Peccary Hills

Biodiversity Assessment

For: Maya World Adventures

2005

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Biodiversity Assessment of Peccary Hills

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An Introduction to The Peccary Hills Area

The Peccary Hills are a well kept secret, despite lying within easy reach of Belize City – they are one of the most accessible wilderness areas within Belize, yet perhaps the least well known. The land, a combination of tower karst limestone, cave systems, tropical broadleaf forest, pine savanna and riverine mangrove, is a unique haven, isolated from the human impacts affecting much of the rest of Belize until very recently. Now, however, with the recent development of the Coastal Road, the construction of an access bridge over the Sibun River at Gracie Rock, and the purchase of part of the land for extensive property development, the area and its wildlife are coming under increasing pressure.

Gracie Rock community and Maya World Adventures have forged a partnership to seek ways to prevent the destruction of this incredibly rich, old-growth forest, and ensure its sustainability as a functional conservation area. With one of the highest observed densities of prey species in the country, supporting jaguar, puma and the smaller wild cats (margay, ocelot and jaguarundi); one of the few remaining populations of spider monkeys (*Ateles geoffroyi*), and plant species (such as *Louterdium chartaceum*) endemic to the steep limestone hills, the Peccary Hills have been highlighted as important for the maintenance of biodiversity in Belize. Added to this is their importance as a cultural resource, the numerous caves of the limestone hills having acted as places of worship for Maya in the past, some 1000 to 1300 years ago, leaving pottery vessel and jaguar tooth offerings as evidence of their presence.

This biodiversity assessment is the first step towards the creation of the Peccary Hills co-managed conservation area, bringing together the maintenance of viable biodiversity with the sustainability of community livelihoods, through the abatement of critical threats and the implementation of effective protection and management measures. It provides background information on the natural resources and physical characteristics of the area, and places it within the conservation context of the country.

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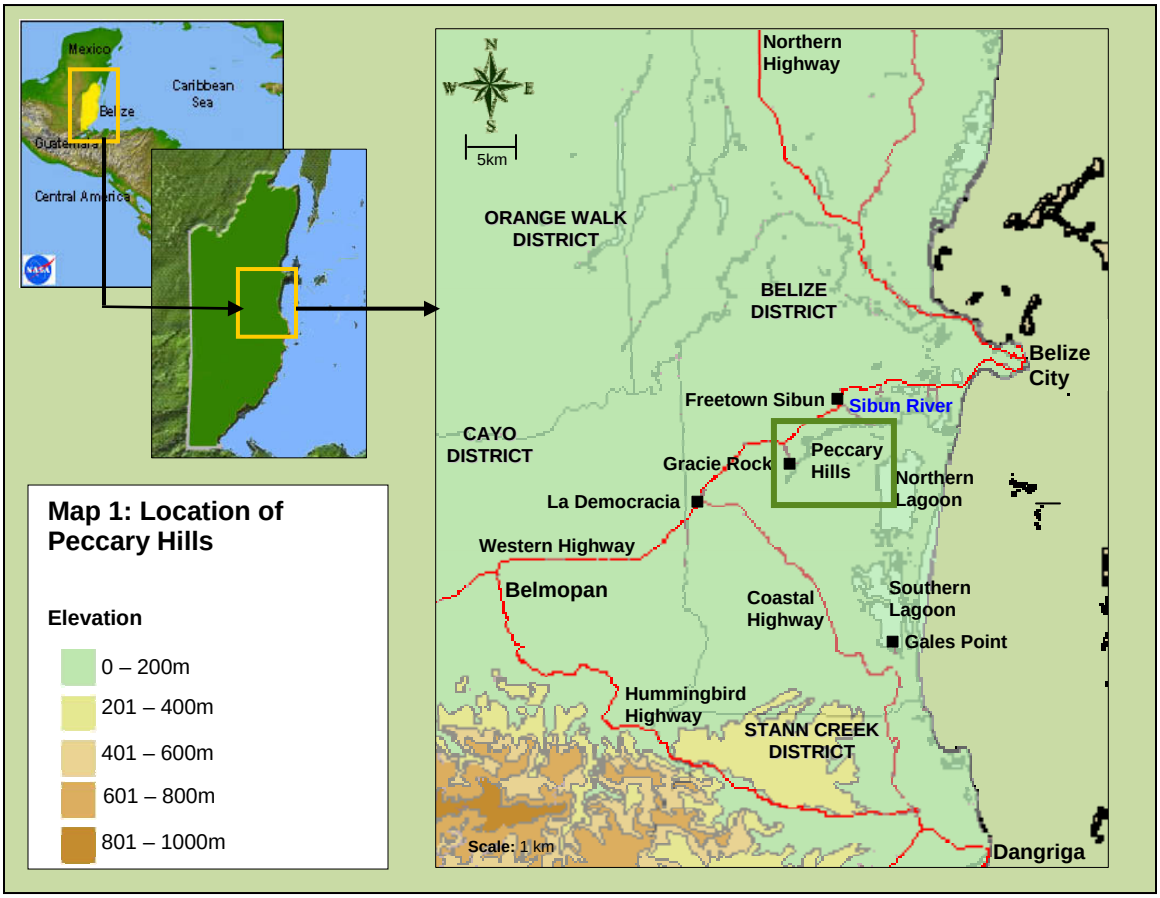
1.0 Background

1.1 Location

The Peccary Hills are situated in Belize District, the most developed of the six districts of Belize. The focal area, a combination of national and private lands, lie 30 km south west of Belize City, on the western shore of Northern Lagoon, stretching northwest to the Sibun River (Map 1). To the south lies the Manatee Forest Reserve, and to the west is the Runaway Creek Nature Preserve. The Peccary Hills area covers approximately 18,600 acres of tropical broadleaf forest and short grass savanna, freshwater creeks and mangroves. It has very distinctive physical features – with tower karst limestone rising out of the flat coastal plain, forming steep sided hills, with cliffs, limestone arches, and impressive cave structures.

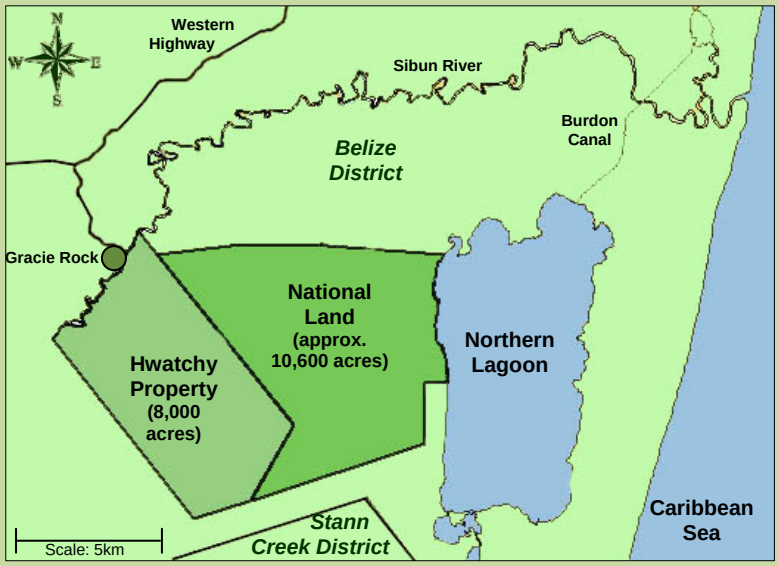


Map 1: Location of Peccary Hills

The primary stakeholder community is Gracie Rock, with a population estimated at approximately 170, consisting of households scattered along both sides of the Sibun River. Other communities that also impact the area include Freetown Sibun and La Democracia, to the north (communities that lie along the Western Highway) and Gales Point to the south. Belize City, with a population estimated at 59,400. (CSO, 2004), lies 30km to the northeast.

1.2 Site Description

The Peccary Hills area encompasses both private and Government land, in two contiguous properties, lying within the Manatee Special Development Area. The first is 8,000 acres, privately owned by Hwatchy International Ltd. The second area of 10,600 acres lies to the north, and is currently national land (Map 2).



Map 2: The focal area – the Hwatchy property and national land to the east

The ecosystems within these two tracts of land are a matrix of broadleaf forest, short grass and pine savannah, freshwater creeks, swamp forest, and mangrove, sheltering a representative array of Belize's mammals, including jaguar, puma, paca, Baird's tapir, white tailed deer, red brocket deer, Yucatan black howler monkey and the Central American spider monkey.

The Xibun Archaeology Research Project has completed an initial investigation of the ancient Maya settlements, cave systems and associated Maya pottery of the Sibun area, left as part of the Maya presence during the Terminal Classic period, between AD700 and AD1000, over 1000 years ago (McAnany and Thomas, 2003). This identified a small settlement in the karst area, north of Freshwater Creek, and the presence of a cave of major ceremonial significance (Arch Cave).

The adjacent Northern Lagoon is part of a network of waterways that are highlighted for the presence of the critically endangered goliath grouper, and for their importance for the West Indian manatee (Auil, pers. comm.), a species that also ventures at times up both Freshwater Creek and the Sibun River.

Traditionally, the Peccary Hills area has been used for subsistence hunting and fishing, with some local quarrying of sand from the short grass savanna areas by the community of Gracie Rock. Gracie Rock was founded during the early days of European settlement in Belize, with the movement of escaped slaves along the water systems radiating out from the Belize City area. These fugitives settled on the banks of the Sibun River and tributaries such as Runaway Creek. Even today, the small community is spread out in a line following the river. In the past, the income of this small community was based on employment at the Rockville quarry, though this has now dwindled, leaving the community without an income base until recently, and reliant on subsistence farming.

Within the last five years, the development of Maya World Adventures tourism activities within the Peccary Hills area has halted the financial decline of Gracie Rock, providing employment and training for those wanting work. The tourism relies on the near-pristine nature of the tropical forest and the protection of the wildlife. It also relies on the continued access to the ceremonial sites within the many caves, and to the undisturbed waters of Freshwater Creek. These are also qualities valued by the community members, leading to a collaborative partnership between members of Gracie Rock and Maya World Adventures, seeking a means to ensure the long-term protection of the area, putting in place the necessary infrastructure for sustainability, and developing and implementing conservation goals and actions that contribute to the long-term national goals for biodiversity protection.

In 1994, the Gracie Rock subdivision, 8000 acres of the focal area, was purchased by Hwatchy International, with plans for large-scale subdivision and the construction of a housing development. A bridge was constructed over the Sibun River at Gracie Rock to access the property, and a series of roads were created in the first phase of the development.

The development stalled in the late 1990's, providing a window of opportunity to secure the conservation of this unique wilderness area. To provide a short term means to prevent any further impacts from occurring, Maya World Adventures negotiated an option to purchase the 8,000 acre property, to provide time to seek funds to purchase the property for conservation before development and sale of house lots starts, and whilst conservation is still an option. This agreement gives temporary access to the land and management rights to Maya World Adventures, but expires in mid-2006.

In support of aims of the Maya World Adventures / Gracie Rock Community goals for the long-term conservation of these lands that are so rich in biophysical resources, the Government of Belize has indicated a willingness to negotiate the contribution of the 10,600 acres of national lands to link the 8,000 acre Hwatchy property through the savanna to Northern Lagoon to the east. The purchase of the Hwatchy property will therefore also provide the leverage needed to secure an additional, larger contiguous tract of land to significantly increase the core area under conservation and provide greater connectivity with adjacent protected areas and other unimpacted natural systems. Under the business plan of Maya World Adventures, the management costs for the conservation of the entire 18,600 acres are assured, on an ongoing sustained basis, along with the continued local employment and participation that has established such broadscale community support. What are urgently needed are the funds to purchase the Hwatchy property, to secure the long-term conservation of its rich biodiversity and cultural resources, and the leverage to secure those of the adjacent national lands.

2. Conservation Importance of Peccary Hills Area

Under the Protected Areas System Assessment and Analysis (NPAPSP, 2005) the Peccary Hills and adjacent savanna system were identified as one of the 'gaps' in the protected area system. The importance of the area was demonstrated by the presence of under-represented ecosystems and endemic, threatened and / or endangered species.

As noted within the above-mentioned Assessment and Analysis, follow-up Rapid Ecological Assessments will determine the real importance of the areas identified in the gap analysis. Applying data collected from the current REA, and using the NPAPSP Site Scoring System, the biophysical features (encompassing biodiversity, cultural resources, watershed protection, etc) of the Peccary Hills attain a score of 90 – a score equaled or exceeded by only three protected areas, as scored under the same system. Whilst this score should not be taken as demonstrating that the Peccary Hills area is the fourth most important area in Belize, it is clearly a critical area that currently lies outside Belize's protected area system.

2.1 Protection of Biodiversity

The current biodiversity assessment has documented a species richness that significantly surpasses that of most other areas surveyed in Belize by these authors – including protected areas that are many times the area of the Peccary Hills. For so many ecosystems, with their component flora and fauna, to be located within an area of less than 20,000 acres is remarkable. The near pristine state of much of the project area's biodiversity is no less remarkable, especially given the currently rapid fragmentation and degradation of much the remaining lowland wilderness areas of Belize.

