lists**

Order - Passeriformes (Perching Birds)	
Family - Troglodytidae (Wrens)	
Genus species	Common Name
Henicorhina leucosticta ((Cabanis 1847))	White-breasted Wood-wren
Thryothorus maculipectus (Lesfresnaye 1845)	Spot-breasted Wren [Katy-yu-baby-di-cry]
Uropsila leucogastra ((Gould 1837))	White-bellied Wren
Order - Passeriformes (Perching Birds)	
Family - Turdidae (Thrushes)	
Hylocichla mustelinus ((Gmelin 1789))	Wood Thrush
Turdus grayi (Bonaparte 1838)	Clay-colored Thrush [Brown Cusco]
Order - Passeriformes (Perching Birds)	
Family - Tyrannidae (Tyrant Flycatchers)	
Attila spadiceus ((Gmelin 1789))	Bright-rumped Attila
Empidonax albigularis (Sclater & Salvin 1859)	White-throated Flycatcher
Megarynchus pitangua ((Linnaeus 1766))	Boat-billed Flycatcher [Kiskadee]
Mionectes oleagineus var. ((Lichtenstein 1823))	Ochre-bellied Flycatcher □
Myiarchus crinitus ((Linnaeus 1758))	Great Crested Flycatcher
Myiarchus tuberculifer ((d'Orbigny & Lesfresnaye 1837))	Dusky-capped Flycatcher
Myiarchus tyrannulus ((Muller 1776))	Brown-crested Flycatcher
Myiozetetes similis var. ((Spix 1825))	Social Flycatcher [Katy-yu-baby-di-cry]
Oncostoma cinereigulare ((Sclater 1857))	Northern Bentbill
Ornithion semiflavum ((Sclater & Salvin 1860))	Yellow-bellied Tyrannulet
Pitangus sulphuratus ((Linnaeus 1766))	Great Kiskadee [Kiskadee]
Poecilatriccus sylvia var. ((Desmarest 1806))	Slate-headed Tody-flycatcher □
Todirostrum cinereum ((Linnaeus 1766))	Common Tody-flycatcher
Tolmomyias sulphurescens ((Spix 1825))	Yellow-olive Flycatcher
Tyrannus melancholicus var. (Vieillot 1819)	Tropical Kingbird □
Tyrannus savana (Vieillot 1808)	Fork-tailed Flycatcher

## Aguacaliente Wildlife Sanctuary Species Lists

Order - Passeriformes (Perching Birds)	
Family - Vireonidae (Vireos)	
Hylophilus decurtatus ((Bonaparte 1838))	Lesser Greenlet
Hylophilus ochraceiceps (Sclater 1859)	Tawny-crowned Greenlet
Order - Pelecaniformes (Pelicans & Relatives)	
Family - Anhingidae (Aningas)	
Anhinga anhinga ((Linnaeus 1766))	Anhinga [Snakebird, Shag]
Order - Pelecaniformes (Pelicans & Relatives)	
Family - Phalacrocoracidae (Comorants)	
Phalacrocorax brasilianus var. ((Gmelin 1789))	Neotropical Cormorant [Shag]
Order - Pelecaniformes (Pelicans & Relatives)	
Family - Phalacrocoracidae (Cormorants)	
Phalacrocorax brasilianus var. ((Gmelin 1789))	Neotropical Cormorant [Shag]
Order - Phoenicopteriformes (Flamingos)	
Family - Pphoenicopteridae (Flamingos)	
Phoenicopus ruber (Linnaeus 1758)	American Flamingo
Order - Piciformes (Woodpeckers & Relatives)	
Family - Picidae (Woodpeckers)	
Campephilus guatemalensis ((Hartlaub 1844))	Pale-billed Woodpecker [Father Red-cap]
Dryocopus lineatus ((Linnaeus 1766))	Lineated Woodpecker [Colonté]
Order - Piciformes (Woodpeckers & Relatives)	
Family - Ramphastidae (Toucans)	
Pteroglossus torquatus var. ((Gmelin 1788))	Collared Araçari [Phyllis, Medio Pito]
Order - Psittaciformes (Parrots & Allies)	
Family - Psittacidae (Parrots)	
Amazona autumnalis ((Linnaeus 1758))	Red-lored Parrot
Aratinga nana var. ((Vigors 1830))	Olive-throated parakeet [Aztec Parakeet, Keetie]
Order - Tinamiformes (Tinamous)	
Family - Tinamidae (Tinamous)	
Crypturellus soui ((Hermann 1783))	Little Tinamou [Bawley]
Order - Trogoniformes (Trogons)	
Family - Trogonidae (Trogons)	
Trogon massena (Gould 1838)	Slaty-tailed Trogon
Trogon melanocephalus (Gould 1836)	Black-headed Trogon [Ramatutu]

## Aguacaliente Wildlife Sanctuary Species Lists

Kingdom: Animalia	
Phylum: Chordata (Craniata), Class: Mammalia (Mammals)	
Order - Didelphimia (American Opossums)	
Family - Didelphidae (Possums)	
Genus species	Common Name [Local Names]:
Didelphis marsupialis/virginiana []	Opossum, Zorro
Order - Xenarthra (Edentata)	
Family - Dasypodidae (Armadillos)	
Dasybus novemcinctus []	Armadillo Dilly, Wech
Order - Chiroptera (Bats)	
Family - Noctilionidae (Bulldog Bats)	
Noctilio leporinus	Greater Fishing Bat
Order - Perissodactyla (Odd-toed Ungulates)	
Family - Tapiridae (Tapirs)	
Tapirus bairdii []	Baird's Tapir Mountain Cow, Danto, Tzimin,
Order - Artiodactyla (Even-toed Ungulates)	
Family - Cervidae (Deer)	
Odocoileus virginianus truei var. (Merriam 1898)	White-tailed Deer [Savanna Deer, Venado]
Order - Carnivora (Carnivores)	
Family - Mustelidae (Weasels)	
Lontra longicaudis annectens (Offers, 1818)	Neotropical River Otter Water Dog, gato de agua, lobi]
Order - Carnivora (Carnivores)	
Family - Cats (Felidae)	
Leopardus pardalis []	Ocelot Tigercat
Puma concolor/Panthera onca []	Puma and/or Jaguar Tiger, Tigre
Order - Carnivora (Carnivores)	
Family - Procyonidae (Raccoons)	
Nasua narica []	White-nosed Coati Pisote, Quash, Chiik
Potos flavus []	Kinkajou Nightwalker, Mico de Noche
Procyon lotor shufeldti (Nelson and Goldman)	Raccoon [Northern Raccoon, Mapache]
Order - Primates (Apes and Monkeys)	
Family - Cebidae (New World Monkeys)	
Alouatta pigra pigra var. (Lawrence 1933)	Yucatan Black Howler Monkey [Guatemalan Black Howler Monkey, baboon, Mono aullador negro, saraguato]
Order - Rodentia (Rodents)	
Family - Agoutidae (Pacas)	
Agouti paca nelsoni var. (Goldman)	Paca [Gibnut, Tepesquintle]