Data collection during the biodiversity assessment demonstrated that this area appears to be one of four nationally important wildlife refuge areas within Belize – the other three being the Maya Mountains, Gallon Jug, and the Shipstern / Fireburn area. The presence of a large prey base, the relatively low human pressure, the presence of over twenty species of concern (IUCN, 2004), regionally vulnerable sub-species such as the Central American spider monkey (*Ateles geoffroyi yucatanensis*) and both regional and national endemic species all highlight the importance of protecting this area. The area also harbours perhaps the only remaining viable population of the endangered regionally endemic Central American River Turtle (*Dermatemys mawii*).

Conservation of the Peccary Hills area will provide direct protection for twenty four species of international concern (two of these still to be confirmed) – one of these is considered critically endangered, five are considered endangered, six are classed as vulnerable, and twelve are lower risk / near threatened (Table 1). Two further species (red brocket (*Mazama americana* and Neotropical river otter (*Lontra longicauda*)) are considered 'data deficient' – there being insufficient data to give a status, and yet they are considered to be at risk.

Table 1: Species of International Concern (IUCN: Red list 2004) of Peccary Hills Area		
Critically Endangered	Goliath Grouper	*Epinephelus itajara*
Endangered	Yucatan Howler	*Alouatta pigra*
	Baird's Tapir	*Tapirus bairdii*
	Yellow-headed Parrot*	*Amazona oratrix*
	Central American River Turtle	*Dermatemys mawii*
	Yaxnik	*Vitex gaumeri*
Vulnerable	West Indian Manatee	*Trichechus manatus*
	Central American Wooly Opossum*	*Caluromys derbianus*
	Cerulean Warbler	*Dendroica cerulea*
	Spanish Cedar	*Cedrela odorata*
	Palmacita	*Gaussia maya*
	Large-leaved Mahogany	*Swietenia macrophylla*
Lower Risk / Near Threatened	Jaguar	*Panthera onca*
	Puma	*Puma concolor*
	Water opossum	*Chironectes minimus*
	Great curassow	*Crax rubra*
	Black Catbird	*Melanoptila glabrirostris*
	Painted Bunting	*Passerina ciris*
	Morelet's Crocodile	*Crocodylus moreletii*
	Mexican Giant Musk Turtle	*Staurotypus triporcatus*
	Common Slider	*Trachemys scripta*
	Narrow-bridged Musk Turtle	*Claudius angustatus*
	Tabasco Mud Turtle	*Kinosternon acutum*
	Cycad, Palmita	*Zamia polymorpha*
	* requires confirmation	

Also useful for highlighting threatened species is Appendix 1 of CITES (Convention on International Trade in Endangered Species, 2005). This listing reflects concerns over ensuring that international trade in specimens of wild animals and plants does not threaten their survival, and so concentrates more on species that have a commercial value internationally. Twenty species fall under this category, including the five cat species. The ocelot, margay, jaguarundi, jabiru and boa constrictor are the only six of these CITES listed species that do not occur also on the IUCN Redlist (Table 2).

Table 2: CITES Appendix One Species of Peccary Hills Area	
Mammals	
Alouatta pigra	Yucatan Black Howler Monkey
Lutra longicaudis	Neotropical River Otter
Herpailurus yaguarondi	Jaguarundi
Leopardus pardalis	Ocelot
Leopardus wiedii	Margay
Panthera onca	Jaguar
Trichechus manatus	West Indian Manatee
Tapirus bairdii	Baird's Tapir
Birds	
Jabiru mycteria	Jabiru
Amazona oratrix	Yellow-headed Parrot
Reptiles	
Crocodylus moreletii	Morelet's Crocodile
Boa constrictor	Boa Constrictor

2.2 Protection of Watersheds

The Peccary Hills property plays an important role in protecting a not-insignificant portion of the southern watershed of the Sibun River – one of Belize's cleaner rivers on which several communities rely for their primary source of water. Concerns amongst the various communities about past deterioration of water quality in the Sibun led to the establishment of a community-based organization that undertook extensive public awareness actions to help reduce and mitigate inappropriate land-use activities that were seen to be detrimental to the health of the river itself, and to the communities dependant upon it. Maintaining the natural vegetation buffer along the 5.75km of southern riverbank of the Sibun River within the property is a significant contribution to the maintenance of the health and biodiversity of this system

The entire watershed of the Freshwater Creek system lies within the Peccary Hills and adjacent national lands to the east. The proposed conservation management and tourism development of these properties provide a rare opportunity to place an entire watershed under a single management programme. In terms of protecting the health of this system, and its diverse flora and fauna – including the endangered Central American River Turtle – effective conservation management from the upper headwaters draining from the Peccary Hills and swamp forests, through the mid and lower reaches to the Creek's exit into Northern Lagoon is far more likely to be successful than in fragmented systems more typical of the coastal plain.

Both these watersheds would be negatively and irreversibly impacted if the Hwatchy Development project were to resume. Effective business management of these systems as part of the primary tourism resource – a near pristine system of hills, forests, savannas and waterways, with tremendously rich wildlife – should develop a healthy balance between the conservation of natural resources and providing the sustainable development so needed at both a local and national scale.

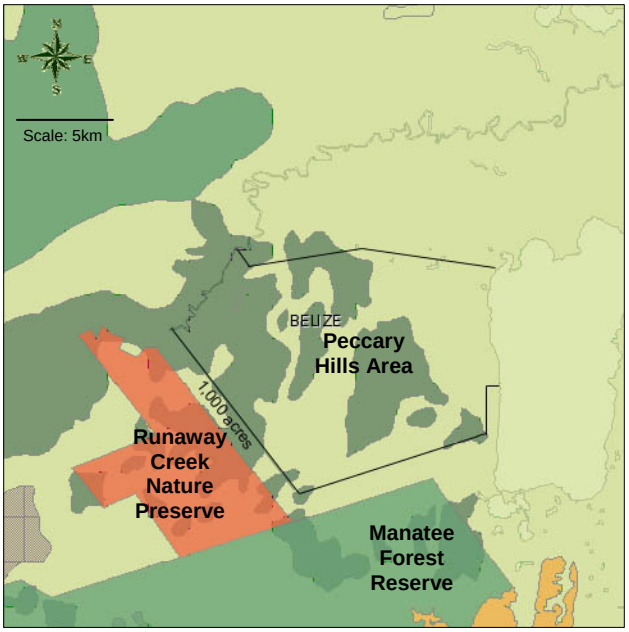
2.3 Connectivity

In terms of connectivity in the maintenance of biodiversity, there are several considerations regarding the role of the Peccary Hills area:

- Providing connectivity between the Manatee Forest Reserve, Gales Point Wildlife Sanctuary) and the Sibun River
- Providing connectivity of forested vegetation along the southern bank of the Sibun River – of special relevance to the Central American River Turtle (endangered), the Yucatan Black Howler monkey (endangered), the Central American Spider Monkey (vulnerable) and, to a lesser extent, the Baird's Tapir (endangered)
- Providing connectivity throughout the entire watershed of the Freshwater Creek system, of particular importance to the endangered Central American River Turtle, and to the health of the Northern Lagoon ecosystem, with its populations of West Indian Manatee (vulnerable) and herons / egrets.
- Providing connectivity with, and core conservation area extension for, the Runaway Creek Nature Preserve, and from there into the national biological corridor system.

With the failure of both the National Biological Corridors Programme (under the Meso-american Biological Corridors Programme) and the Northern Belize Biological Corridors Programme (under Programme for Belize) to bring about the implementation of wildlife corridors as a means to mitigate habitat fragmentation, much of Belize's biodiversity is now in a precarious position. Whilst international conservation organizations are assisting national efforts to preserve the biodiversity of the Maya Mountains, and significant portions of the coastal plains of Toledo

District, the outlook for much of the biodiversity in the broadleaf forests and of savannas of Stann Creek, Belize, Orange Walk and Corozal Districts is now beginning to look very bleak.



Map 3: Connectivity between the Peccary Hills and adjacent areas
Map adapted from BERDS

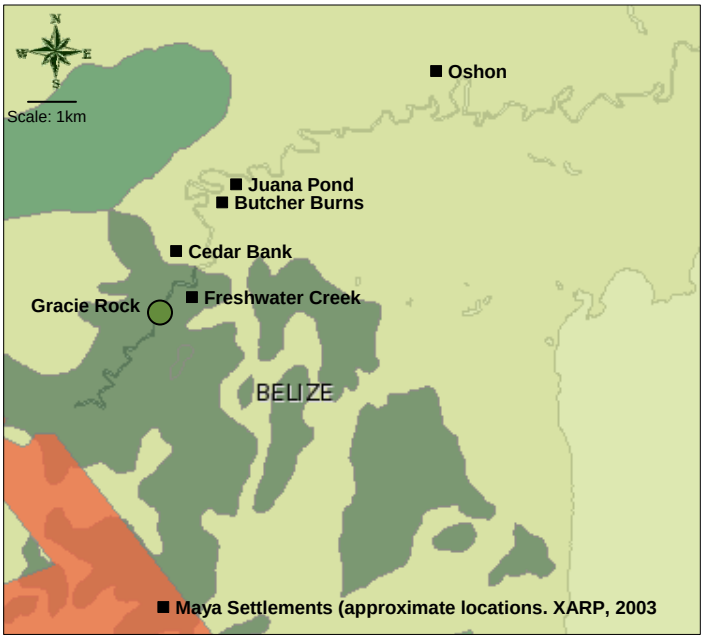
National development has accelerated considerably over the last decade, resulting in rapid fragmentation and isolation of remaining wilderness areas over these large portions of Belize. The few protected areas in the coastal plain north of Toledo District are mostly Forest Reserves, which with the limited resources available to the management agency (the Forest Department), are failing to maintain much of their biodiversity. Private and NGO initiatives to provide core area protection and connectivity are increasingly becoming the only real route to preserving much of the rich biodiversity of Belize's lowlands. Such initiatives are commonly severely hampered by the lack of medium to long-term financial sustainability – the proposed conservation management of the Peccary Hills area, supported by professionally managed tourism operations has the potential to become a model for how Belize can establish a viable balance between biodiversity conservation and development needs.

2.4 Protection of Geological Features

The recognition of the importance of karst landscapes as a conservation target by the IUCN World Commission on Protected Areas in 1997, and the increasing need for their protection, has led to an evaluation of karstic scenery and its protection throughout Central America (Kueny and Day, 2002). The region contains a significant proportion of the global karstic limestone, stretching from The Yucatan Peninsula to Panama, with 18% under some form of protection. Belize is highlighted as the country with the largest area of karst under protection (68% of the total karst landscape of the country falls within protected areas), however this is fast being eroded as the karst areas come under increasing pressure, with quarrying for limestone hardcore, and dereservation of forest reserves whittling away at the protected areas.

2.5 Protection of Cultural Heritage

The Xibun Archaeological Research Project (XARP) worked within the Sibun River Valley for three years (1997, 1999 and 2000), building up a knowledge of the ancient Maya and the impacts they have had on the present landscape. During the three field seasons, a total of nineteen Maya sites were located, stretching from the base of the Sibun gorge to the mangrove swamps of the estuarine area. These varied from small house mounds to large pyramids, but were united in their proximity to the Sibun River and its tributaries. The densest concentration of Maya settlements is in the middle reaches, between Runaway Creek and Indian Creek, linked to the settlements of the Gracie Rock area by the river (Map 4).



Map 4: Identified Maya Settlements in the Gracie Rock area
Map adapted from BERDS

Two major settlements were identified within the river valley – the first, Hershey, lies close to the opening of the Sibun Gorge. The second, Oshon, lies 10km from the river mouth and would have been the administrative centre for smaller settlements within the Gracie Rock area (Thomas, Marx and Bermingham, 2003).

The Maya settlements in the Sibun River valley in the Terminal Classic era have left their mark, with the discovery of ceremonial pottery vessels left as offerings within the caves of the karst area. These caves held great cultural significance for the Maya, being thought to represent the entrance to the underworld, where the gods resided. Offerings in the form of food, water and incense to carry messages to the gods, were left within the caves in ceremonial vessels One such cave – Arch Cave – was investigated by the Xibun Archaeology Research Project. This cave, deemed "the most amazing thing I have ever seen!" by archaeological caver P. Paterson (Leonard, 2003), shows signs of modification by the Maya, as well as housing fifteen complete pottery vessels, ranging from 'ollas', (globular vessels with rounded walls and a narrow neck, possibly holding offerings of water or food), to bowls (shorter vessels with no neck restriction, often with a pedestal base, some thought to possibly be used to burn incense). Altars surrounded by pots, mostly intact, emphasize the importance of this cave as a sacred site, strengthened by the presence of jaguar teeth – an offering to the gods (Photograph 1).

Photograph 1:
Ceremonial vessels, Arch Cave

Other caves, too, have been found to contain similar examples of Maya pottery. Perhaps the most astounding fact about this area is that, in view of its location, so close to Belize City, and to the Gracie Rock access road, the vessels have not been looted (as has occurred with many other caves in the karst areas of Belize). This appears to be due entirely to the respect the Gracie Rock community members have for the offerings and their significance, and a desire to keep their presence relatively secret within Belize.

A small Maya settlement (given the name Freshwater Creek) was recorded from within the Peccary Hills area, east of Arch Cave. A larger site, Cedar Bank, was uncovered to the north of the Sibun River, showing signs of both pre-colonial and colonial settlement (McAnany and Thomas, 2003).

2.6 Contribution to the Local Community

Historically, these lands have been important to the people of Gracie Rock for small-scale milpa farming, hunting and fishing, and as a source of other forest products. Significant social change has occurred in the community over the last twenty years, with a significant portion of the younger generation moving away from the traditional subsistence lifestyle in favour of a less taxing existence in Belize City, and even further afield. Some of those who remained took up work at the nearby quarry, and became less reliant upon the surrounding natural resources. More recently still, with the downsizing of the quarry workforce, the community of Gracie Rock had suffered a significant economic downturn, from its already low-income level.

The tourism development to date, under Maya World Adventures has brought about a significant re-invigoration within the community. It is clear that the provision of regular work, under a caring management, has re-instilled a sense of community pride within Gracie Rock. The local skills and knowledge of the natural resources that had been unable to sustain the community are at last both needed and rewarded – providing a significant portion of the households with a regular and reliable income. At the same time, new skills are being developed that further enhance prospects for continued improvements to standards of living within the community. In so doing, the tourism use of the Gracie Rock property has dramatically reduced remaining anthropogenic pressures on the natural resources. The project is very much in line with the Government of Belize's desire to see local communities benefit from protected areas – and may become a model of how to build financial sustainability and community support into protected area management.

3. Historical Impacts that have shaped the Peccary Hills Area

3.1 Maya and Colonial Influences

One focal area of the Xibun Archaeological Research Project was the development of an idea of land use over time using pollen core analysis. During the main period of Maya settlement (AD700 to AD1000), the presence of domesticated maize pollen and remnants of charcoal, and the relatively high levels of associated vegetation species composition, such as sapote and hogplum suggested an open, cultivated river valley (Jones, 2003). Following this period, pollen analysis suggests a naturally regenerating forest with small-scale milpas, and a slightly elevated abundance of semi-cultivated tree species. This is followed by a time when the area was heavily forested, with a gradually increasing abundance of cohune and other, non-economic species.

This reforestation stopped abruptly during colonial days, with pollen analysis indicating a shift from trees to pasture in the area being surveyed, suggesting the river valley was once again going through a period of intensive agriculture.

These human influences have helped to shape the current forest structure, selecting for some species, providing conditions suitable for the expansion of others such as cohune, and removing some trees through over-harvesting.

3.2 Logging

It can be presumed that significant logging occurred throughout the late nineteenth and early twentieth century, with logs being floated down the Sibun River – but no evidence of this past timber extraction remains. Records of more recent past logging in the area, however, are largely lacking. It is known that one logging operation in the late 1980's or early 90's extracted mahogany and Spanish cedar from the more accessible portions of the alluvial flatlands. This would appear to have been a brief and low-intensity extraction – very few signs remain of such activities: a few narrow tracks can still be discerned passing between the hills, but tree stumps and detritus are not in evidence. The brevity and focus of that logging operation are demonstrated by the wealth of timber resources of other commercial species which remain, even in accessible areas. Local reports also suggest that much of the pine was removed from the savanna to the north, under concession.

3.3 Fire

There are three areas to consider in terms of fire:

Short-grass savanna

Most short-grass savannas in Belize are exposed to anthropogenic fires on an annual basis, sometimes even more frequently. Fires are primarily started by hunters, aiming to attract white-tailed deer to the new shoots that rapidly emerge from the ashes of burnt savanna. Subjective perception is that these fires are increasingly common in recent years – perhaps a reflection of increasing human population and increased mobility of hunters. Frequent fires have a pronounced impact on short-grass savannas, eradicating pine trees, and often the oaks and madre-de-cocao stands associated with the pine. Overall, frequent fire reduces overall species richness – favouring the few species able to either withstand fire, or rapidly regenerate from fire events. In the context of the Peccary Hills area, it is known that as recently as 20 years ago, pine stands were far more extensive on the savannas than is now the case. With this habitat alteration came the significant reduction in feeding and breeding grounds for the now endangered yellow-headed parrot. If long-term conservation management is to be initiated for this area, fire management and habitat restoration within

these savannas should be high on the list of priorities. The extent of the savannas would be sufficient to play a significant role in the recovery of the yellow-headed parrot from its current precipitous fall in numbers, if appropriate habitat restoration and fire-management programmes were to be implemented.

Hill-tops

Rising abruptly from the flat coastal plain, the Peccary Hills are the first elevation features in the path of summer storms pushed by the trade winds. Not surprisingly therefore, the tops of the karst limestone towers are very vulnerable to lightning strikes, and resultant fires. The seasonally xeric conditions on these hilltops further enhance the likelihood of lightning strikes igniting isolated fires on these exposed localities. No data is available for the frequency of such natural fires in this area, but vegetation provides some clues. In a few instances, small areas of *Pteridium* bracken occur at or close to the tops of some of the hills – these are likely to indicate incidences of two or more fires at the same location, and resultant soil degradation. Signs of 'flash' fires are evident on the trunks of some of the hill-top tree-trunks; regeneration of original vegetation is likely to be relatively fast in such instances – but these natural fires are likely to be a causal factor in the determination of vegetation type on these craggy limestone hill-tops.

Past-development area

The Hwatchy Development cleared a significant tract of alluvial forest running down the centre of the property in the late 1990's. Whilst much of this cleared land now supports regenerating secondary forest, two areas totaling approximately 75 acres have subsequently been exposed to fire on two occasions, the most recent occurring in 2005. One of these fires spread some way up adjacent hill slopes, further exacerbating the impact of the original land clearance. The source of these two fires is unknown, but can be assumed to be anthropogenic in origin.

3.4 Hwatchy Development

The Taiwanese Hwatchy Development project poses an enormous threat to the biological integrity of the Peccary Hills. Much of the 8,000 acre property was earmarked for housing subdivision, including areas in the riverine floodplain and on slopes far too steep for this type of development. Were the project to go to fruition, the old-growth forests, the rich biodiversity resources (including endemic and endangered species), along with all connectivity functionality, would be lost in perpetuity. Fortunately, the project stalled in the relatively early stages – having invested significant funds on site and infrastructure preparations. A semi-permanent bridge was built across the Sibun River, to allow easy access from Gracie Rock; a central hardcore-filled roadway was pushed approximately 3.5km through the property, with two feeder roads covering an additional 2.5km were established. It is estimated (from the current survey) that approximately 215 acres of alluvial forest was cleared, of which about 75 acres have been subsequently impacted by fire. Stalling when it did, the Hwatchy development project severely impacted approximately 6% of the lowland forests of the property. Another ramification of the project is the resultant increased accessibility to this otherwise almost pristine system – access to game species, timber resources and the Maya artifacts that abound in several of the caves. The current management agreement has enabled the recent construction of a gated entrance at the river crossing, as a significant step towards limiting unauthorized access and potential hunting and looting on the property.

4. Review of Current Situation – Areas of Concern

The Peccary Hills and adjoining lands leading to Northern Lagoon are unique in many ways, with:

- a broad array of ecosystems within a relatively limited area
- the majority of the ecosystems being in near-pristine condition with old-growth forests that disappeared from most of Belize's coastal lowlands decades ago
- the presence of a plant species endemic to this particular locality and several others of conservation concern
- the highest prey base (for the large cats) seen by the consultants anywhere in Belize
- one of the very few populations of spider monkeys outside the Maya Mountains
- perhaps the only remaining viable population of the regionally endemic Central american River Turtle anywhere

The cave systems that are scattered throughout the karst hills are said to be some of the most impressive in the region, the presence of undisturbed ancient Maya antiquities and ceremonial fire-hearths is remarkable.

This whole system was faced with almost total alteration and loss of biodiversity in the late 1990's under the Taiwanese Hwatchy Development project – which embarked upon the initial phases of what was to be an extensive housing and subdivision development stretching throughout not only the heart of this remarkable area, but up the hills themselves. The project stalled after clearing approximately 215 acres of the 8,000 acre property, providing breathing space for concerned stakeholders to look for alternatives. Since then, Belizean businessman, David Gegg, negotiated a lease on the land for use as a tourism destination – with an option to purchase. Through his company (Maya World Adventure), Mr. Gegg has invested approximately US$1million developing and implementing his tourism development plan, working with the stakeholder community of Gracie Rock to deliver a remarkable combination of wilderness experiences to the tourism market. The next step is to ensure that this remarkable wilderness remains protected for the benefit of future generations.

In providing employment, skills training and the replenishment of self-respect for the community of Gracie Rock, the project has perhaps uniquely (in Belize) gained broadscale community support for its objectives – and could become the model for building financial sustainability and community support into protected area management in Belize.

The massive threat facing this impressive partnership between conservation ideals, sustainable development and business interests, is the expiration of the current lease on the property in 2006 – and with it, the option to purchase. The solution being sought is to purchase the lands, and for them to be placed in trust for conservation management in perpetuity (in a manner similar to the Rio Bravo Conservation Management Area), with management to be funded through the continuation of the tourism business developed over the last three years. The Government of Belize has indicated that it is prepared to entertain the contribution of approximately 10,600 acres of lands (possibly under a debt for nature swap), to link the Peccary Hills property with Northern Lagoon to the east (Gegg, pers. com.), and an option to purchase a further 1,000 acres to the west is currently being negotiated so as to provide direct connectivity with the Runaway Creek Nature Preserve.

A management structure is being developed to formally incorporate the interests and involvement of the stakeholder community of Gracie Rock, and guarantee the business security for the tourism development that finances the conservation management and ensures stakeholder support through long-term employment and social benefit. The missing ingredient is the finance for the land acquisition. With the establishment of a trust status (or other such legal structure) to guarantee the conservation status of the property in perpetuity, this would appear to be a perfect scenario for a one-off investment in the conservation of a unique assemblage of near-pristine ecosystems, rich in threatened, endangered and regionally (and locally) endemic species, where management sustainability has already been achieved.

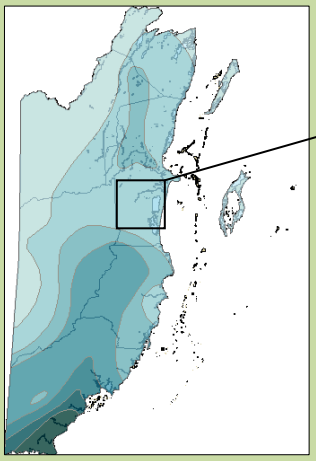
5.0 Physical Characteristics

5.1 Climate

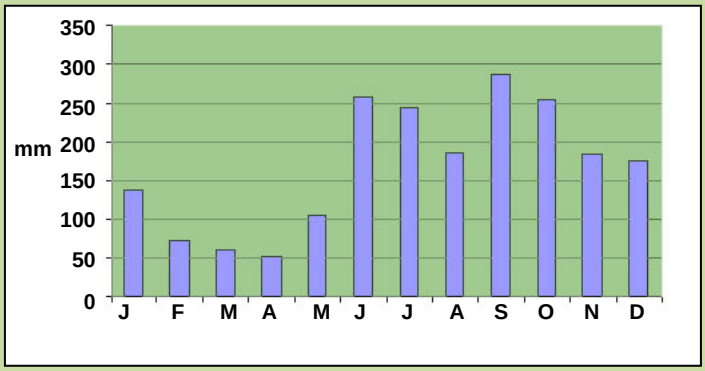
Belize lies within the outer tropical geographical belt - the relatively high temperature and rainfall patterns associated with the tropics are one of the factors that promote and sustain the high levels of biodiversity within the region. Prevailing winds are easterly from the Caribbean.

5.1.1 Rainfall Patterns

The Peccary Hills area is situated on the central coastal lowland, an area with distinct wet and dry seasons, defined climatically as sub-tropical. It lies within the second driest rainfall belt in Belize, with an average annual rainfall of 228cm per annum (National Meteorological Service, 2005; Map 5).



Map 5: Rainfall belts in Belize



Graph 1: Rainfall

Rainfall varies throughout the year, with the highest rainfall occurring between June and December, peaking in September at 286mm, during the tropical storm season. The dry season has minimum rainfall levels of 51.7mm, recorded in April.

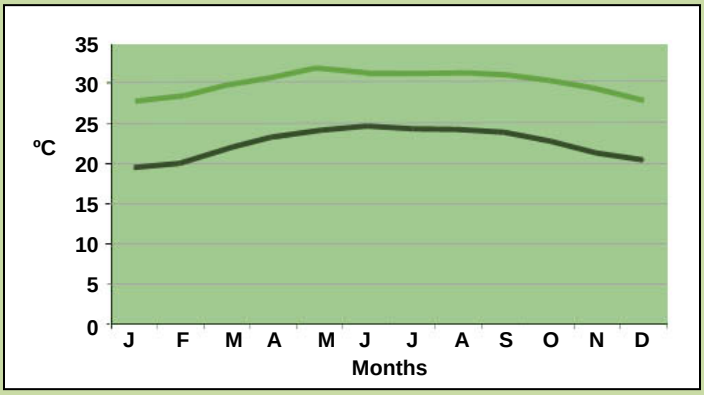
Data Sourcse: Map 3: BERDS (Appendix ..)
Graph 1: National Meteorological Service of Belize, 2005.

There is a pronounced dry season stretching from February through to the end of May, with minimum monthly rainfall of as low as 51.7 mm in April, the driest month. This is followed by a wetter season (June to December / January) with maximum rainfalls in the region of 280cm, punctuated by a mini dry season in August. The majority of the rain falls within the hurricane season, associated with passing tropical storms (particularly between September and November). This seasonality of rainfall is reflected in the vegetation conditions, with the

limestone karst hills becoming seasonally very xeric. The short grass savanna and associated pine also become parched, and as a result are prone to extensive seasonal wildfires, started by hunters seeking to attract game to the ash and regenerating grass shoots.

5.1.2 Temperature

Lying within the subtropics, annual temperatures in coastal central Belize (including the Peccary Hills area) average approximately 26ºC, with fluctuations throughout the year. Minimum temperatures of 19.5ºC occur in January, during the cold fronts, whilst maximum temperatures of 31.8ºC are recorded in May.



Graph 2; Table 3:

Temperature

Temperature in the Peccary Hills area fluctuates throughout the year, dependent on the prevailing winds.

Month	Mean Temperature °C		Mean Total Rainfall (mm)	Mean Number of Rain Days
	Daily Minimum	Daily Maximum		
Jan	19.5	27.6	137.9	11.8
Feb	20.1	28.3	72.6	7.4
Mar	21.8	29.5	59.2	4.9
Apr	23.1	30.7	51.7	3.9
May	24.2	31.8	104.6	6.1
Jun	24.7	31.3	257.6	14.1
Jul	24.3	31.1	243.5	16.3
Aug	24.2	31.3	186.9	15.9
Sep	23.9	31.0	286.5	15.9
Oct	22.7	30.2	254.6	15.4
Nov	21.3	29.1	182.8	12.6
Dec	20.4	28.0	175.6	11.9

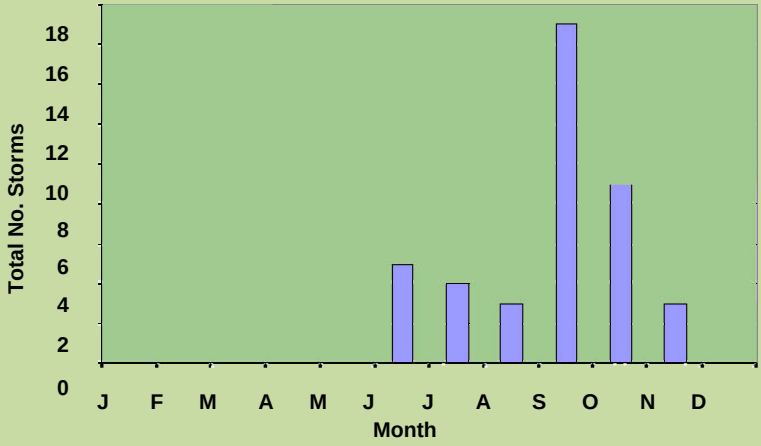
Data Sourcse: Graph 2, Table 3: National Meteorological Service of Belize, 2005.

5.1.3 Weather Systems

Belize is affected by three very distinct seasonal weather systems - the Trade Winds (blowing from the east), tropical storms (occurring between June and November), and northers (occurring between October and April), all of which have an influence on the rainfall and temperature patterns.

Tropical Storms

Tropical storms form in the Atlantic Ocean over warm, tropical waters and are non-frontal, developing highly organized circulations. Ranging in scale from tropical depressions (with sustained wind speed < 74 mph) to hurricanes (with sustained wind speed > 74 mph), these storms move westward towards the Caribbean, gathering strength until they hit land.



Graph 3: Tropical Storm frequency per month, from 1889 – 2000, making landfall in Belize

Data Source: National Meteorological Service of Belize, 2005. Data from 1889 - 2000

Hurricanes play a major role in the structural development of forests in Belize (that of Peccary Hills being no exception), reflecting the perturbation dependence of forests that lie within the Atlantic hurricane belt. This has resulted in the general term "hurricane climax forest", with a species composition influenced by the cycle of natural disturbance from these tropical storms.

Table 4: Hurricanes affecting the Peccary Hills Area

Year	Hurricane	Speed at Landfall	Date of Landfall	Notes
1961	**Hattie**	150mph	31/10/1961	Made landfall approx. 25km north east of the Peccary Hills area, with a tidal surge of between 10 and 15 ft on the coast.
1978	**Greta**	110mph	19/9/1978	Made landfall just north of Stann Creek, approx. 40km south of the Peccary Hills area, resulting in a tidal surge of between 4 and 10ft.
2000	**Keith**	69mph	03/10/2000	Made landfall 50km north of the Peccary Hills area, resulting in substantial flooding

Data Source: National Hurricane Centre

The Peccary Hills area has been affected by a number of hurricanes in the recent past – with Hurricane Hattie in October 1961 being the most severe. This made landfall just to the east of the area, with hurricane force winds estimated at 150mph, and tides of 10 to 15 feet above normal, sweeping salt water many miles inland over the low areas. This flooding was further exacerbated by torrential rain (National Hurricane Centre, 1961).

More recently, Hurricane Keith, in October 2000, not only brought flooding, but also resulted in the denudation of the trees in the karst area to the west of Northern and Southern Lagoons (pers.com. Gales Point resident). These are reported to have re-leafed, suggesting that the storm was not as devastating as the more recent Hurricane Iris, which caused wholesale massive damage to forest structure in southern Belize in 2001.

Hurricane Keith also resulted in substantial flooding of the area as a result of the heavy rainfall associated with the hurricane (32.67 inches being recorded at the nearby at the Philip Goldson International Airport), with the majority of the karst valleys being flooded with significant amounts of water (Gracie Rock community members, pers. com.).

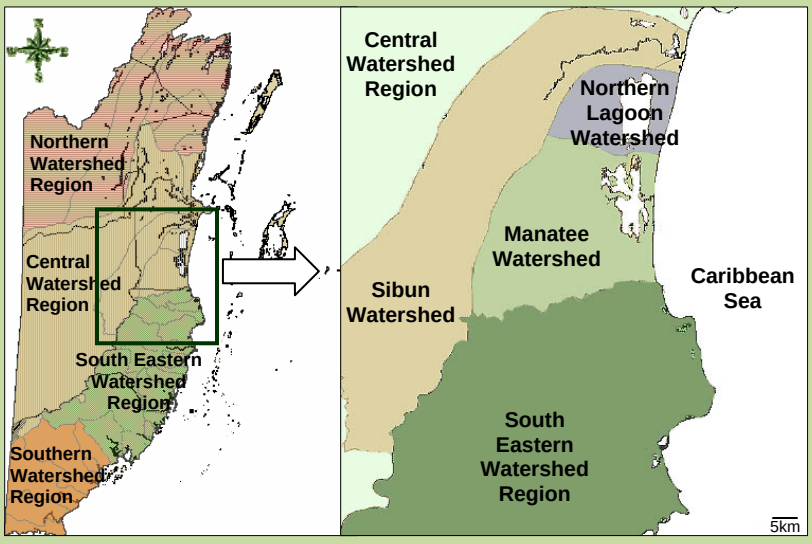
The landscape of the Peccary Hills, with caves, hills and sheltered valleys, ensures that the wildlife and forest structure is more sheltered, and better able to withstand hurricane force winds and flooding than in the coastal plain broadleaf forest of Toledo, where recent biodiversity assessments show that some devastated areas of broadleaf forest now have extremely low vertebrate presence.

Northers

Northers affect the country from October through to April (with highest frequency in December, January and February). These cooler air masses move down from North America, bringing cooler temperatures and, on occasions, heavy rain and winds. These have little effect on the Peccary Hills area other than the reduction in temperature, possibly reducing herptile activity during the coldest days and nights.

5.2 Hydrology of Peccary Hills

The Peccary Hills area lies within two watersheds – the Sibun Watershed (273,377 acres) and the Northern Lagoon Watershed (37,818 acres), both located in the Central Watershed Region (Map 6).



Map 6: Watershed Regions and Watersheds of the Peccary Hills area
Data Source: Berds (Appendix Six, Meerman and Clabaugh, 2005)

5.2.1 The Sibun Watershed

The headwaters of the Sibun River consist of many small, fast flowing streams that drain the granite-based, acidic Maya Mountains from a maximum elevation of 960m, to then flow in the mid-reaches, through alkaline limestone karst, with characteristic disappearing streams that flow underground through cave systems, to reappear on the flat coastal plain. Here they flow more slowly, joining to form the Sibun River. The lower reaches of the river meander across the alluvial coastal plain, with the formation of ox-bow lakes and abandoned channels over time, to flow into the Caribbean Sea.

A section of the lower reaches of the Sibun River provides delineation of the north western boundary of the Hwatchy property.

The Sibun River has the reputation of being the fastest river in Belize to rise, and the most frequent to flood (Wright, 1959). During storm events (usually once or twice a year) the river inundates the flood plain, covering the lower lying valleys between the karst hills with water up to a meter or so in depth, spreading up to 1 km from the river. This periodically deposits great volumes of silt on the floodplain, providing a deep, rich soil that has attracted agriculture to the area in both Maya and present times. Further flooding also occurs from a tributary of the Sibun (Runaway Creek) in the north west of the property (Meerman, 1996).

The Peccary Hills area is sufficiently far inland that it is not subjected to tidal influences and changes in salinity, though local reports suggest that marine species do seasonally enter the river system as far as Gracie Rock.

5.2.2 The Northern Lagoon Watershed

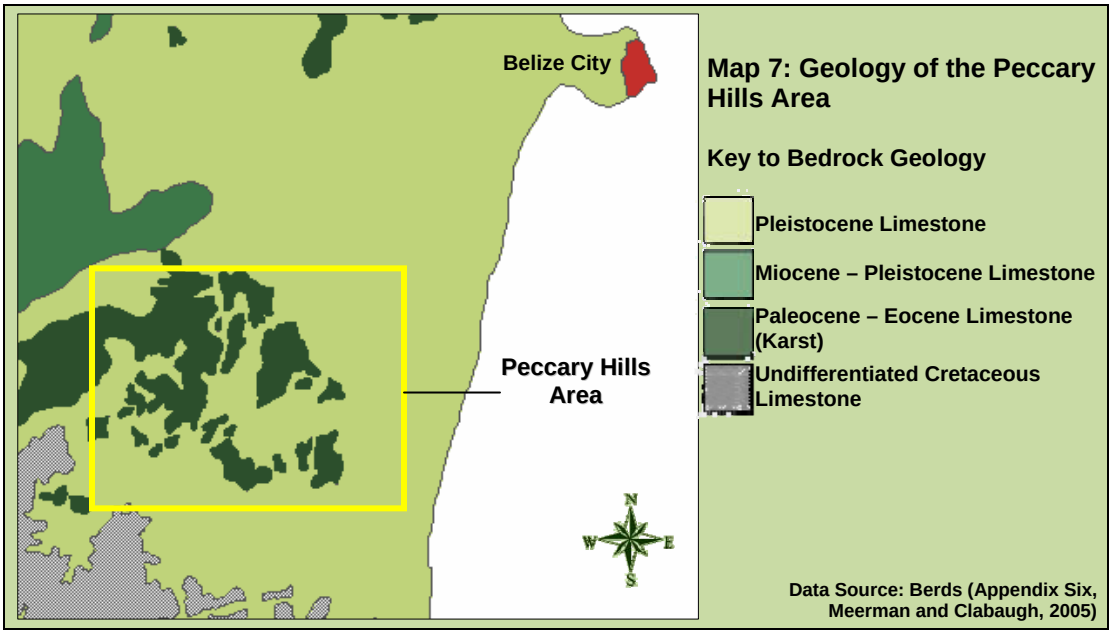
Small creeks from the swamp forests, and sheet runoff from the savanna, drain into Freshwater Creek then empty into Northern Lagoon, one of two large lagoons within the Central Watershed Region. This is then linked with the sea, through Burdon Canal to the north, and the Southern Lagoon to the south. During storm events, this network of creeks floods, leading to inundation of much of the surrounding savanna area, exacerbated by the low permeability of the sub-soil.

During even minor storms, increases in water level in Northern Lagoon will result in inundation of low lying savanna areas with brackish water, influencing the ecosystem located there.

Major storm events, such as Keith in 2000, result in the Sibun inundating the area north of its course as far as the Western Highway, and flooding the valleys of the karst area to the south. During such hurricane events, storm surges of four feet or more have been recorded in the coastal areas, leading to extensive flooding of the coastal savanna (National Hurricane Centre, 2005), conceivably resulting in connectivity between the two watersheds

5.3 Geology

The Peccary Hills area lies to the south-east of the Sibun River, and is characterized by two main geological features – the low to medium height karst hills, and the low lying coastal plain (Map 7).



5.3.1 Karst Hills

The Peccary Hills are located in Sibun-Manatee karst region, the most northeasterly of the eight karst regions that have been identified in Belize (Miller, 1996). Lundell (1934) identified the Sibun River to be the southern most extent of the Yucatan limestone shelf (Tripplett, 2003). The area is considered to be an extension of the Boundary Fault region, an area estimated at 550km², with a maximum relief of 200m (Miller, 1996). Much of the area is tower karst (Photograph 2) – the final stage in the erosion of limestone deposited on the coastal plain 65 to 125 million years ago, indicative of the area being covered by a warm, shallow sea. As sea level dropped, the sedimented limestone bedrock became exposed, and was infiltrated by water, eroding to create sinkholes over time. These increased in size over time to gradually join together, leaving only the hardest remnants of the original cretaceous limestone standing as tower karst, rising out of a flat valley floor. The recent nature of the landscape is indicated by the limited amount of colluvium at the base of the towers.

Photograph 2:
Karst scenery - Limestone cliffs and caves of Peccary Hills

The northwestern Peccary Hills themselves have been classified as Tertiary dolomite (Cornec, 1986) (though more recent samples from the Gracie Rock area show a pure calcite rather than a dolomite

(Miller, 1996)), and consist of many hills of both the classical tower and cockpit formations.

5.3.2 Pleistocene Plain

The Pleistocene limestone bedrock, deposited between 1.6 million and 8,000 years ago, lies to the east of the karst hills, and supports a gradient from short grass savanna to open pine forest. It underlies sand-based alluvium deposits derived from the Maya Mountains.

Photograph 3:
Coastal Plain of Peccary Hills,
With karst slopes in background

5.4 Soils and Land Use

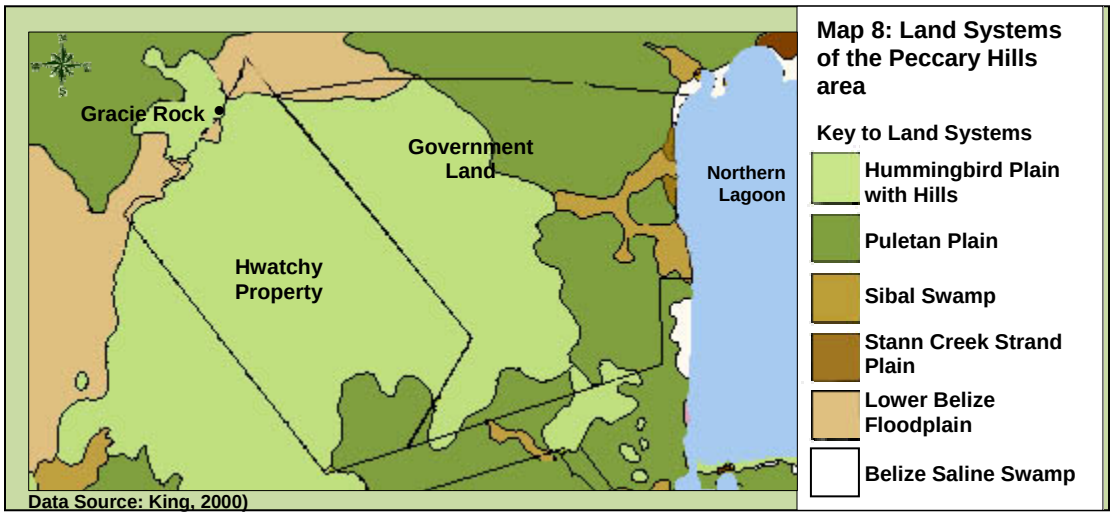
Two major soil and land use studies have taken place in Belize – the first a comprehensive study of the whole country by Wright et. al. (1959), looking at soils and associated vegetation assemblages in great detail. The second is a more recent series of studies by King et. al. (1986, 1989 and 1992), based on Wright, but using techniques such as satellite imagery to update the original report. King et. al. demarcated a number of land regions and systems throughout Belize to classify different soil characteristics. Under this system, three Land Regions and six Land Systems are recognized within the Peccary Hills area.

5.4.1 Land Regions

Land Regions are broadscale divisions of the landscape into different units based primarily on topography. Of the three Land Regions present in the Peccary Hills area, there are very defined boundaries between the two main Land Regions, based primarily on the topography, with the limestone tower karst area falling within the Central Foothills, whilst the flat savanna to the east and northeast is classified as part of the Central Coastal Plain. The floodplain for the Sibun River falls within the third Land Region, the Northern Coastal Plain.

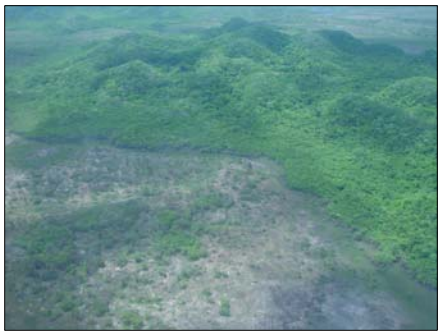
5.4.1 Land Systems

Within the Land Regions, classification of Land Systems and soil types are more heavily influenced by the geology and topography of the area, with the parent bedrock and steepness of the terrain playing an important part in soil characteristics. The Peccary Hills area is categorized as being comprised of six different Land Systems (King et. al., 1992).



Photograph 4: Hummingbird Plain with Hills. A significant proportion of the Peccary Hills area, this encompasses the rich broadleaf forest and steep hills of the karst area, characterized by medium to tall karst landscape, standing in a flat alluvial plain.

Photograph 5: Lower Belize Floodplain: The Sibun River has carved a route through the karst landscape to the northwest, resulting in a small band of low-lying floodplain following the course of the river. The majority of the Gracie Rock community members have houses and farms situated in this belt, the problems of seasonal flooding of the Sibun River following heavy rains being outweighed by the agricultural value of the alluvial soil.



Photograph 6: Puletan Plain. The low-lying, flat plain with acidic soils and short grass savanna / pine vegetation complex is a nutrient-poor land system which, like that of the karst hill slopes of the 'Hummingbird Plain with Hills' that rise behind it, is of no agricultural value. The edge between these two land systems is sharply defined.

Photograph 7: Sibal Swamp. This land system lies adjacent to Freshwater Creek, following its course as it crosses the Puletan Plain, draining into Northern Lagoon. It is characterized by taller, marsh vegetation and stretches in the low-lying inundation area to the south, as herbaceous swamp.

Photograph 8: The west shoreline of the lagoon is comprised of two further land systems, with a small area of '**Stann Creek Strand Plain**' to north and south of the mouth of Freshwater Creek. North of these lies a small low tidal inundation area of the '**Belize Saline Swamp**' land system, heavily influenced by the semi-saline water of Northern Lagoon that regularly floods the land.

Table 5: Land Regions, Land Systems and Soil Types within the Peccary Hills area

Land Region	Land System	*Subunit*	Soil Type ***Suite:*** Sub-suite	Characteristics	Location within the Peccary Hills area
Northern Coastal Plain	Lower Belize Floodplain (BF)	***Alluvial Wash***	***Melinda:*** Sennis	Soils deposited as riverine alluvium over old coastal alluvium.	These two soil types are alluvial, being deposited on the floodplain of the Sibun river, and therefore following the course of the river
		High Floodplain	***Melinda:*** ***BV:** Lemonal > Freetown		
	Belize Plain (BP)	***Pitted Plain***	***Puletan:*** ***BV:** Hattieville + Double Head Cabbage*	Moderately acidic, dry, sandy soils of the deeper deposits of silicaceous old alluvium on the coastal plain, deposited in shallow water. Soils are heavily leached, and waterlog in wet weather, with flooding and surface wash occurring. Following heavy rain, sheet wash occurs, collecting in low areas to form temporary swamps and pools	Large expanse of low-lying short grass savanna in the north east of the Peccary Hills area, draining into Tum Tum Creek
		Low Plain	***Puletan:*** Bocotura		
		Braided Plain	***Puletan:*** Bocotura?		
	Sibal Swamp (SW)	***Herbaceous Swamp***	***Tintal:*** Sibal	Permanently waterlogged mineral and organic soils of freshwater swanps, with a wet peat surface extending to a depth of 50cm or more, overlying waterlogged mineral soils	The Marsh Forest subunit follows the course of Freshwater Creek; Two small areas of Herbaceous Sibal Swamp lie on the west coast of Northern Lagoon, in lower lyng areas more prone to inundation
		Marsh Forest Plain	***Tintal:*** Sibal		
Central Coastal Plain	Puletan Plain (TP)	***Flat Plain***	***Puletan***	Sandy topsoils occurring on old coastal deposits, with seasonal waterlogging.	Lying to the east of the karst region, between the tower karst and the western shore of Northern Lagoon.
		Pitted Plain	***Puletan***	A wet peat surface extending to a depth of 50cm or more, overlying permanently waterlogged mineral soils	
		Very Poorly Drained Basin	***Tintal:*** Sibal		
	Stann Creek Strand Plain (SB)	***Poorly drained Swale***	***Tintal:*** Hopkins	Wet gleys and peats of permanent freshwater swamps. Extremely poorly drained	Small patches of herbaceous swampadjacent to Northern Lagoon
	Belize Saline Swamps (TY)	***Low Tidal Flat***	***Tintal:*** Ycacos	On the lower tidal flat areas, deeper, permanently wet mineral and organic saline soils of mangrove swamps. The higher tidal flat areas consist of sandy coastal deposits with beach forest vegetation.	Located on pockets of lower land adjacent to Northern Lagoon,
		High Tidal Flat	***Tintal + Turneffe*** Ycacos + Hopkins		
Central Foothills	Hummingbird Plain with Hills (BX)	***Medium Karst***	***Chacalte:*** Cabro > (Xpicilha +San Lucas + Quamina)	Chacalte soils are derived from the limestone karst, with a supply of bases from limestone offset by heavy leaching. Three main subunits are represented in the area – Cabro, Xpicilha and San Lucas. Cabro soils are the most common in the karst area, and are shallow and bouldery; xpicilha soils are of moderate depth, found on lower slopes of the hills; San Lucas are the deepest, found at the base of the hills.	These soils form the central core of the karstic region of the Peccary Hills area. ***BV**: Belize Valley Soils (Jenkins et. al. 1976) ***SC:** Stann Creek Soils (King et. al. 1989)
		Low Karst	***Chacalte:*** Cabro + Quamina > (Xpicilha +San Lucas)		
		Slightly Undulating Plain	***Chacalte:*** ***SC**:Regalia + Serpon > Quamina		
		Flat Alluvial Plain	***Melinda:*** Quamina > (Puletan + Canquin)	Predominantly weakly developed river alluvium soils	

6.0 Biodiversity Assessment

6.1 General Methods

General Methods

The conservation importance of an area is typically determined through an assessment of its biodiversity, achieved through recording the species presence, species distribution, condition and /or abundance of key species. Where a good baseline exists, a biodiversity assessment can concentrate on the latter, looking at species densities and abundance in different ecosystems, or comparisons with other areas of Belize or the region. In this instance, however, where little or no baseline data exists, the primary biodiversity assessment requirement is for data on species presence and distributions, to provide a baseline for future work on abundance.

The vegetation component of the current biological assessment of the Peccary Hills area focused largely upon the collection of validated data on vegetation types, from transects, ground-truthing point checks, aerial reconnaissance and photography, to determine the actual vegetation types their location, and extent, and to generate an updated ecosystem map for the area. Predominant and / or characteristic species of flora, and relative abundances associated with each habitat were identified and listed where possible.

Preliminary site visits to each of the main habitat types were used to ground-truth existing ecosystem mapping (Meerman & Sabido, 2001 & 2004), identify principal discrepancies, and develop preliminary lists of predominant plant species for each ecosystem. Resultant data was then used to re-evaluate the existing ecosystem map, and identify the locations for point stops where further ground-truthing would be required

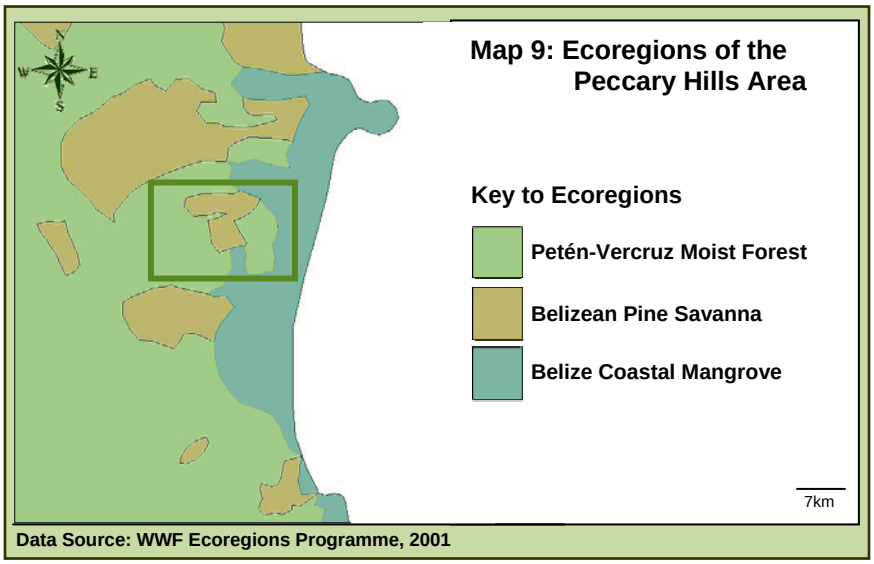
Point stops were conducted within each of the identified ecosystems, and across identified ecoclines, noting habitat structure, predominant species, relative abundance, and drainage characteristics. Point stops, recording the same data as in the line transects, were conducted to provide additional and broader coverage within the survey time available

The major vertebrate groups were surveyed using a variety of techniques – Lenny Gentle conducted a series of transects and point surveys to initiate a bird species list for the area, and data was also gathered from field studies in the adjacent Runaway Creek private reserve. Fish were surveyed through a series of both diurnal and nocturnal point surveys in a variety of water systems, whilst mammals were recorded from opportunistic sightings, from signs of their presence (tracks and faeces), and from nocturnal surveys. Reliable local reports were also noted, as were past survey results (primarily Meerman, 1996, Horwich and Lyon, 1991(?) and McAnanay and Thomas, 2003). Amphibians were surveyed along transects, and reptiles were surveyed largely opportunistically during ecosystem ground-truthing.

6.2 Ecosystems of the Peccary Hills Area

6.2.1 Ecoregions

Under the WWF Terrestrial Ecosystem initiative, the tropical and subtropical moist forest biome of the Neotropical biogeographic region is further subdivided into eighty Ecoregions, of which three are represented within the Peccary Hills area – the Petén-Veracruz Moist Forest, the Belizean Pine Savanna and Belize Coastal Mangrove (Map 9).



Petén-Veracruz Moist Forest

This large block of tropical forest stretches through Belize, Guatemala and southern Mexico, the northern limit being approximately 22°N, towards the northern extent of Veracruz State in Mexico, with the southern extent reaching approximately 15°N, just north of the southern border of Guatemala.

Photograph 9:
Petén-Veracruz Moist Forest

Throughout their range, these forests tend to be a matrix of moist tropical forest, bajo, wetlands and riparian habitats. Species-richness is high (though the number of endemic species is low) with a high proportion of tightly linked ecological interactions such as symbiosis. Many tree, vertebrate and invertebrate species occur at relatively low densities, resulting in large areas being needed for the support of viable populations, particularly of the larger predators. This ecoregion is classed as 'Critical/ Endangered' as the rate of deforestation increases (World Wildlife Fund, 2001). Throughout Central America, this results in not only the loss of key predators, but also secondary local extinctions and changes in species composition when these key species are removed. These tropical and sub-tropical forests are very susceptible to change, with understory species being sensitive to even small disturbances in the microclimate, and unwilling to move through more open habitats, making them particularly vulnerable to habitat fragmentation. For all these reasons, tropical moist forests such as that of the Peccary Hills area typically require large protected areas to maintain viable populations and sustain ecological processes, with buffering from edge effects, and provision for linkage through natural habitat corridors.

Belizean Pine Forest

Photograph 10:
Belizean pine forest, showing effects of increasing frequency of fire

Highlighted as one of the few regional fragments of lowland pine forests (World Wildlife Fund, 2001), this ecosystem shows a gradient from fully developed pine forest through short grass savanna and pine, to short grass savanna (without pine) dependant on soil type and frequency of fires. Under the WWF categories, it is given the conservation status critical / endangered. This ecosystem is severely threatened by increasing frequency and intensity of fire, following past logging pressures. The pine savanna within the Peccary Hills area shows the impact of anthropogenic fire, with a reduction in the range of pine stands in recent years.

Belizean Coastal Mangrove

This mangrove ecoregion runs along the coast of Belize, as far south as the Bahia de Annatique in Guatemala. Within the Peccary Hills area, mangroves are located on the lower reaches of Freshwater Creek, and on the western shore of Nortern Lagoon. It is the waters of these areas that are important for West Indian manatees, as feeding and nesting grounds for herons and egrets, and as a refuge area for juvenile fish species. The mangroves also play an important role in buffering the land from wave action, especially during storm events, and clearance can lead to extensive erosion of the coast. This ecoregion is considered 'vulnerable' under the WWF Ecoregions Programme (World Wildlife Fund, 2001) with increasing threat of clearance for coastal development throughout its range.

6.2.2 Ecosystems

Introduction

A significant component of this survey was the ground-truthing of ecosystem mapping previously carried out at a national scale in the development of the Belize Ecosystems Map (Meerman & Sabido, 2004). Ground-truthing included ecosystem identification, mapping assessment of condition, and relevance in the national context. The UNESCO terminology followed in the Belize Ecosystems Map is used here.

Several additional ecosystems were identified in the course of the current survey, reflecting the more detailed data available from the quite extensive groundwork. One of these (Tropical evergreen seasonal broadleaf lowland swamp forest: high variant) is one of four terrestrial ecosystems flagged under the 2005 gap analysis of Belize's protected area system as being severely under-represented within the existing protected areas (Meerman, 2005). The conservation importance of these ecosystems, in the national context, is evaluated within Section 2 (Conservation Planning), with summary notes presented here on extent and relevance.

The national context is evaluated in relation to the national percentage target for protection of each ecosystem (Meerman, 2005).

- **Tropical evergreen seasonal broadleaf lowland forest over steep calcareous hills**

  Legend Code from Belize Ecosystem Map: 20

  The Peccary Hills property is dominated by the steep karst limestone hills, rising abruptly from the alluvial plain. Reflecting the rapid drainage, and seasonally dry soils, the vegetation differs markedly from that on the flat plains, showing a regular gradient in forest structure and species composition from the base to the top of each hill.

Photograph 10: Steep calcareous hills (with rolling calcareous hills in the foreground)

  Predominant or common species include: *Attalea cohune, Aspidosperma megalocarpon, Astronium graveolens, Bernoullia flammea, Brosimum alicastrum, Bursera simaruba, Caesalpinia gaumeri, Cecropia peltata, Ceiba pentandra, Chamaedorea pinnatifrons, Coccoloba belizensis, Cordia alliodora, Cryosophila stauracantha, Cupania sp., Desmoncus orthacanthos, Dialium guianense, Dracaena americana, Euterpe precatoria, Ficus sp., Guazuma ulmifolia, Hampea stipitata, Heliconia spissa, Manilkara staminodella, Metopium brownei, Mutinga calabura, Pimenta dioica, Piper hispidum, Pouteria sp., Protium copal, Sabal mauritiiformis, Schizolobium parahyba, Simarouba glauca, Spondias radlkoferi, Vitex gaumeri, Vitis tiliifolia, Xylopia frutescens, Zamia polymorpha, Zanthoxylum sp. and Zuelania guidonia. Ground cover plants include Adiantum tenerum, Anthurium schlechtendalii, Begonia sericoneura, Tradescantia spathacea and Selaginella sp*.. Towards the tops of the hills, species such as *Lysiloma latisiliquum, Plumeria obtusa* and the orchids *Catasetum integerrimum, Encyclia cochleata and Myrmecophila tibicinis* become more abundant. Close to the peaks of the hills *Clusia sp*. are found, as well as *Agave angustifolia* – indicative of seasonally very xeric conditions. Where fires (both lightning strike and anthropogenic) have burnt limited areas, the fern *Pteridium caudatum* sometimes becomes dominant.

The shrub *Louteridium chartaceum*, known to be endemic to the Peccary Hills, is reportedly also tolerant of intermittent fire (Meerman, J., pers. com.). Passionflowers identified to date on these steep hills include *Passiflora cobanensis, P. lancetillensis, P. mayarum and P. rovirosae*. A new species of *Zamia* (*Zamia sp. nov*., similar to *Ceratozamia robusta*), was observed on one hilltop during the survey – previously recorded in Cayo District, it is currently being described, and is thought to have a total range of less than 9,000 acres (Meerman, pers. com.). Tree Height ranges from over 25m on the lower slopes to 8m on the hill-tops.

Photograph 11: ***Zamia sp. nov.***

The total area of this ecosystem, combined with that on the lower 'rolling calcareous hills' slopes is approximately 4,700 acres. Whilst detailed mapping of the distinction between these two ecosystems is beyond the scope of this project, it is estimated that of the combined 4,700 acres, the 'tropical evergreen seasonal broadleaf lowland forest over steep calcareous hills' occupies approximately 80% of the total – equating to about 3,750 acres. Whilst this ecosystem is considered to meet national targets for percentage protection (Meerman, 2005), it should be noted that human incursions are severely impacting tracts of this ecosystem within some protected areas (e.g. farming in the Vaca Forest Reserve), so the area truly protected may be significantly less than that mapped within the existing protected areas. This ecosystem is in particularly good condition throughout much of the Peccary Hills area, is currently afforded better protection than almost any other example of this system in the Country, and is additionally important as a viable ecosystem geographically separated from all others of this type – i.e. those in the Maya Mountains to the west.

- **Tropical evergreen seasonal broadleaf lowland forest over rolling calcareous hills**

  Legend Code from Belize Ecosystem Map: 19

  This ecosystem had not been identified or mapped previously in this locality. Whilst not mapped in the course of this survey, it was identified around the lower limits of many, or even most of the steep karst hills – often in a narrow band of as little as 25-40m, ending abruptly as the steep limestone cliffs and rock outcrops emerge from the foothills. The system is intermediate, in terms of species composition and forest structure, between that of the steep karst slopes and that of the alluvial plans. Tree height is of the order of 30m in some areas. This habitat can be defined by its canopy height, and by the presence of *Dialium guianense* (largely absent from the flat alluvial plain), and by the absence of *Euterpe precatoria* and *Plumeria obtusa* (largely confined to the steep karst hills ecosystem).

  Detailed mapping of this system, as distinguished from that on steep calcareous hills (see above) was beyond the level of resolution of this, and national, surveys. However, it is estimated that this ecosystem occupies approximately 20% of the 4,700 occupied by the two systems – equating to approximately 950 acres. This ecosystem is considered to be significantly under-represented within the currently protected areas of Belize (Meerman, 2005), with only 29,400 acres protected nationally – as compared with the target of 55,500. Whilst formal protection of the Peccary Hills would only increase the percentage of this ecosystem under protection by 3%, its relative contribution to the protected areas system would be significantly enhanced by its condition and geographical location.

- **Tropical evergreen seasonal broadleaf lowland forest over calcareous soils: Yucatan variant**

  Legend Code from Belize Ecosystem Map: 23

  This ecosystem is arguably the best categorization of the vegetation occurring on the small, forested hummocks that are dotted across the savanna ecosystems within this locality. Whether considered as a separate ecosystem, or as a sub-component of the savanna ecosystem is largely immaterial. The similarity of these vegetation patches with those in northern Belize reflects the seasonally very dry, shallow soils overlying limestone outcrops. Canopy height on these outcrops varies from 6-8m. *Astronium graveolens, Bucida buceras, Bursera simaruba, Cameraria latifolia, Chamaedorea seifrizii, Chrysophyllum mexicanum, Coccoloba belizensis, Gliricidia sepium, Manilkara zapota, Metopium brownei, Piper hispidum, Pouteria campechiana, Sabal mauritiiformis, Syngonium sp.,* and *Thrinax radiata* are the more predominant plants on these hummocks.

  Whilst only 60% of the target area of 46,750 acres is currently protected within the protected areas of Belize, the potential addition of the 56 acres mapped within the Peccary Hills is not significant in terms of area. It is however interesting as being a disjunct example of an ecosystem primarily occurring further north in Orange Walk and Corozal Districts.

- **Tropical evergreen seasonal broadleaf lowland forest over calcium-rich alluvium**

  Legend Code from Belize Ecosystem Map: 28

  Located on the northwestern portion of the property, in the flat lowlands between the karst hills, this ecosystem shows significant variation in stature and species composition – reflecting variation in hydrology, and past land use. Undisturbed areas have a very high canopy, with emergents reaching 30m in height – some of the tallest forest in Belize. Species richness is high, with these intact forest tracts harbouring an evidently healthy population of both Central American spider monkeys and Yucatan howler monkeys. Past selective logging activities had been concentrated upon mahogany and Mexican cedar – such that numerous other hardwoods were left, and are present in good densities, and of massive stature. The Hwatchy Development had cleared a significant portion of this forest up the centre of the property in the late 1990's, but largely left the narrower tracts between the hills untouched. The areas which had been cleared are now regenerating secondary growth, and with good seed-stocks close-by, it can be anticipated that a species-rich forest will become re-established in these areas. Forest on this soil-type is one of those most favoured for farming, such that mature tracts of forest such as those on the property are very rarely found in Belize in such close proximity to human communities.

  Species identified to date within this ecosystem on the property include: *Acacia collinsii, Acacia dolichostachya, Acacia glomerosa(?), Acosmium panamense, Aechmea bracteata, Alibertia edulis, Anthurium sp., Ardisia sp., Aristolochia grandiflora, Aristolochia maxima, Aspidosperma megalocarpon, Attalea cohune, Bactris major, Bactris mexicana, Balizia leucocalyx, Bauhinia herrerae, Bauhinia jenningsii, Bromelia plumieri, Brosimum alicastrum, Bucida buceras, Bursera simaruba, Caesalpinia gaumeri, Calophyllum brasiliense, Cassia grandis, Cecropia peltata, Cedrela odorata, Ceiba pentandra, Chrysophyllum mexicanum, Coccoloba barbadensis, Coccoloba belizensis, Cochlospermum vitifolium, Cojoba arborea, Costus pulverulentus, Cryosophila stauracantha, Cupania belizensis, Dalbergia stevensonii, Desmoncus orthacanthos, Dioscorea sp., Enterolobium cyclocarpum, Encyclia cochleata, Epidendrum nocturnum,*

Epidendrum rigidum, Eugenia sp., Ficus spp., Gouania sp., Guazuma ulmifolia, Guettarda combsii, Hampea trilobata, Helicteres guazumifolia, Inga pinetorum, Licania platypus, Lonchocarpus guatemalensis, Luehea seemannii (?), Luehea speciosa, Manilkara staminodella, Manilkara zapota, Maxillaria uncata, Metopium brownei, Miconia argentea, Passiflora biflora, Passiflora coriacea, Passiflora oerstedii choconiana, Passiflora rovirosae, Passiflora serratifolia, Philodendron spp., Piper amalago, Piper auritum, Piper hispidum, Piper peltatum, Pimenta dioica, Piscidia piscipula, Pisonia aculeata, Pithocellobium sp., Polypodium sp., Pouteria campechiana, Protium copal, Psychotria poeppigiana, Quararibea funebris, Renealmia sp., Roupala montana, Roystonea regia, Sabal mauritiiformis, Samanea saman, Sapindus saponaria, Scaphyglottis leucantha, Schizolobium parahyba, Selaginella sp., Siparuna thecaphora, Spondias radlkoferi, Stemmadenia donnell-smithii, Swartzia cubensis, Swietenia macrophylla, Smilax sp., Solanum sp., Syngonium sp., Tabebuia rosea, Tabernaemontana alba, Tabernaemontana arborea, Thevetia ahouai, Tigonidium egertonianum, Trichospermum grewiifolium, Trophis racemosa, Vanilla sp., Virola koschnyi, Vismia camparaguey, Vitex gaumeri, Vitis tiliifolia, Vittaria sp., Zamia polymorpha, Zanthoxylum sp. and *Zuelania guidoni.,*

Regionally, this ecosystem has been greatly reduced from historical range – having greater agricultural potential than ecosystems occurring on many other soil types. It is quite remarkable that this tall forest type occurs, mostly in good condition, so close to population centres. In Belize, only 61% of the target of 33,670 acres is currently protected. The mapping undertaken within the current survey indicates coverage of approximately 3,275 acres of this ecosystem. Formal protection of this ecosystem would therefore increase the area currently under protection by 16% - a very significant potential component of the protected ecosystems of Belize.

- **Tropical evergreen seasonal broadleaf lowland forest over poor or sandy soils**

  Legend Code from Belize Ecosystem Map: 29

  This ecosystem had previously been mapped as occurring over an area of approximately 335 acres, protruding between the karst hills from a larger tract to the west of the property. It was not visited in the course of the current survey, and is therefore accepted as occurring as previously mapped) (Meerman & Sabido, 2004). Species likely to occur here include *Attalea cohune, Bactris mexicana, Bucida buceras, Calophyllum brasiliense, Coccoloba spp., Miconia spp., Simarouba glauca, Terminalia amazonia, Virola koschnyi, Vochysia hondurensis* and *Xylopia frutescens*.

  Whilst this is an ecosystem whose target level of protection (approximately 33,000 acres) is under-represented by 38%, the 335 acres mapped within the Peccary Hills would only increase the protected tracts by 1.6%, and are not therefore considered of national significance.

- **Tropical evergreen seasonal broadleaf alluvial forest**

  Legend Code from Belize Ecosystem Map: 41

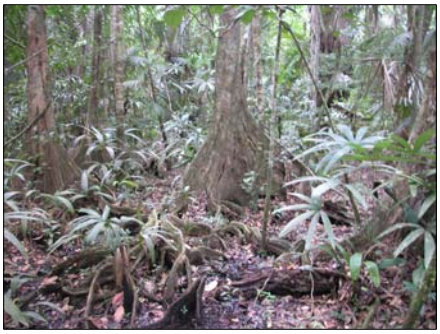
  This ecosystem type was observed in relatively small tracts in a number of places, mostly within the primary floodplain of the central section of Freshwater Creek. Drainage is relatively poor as compared with that on the calcium-rich alluvium: the soil is seasonally water-logged, with hog-wallow relief evident in some areas. An easily accessible tract, close to the main access track to the savanna, is dominated by huge bullet-trees (*Bucida buceras*), standing 30m in height. *Acacia spp., Bactris major, Ficus spp.* and *Schizolobium parahybum* are also prominent components within this system. As the

boundary between this ecosystem and that on the calcium-rich soils is indistinct, it was not mapped within this survey. Total area may be of the order of 200 acres.

Of the targeted 17,243 acres (Meerman, 2005) to be represented within Belize's protected areas, only 6,825 acres of this ecosystem is currently under protection. Because of seasonal agricultural potential, forests on these soils have been heavily impacted by human use throughout Belize. Whilst the area of this system is estimated as being approximately 200 acres, formal protection would increase the national total under protection by about 3% - indicating how little is currently secured for conservation.

- **Tropical evergreen seasonal broadleaf lowland swamp forest: high variant**

Legend Code from Belize Ecosystem Map: 42



Photograph 12: Kaway trees in swamp forest

The tract of this ecosystem within the project area has significant affinity with another ecosystem - 'tropical evergreen seasonal broadleaf alluvial forest'. Indeed the two habitats could be considered as forming a single mosaic – distinguished largely by the duration of flooding and water-logging, and by the distribution of cohune (*Attalea cohune)* which is largely absent from the swamp forest. The swamp forest in this locality has a relatively high canopy of 15-20m; predominant plant species include: *Bactris major, bucida buceras, Calophyllum brasiliense, Coccoloba belizense, Cryosophila stauracantha, Desmoncus orthacanthos, Ficus sp., Metopium brownei, Pachira aquatica, Pterocarpus officinalis,* and *Swietenia macrophylla.* In more open areas, *Calathea spp.* form small dense stands. The ground is evidently flooded for several months of the year, with very extensive hog-wallow relief – in some areas the 'dry' micro-relief hummocks between the inundated hog-wallows and seepages may represent less than 50% of the overall area. Towards the northern edge of this tract of swamp forest, as the degree of seasonal flooding reduces, *Caesalpinia gaumeri, Sabal mauritiiformis* and *Vitex gaumeri* become locally common.

This ecosystem had not been previously mapped in this vicinity. During the course of this survey, it was identified as being one of the most extensive ecosystems, occupying much of the central and western portions of the property. As one of the critical ecosystems identified in the 2005 Protected Areas Gap Analysis as being severely under-represented in the national system of protected areas, its discovery and presence within the Peccary Hills property is of considerable significance. This ecosystem is one of only four terrestrial systems in Belize that do not even meet the 10% minimum level of protection advocated by IUCN (Meerman, 2005). Currently only 23% of the national target of 122,200 acres for the protection of this ecosystem is met within Belize's protected areas. If the approximately 4,650 acre tract of this ecosystem within the 8,000 acre Hwatchy property, and the adjacent national lands leading to the savanna to the east were to be placed under formal conservation management, this would represent a 17% increase in the area of this system currently under protection - a very significant potential component of the protected ecosystems of Belize, and would increase the level of protection over the minimum advocated by IUCN.

- **Tropical evergreen seasonal broadleaf lowland swamp forest: low variant**

  Legend Code from Belize Ecosystem Map: 43

  Low swamp forest was identified and mapped as occurring in a narrow belt, following the course of Freshwater Creek as it cuts across the savanna towards Northern Lagoon. This low swamp forest belt averages 300-450m in width, and covers approximately 600 acres. Most of this system had previously been mapped (Meerman & Sabido, 2004) as being 'broad-leaved lowland shrubland: Miconia variant' - a system that has significant similarity in structure, stature and species overlap with the low swamp forest. The system was re-classified in this survey on the basis of it having a low forest structure with a closed canopy (4-8m), rather than a more open-canopied, shorter shrubland 'canopy', by the absence of *Miconia sp*. throughout most of the system, and by the predominance of species such as *Acoelorraphe wrightii, Bucida buceras, Cameraria latifolia, Chrysobalanus icaco*. Epiphytic *Aechmea sp*. and *Tillandsia spp*. bromeliads are locally common. *Pachira aquatica* is present in low densities, as is *Manilkara zapota. Coccoloba belizensis* and *Sabal mauritiformis* are present on slightly less waterlogged areas. Another tract of approximately 80 acres of this ecosystem was mapped in the northeastern corner of the property, characterized by thin-stemmed trees and stands of *Bactris major*.

  Whilst this ecosystem is considered adequately protected in Belize, the conservation significance of the eastern tract within the project area is in its role in watershed protection of the Freshwater Creek system, and the maintenance of nesting sites of the endangered Central American river turtle (*Dermatemys mawii*).

- **Riverine mangrove forest**

  Legend Code from Belize Ecosystem Map: 51

  Riverine fringing mangrove was identified and mapped along the terminal 500m portion of Freshwater Creek, to its juncture with Northern Lagoon. It occurs as a narrow fringe, averaging approximately 10m in width, along both the northern and southern banks of the Creek and extends a short distance along the shore of the Lagoon. The predominant species is red mangrove (*Rhizophora mangle)* with a few specimens of provision bark (*Pachira aquatica*) and kaway (*Pterocarpus officinalis*). Canopy height ranges from 5-12m.

  This ecosystem is severely under-represented within the protected areas of Belize, with only 16% of the 9,520 acres targeted for inclusion within the protected areas (Meerman, 2005) currently protected. Whilst this ecosystem stretches along several hundred metres of the lower reaches of Freshwater Creek, its extremely narrow distribution dictates that the actual area of this system is very small – under 5 acres. Whilst these tracts cannot be considered of national significance in terms of area, they do play a critical role in watershed protection for the Freshwater Creek system – perhaps one of the more pristine watersheds in Belize.

- **Tropical evergreen broadleaf scrub forest on calcareous crags**

Legend Code from Belize Ecosystem Map: 54

An ecosystem that quite closely resembles this system occurs on the very tops of many of the steep karstic hills within the property; whilst calcareous crag shrublands more typically occur further south and west of this locality in Belize, but the abrupt rise of these hills from the coastal savanna may be creating climatic conditions on the hilltops that more closely resemble those at higher elevations further inland. *Agave angustifolia, Clusia sp., Plumeria obtusa* and a variety of orchids are prominent components of this hilltop vegetation. This system was not mapped within this survey, as individual tracts are so limited – often no more than a few hundred square metres.

Photograph 13: Scrub forest on calcareous crags

Of the 829 acres of this ecosystem mapped to date in Belize, all lie within existing protected areas. The occurrence of a very similar ecosystem, geographically separated from the Maya Mountains poses a number of biodiversity questions. It will be necessary to examine the flora and fauna of this system, and species overlap with the known examples at higher elevations in the southern Maya Mountains, in some detail before a proper analysis of conservation importance can be made.

- **Broad-leaved lowland shrubland: Miconia variant**

Legend Code from Belize Ecosystem Map: 56

Most of what had previously been identified, from satellite imagery for the Belize Ecosystems Map, as being this ecosystem was determined during the current survey to be low swamp forest (see discussion for Tropical evergreen seasonal broadleaf lowland swamp forest: low variant). However, whilst the area skirting the Peccary Hills to the north-east, was not ground-truthed during the current survey, it is likely that this particular tract is indeed Miconia shrubland: it is characteristically found at the foot of karst hills bordering onto savanna habitats (as in this locality), with *Acoelorraphe wrightii, Bucida buceras, Chrysobalanus icaco, Eugenia, Miconia spp., Piper amalgo* and *Xylopia frutescens* being abundant. In a similar locality south of the property (west of Southern Lagoon) *Symphonia globulifera* and *Terminalia amazonia* were recorded within this ecosystem in the interfacing zone with the forest of the steep karstic hills.

Only 47% of the national target area for protection of this system is met by the current protected areas. The approximately 300 acres of this system thought to occur in the northeastern portion of the property would add approximately 4% to the nationally protected tracts if afforded formal protection.

- **Deciduous lowland riparian shrubland of the plains**

  Legend Code from Belize Ecosystem Map: 60

  Examples of this ecosystem can be seen along limited sections of the Sibun riverbank that defines the northern boundary of the property. Tracts were too small to be effectively mapped at the resolution of the current survey. The predominant plant in this locality is generally the riparian bamboo (*Guadua longifolia)* and dumb cane (*Gynerium sagittatum*). *Heliconia latispatha* is locally abundant. Occurrence of this ecosystem in this locality reflects both natural and anthropogenic disturbance of the riverbank.

  Whilst the actual area of this system within the project area is not significant at a national level, it does play a critical role in watershed protection and erosion control along the bank of the Sibun River. It is intrinsically a dynamic system, with its coverage and structure being impacted by both the natural impacts of river flow dynamics, and by anthropogenic impacts. It is a critical nesting habitat in this area for the endangered Central American River Turtle.

- **Short-grass savanna with needle-leaved trees**

  Legend Code from Belize Ecosystem Map: 62

  This open, grassland savanna is dominated by scattered, low-density *Pinus caribaea* and *Quercus oleoides.* The grasslands harbour quite a diverse assemblage of graminoids and herbaceous plants, with the terrestrial orchid *Bletia purpurea* and passionflower *Passiflora urbaniana* adding another highly visible component to the herbaceous ground-cover, along with the cycad *Zamia polymorpha.* Stands of *Acoelorraphe wrightii, Byrsonima crassifolia, Curatella americana* and *Gliricidia sepium* are interspersed amongst the pines and oaks. This ecosystem now covers an area of approximately 1,400 acres in the northeast of the property, a range that is evidently significantly reduced from historical coverage: frequent anthropogenic fires have eradicated pine from areas where they occurred as recently as 20 years previously – leaving a 'short-grass savanna with shrubs'. With the degradation of this ecosystem in relatively recent history (belied by its scenic beauty), it is unlikely that it currently supports a breeding population of the endangered yellow-headed parrot. Fire management, and habitat replenishment should be implemented throughout this system if it is put into conservation management.

  A little under half the area of this system targeted for conservation management is met by the current protected areas of Belize (Meerman, 2005). Additionally, another significant conservation concern regarding this ecosystem is the steady, almost annual degradation that is taking place – frequent anthropogenic fires push the system towards that of short-grass savanna with shrubs, as the populations of pine trees are unable to withstand the frequent fires. This casts a gloomy prognosis for the future of the endangered yellow-headed parrot. The approximately 1,400 acres of this ecosystem mapped within the project area would add a little over 3% to the nationally protected tracts, if formally protected. This potential contribution to both a threatened system (WWF) and the endangered fauna would be enormously extended if active conservation management and fire-control policies were implemented – as few examples of this system are adequately protected in Belize (pers. obs.).

- **Short-grass savanna with shrubs**

Legend Code from Belize Ecosystem Map: 63

Photograph 14: Short grass savanna with shrubs

The current area of this ecosystem within the project areas is approximately 3,700 acres. Actual coverage is dynamic, and is increased over historical extent as a result of anthropogenic fire: pines previously occurred over a larger portion of the savanna habitat than is currently the case. Short-grass savanna with shrubs is a complex mosaic of species assemblages, each reflecting micro-topography, soil hydrology, soil acidity & nutrient availability, fire regime and seed source. In this locality, much of the short-grass savanna is open grassland. *Cameraria latifolia, Chrysobalanus icaco, Curatella americana, Gliricidia sepium* and *Quercus oleoides* occur at low density throughout much of the system, often as dwarfed specimens regenerating from past fires. Lower areas often support stands of *Acoelorraphe wrightii,* or *Eleocharis sp*. – the latter being afforded its own ecosystem categorization under the UNESCO classification (discussion under 'Eleocharis marsh'). Raised, forested hummocks occur across portions of the savanna, with a species assemblage perhaps best characterized under 'tropical evergreen seasonal broadleaf lowland forest over calcareous soils: Yucatan variant' – see discussion under that ecosystem name.

The threshold for proportional protection of this system is slightly exceeded by the current protected areas of Belize. With much of this ecosystem being a degraded form of the pine savanna that is itself a threatened system, active conservation management and habitat restoration programmes should ideally be implemented within this savanna & shrubland system if the area is afforded formal protection. Restoration of the *Pinus caribaea* population and range should be a priority, bringing with it the likely restoration of nesting and feeding habitat for the endangered yellow-headed parrot.

- **Eleocharis marsh**

Legend Code from Belize Ecosystem Map: 65

Previously unmapped within the project area, this ecosystem occurs predominantly in waterlogged or flooded hollows in the short-grass savanna. Generally the extent of each patch is too small to be mapped (as was the case for the Belize Ecosystems Map), but examples were mapped close to the trail leading across the savanna to Freshwater Creek. *Eleocharis* reeds form an almost mono-specific community, with only very low-density occurrence of other herbaceous species. In the context of the Peccary Hills property, these *Eleocharis* marshes are notable for the seasonal presence of jabiru storks, and other wading birds. Whilst these reed marshes are afforded their own categorization under the UNESCO classification system, they would perhaps be better considered as a species assemblage within the short-grass savanna ecosystem. *Eleocharis* was also noted around one shore of the freshwater lake that was mapped close to Northern Lagoon.

This is another ecosystem that is highlighted in the protected area gap analysis (Meerman, 2005) as being seriously under-represented, but with the caution that mapping resolution has been too course to adequately demonstrate the true extent of this system – either inside or outside protected areas. Certainly national mapping showing only 38 acres of *Eleocharis* marsh being within protected areas is an under-estimate.

Within the current survey of the Peccary Hills area, 1.26 acres of this system were mapped, though the true extent could well be an order of magnitude greater.

- **Fire-induced lowland fern thicket**

  Legend Code from Belize Ecosystem Map: 67

  This ecosystem develops on soils that have been degraded by repeated fire events. Small patches are found on several of the hills in the Peccary Hills, probably the result of lightning strikes. Larger tracts running from the central lowland area previously cleared under the Hwatchy Development, and extending up adjacent hill slopes, are undoubtedly the result of anthropogenic fire. The dominant plant is the pan-global *Pteridium caudatum*, with *Scleria bracteata*, and *Byrsonima bucidafolia* often present. Protected from further anthropogenic fire, the smaller tracts on the upper hill slopes are likely to slowly regenerate to forest cover, whereas the larger areas may require active management intervention to facilitate soil repair and forest regeneration. The extent of this ecosystem within the Hwatchy property is too small to be mapped within the level of resolution of this survey.

- **Tropical lowland tall herbaceous swamp**

  Legend Code from Belize Ecosystem Map: 71

  An area of approximately 175 acres of this ecosystem was identified and mapped close to Northern Lagoon, extending to within 100m of the lagoon shoreline. This vegetation had previously been mapped (Meerman & Sabido, 2004) as 'mixed mangrove scrub'; ground-truthing during the current survey did not locate the mangrove species that typically predominate in a mixed mangrove scrub – and the system was identified as tall herbaceous swamp. Course graminoids form a dense ground-cover to approx 0.7m in height, with a relatively dense shrub component dominated by *Acoelorraphe wrightii, Cresentia cujete* and *Concocarpus erectus*.

  As with the *Eleocharis* marsh, it is likely that national mapping efforts (Meerman & Sabido, 2004) under-represent the extent of this ecosystem, such that the evaluation of the significance of its extent within the Peccary Hills is hard to evaluate at the national level. At the local level, it is an unusual ecosystem in this landscape, combined with the mosaic of small freshwater lakes (see below) provide habitat for numerous species not found elsewhere within the study area.

- **Tropical floating leaf communities of freshwater lakes**
  and
  Tropical underwater communities of freshwater lakes

  Legend Code from Belize Ecosystem Map: 72 and 73

  Whilst considered as separate ecosystems within the UNESCO classification system, it is more realistic to consider them as species assemblages within a single ecosystem – the freshwater lake. Separation into two systems does not seem justified. A good example of a freshwater lake ecosystem (with both floating leaf and underwater communities) was identified immediately to the northeast of the tall herbaceous swamp described above. These small lakes, covering an area of approximately 10 acres, have

floating *Nymphaea sp.* water lilies, various underwater plants, with emergent rushes and *Eleocharis* reeds. The system is rich in birdlife including jacanas, egrets and herons.

- **Rooted underwater communities of flowing water**

  Legend Code from Belize Ecosystem Map: 74

  This ecosystem occurs along significant portions of Freshwater Creek. Underwater plant density appears highest in the wider portion known as 'Fishing Ground' and for several hundred metres downstream – probably a reflection of the rather less dense shade from overhanging trees. The predominant plant appears to be *Vallisneria americana.* This system can perhaps be best considered as a habitat within the riverine ecosystem described below.

- **River**

  Legend Code from Belize Ecosystem Map: 77

  Whilst not lying within the property, the Sibun River forms the northern boundary of the property. Harbouring perhaps the only remaining healthy and viable population of the endangered regional endemic, the hicatee (Central American river turtle), this portion of the Sibun River plays a critical role, over and above its functionality in providing connectivity for endangered and threatened terrestrial species such as the Yucatan black howler monkey, the spider monkey and Baird's tapir. As such, it is considered of critical importance that conservation management activities extend to include this portion of the Sibun River, especially in the areas of engendering community support for the protection of these key species. Freshwater Creek is another key riverine ecosystem; originating in the foothills of the Peccary Hills and running through the broadleaf forest and savanna habitats to Northern Lagoon, it's whole watershed is within the project area. Cited by community members as another key area for the Central American River Turtle (which was recorded here during the survey), this system has enormous scope in terms of efforts to preserve this species from pending extinction.

- **Shifting cultivation including unimproved pasture**
  and
  Woody perennial crops

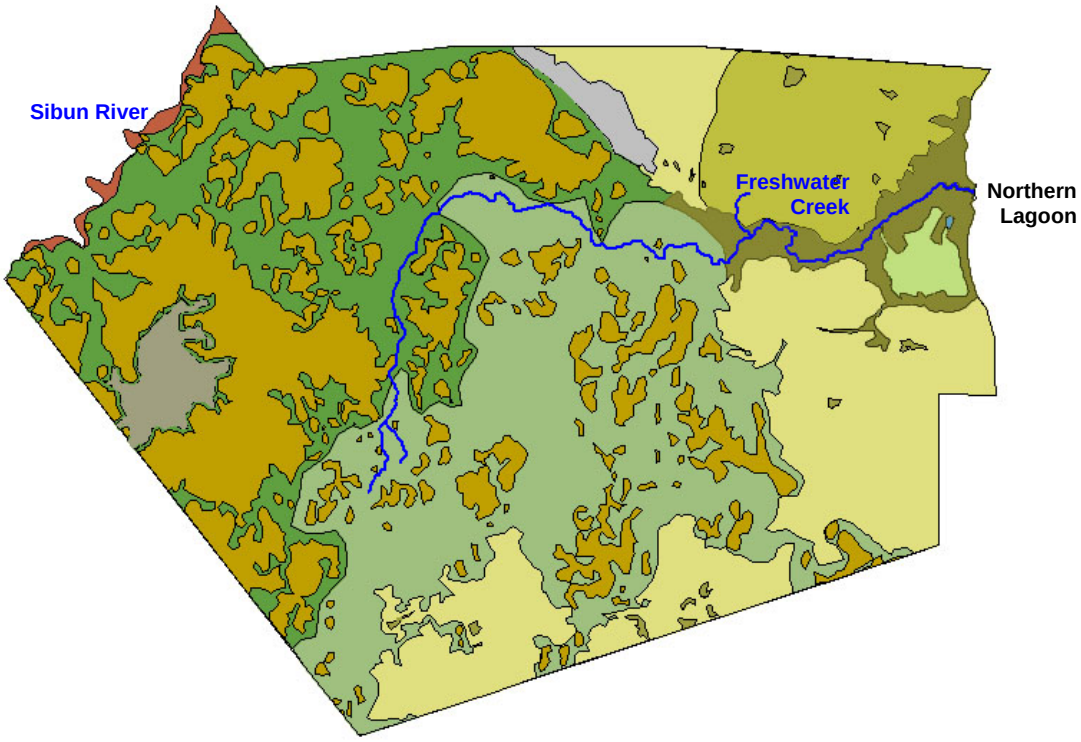
  Legend Code from Belize Ecosystem Map: 80 and 83

  These ecosystems are found in a narrow zone along the southern bank of the Sibun River, associated with the households within that area. The southern limit of these farmlands is defined by the base of the karst hills, or by tracts of low swamp forest that are unsuitable for agriculture. It is roughly mapped as covering an area of approximately 110 acres. This area had not previously been identified or mapped. Local farming in this area includes root crops and a broad variety of fruit trees, with limited livestock.

Table 6: Ecosystems of the Peccary Hills Area

Legend	UNESCO classification
19	Tropical evergreen seasonal broadleaf lowland forest over rolling calcareous hills
20	Tropical evergreen seasonal broadleaf lowland forest over steep calcareous hills
23	Tropical evergreen seasonal broadleaf lowland forest over calcareous soils; Yucatan varient
28	Tropical evergreen seasonal broadleaf lowland forest over calcium-rich alluvium
29	Tropical evergreen seasonal broadleaf lowland forest over poor or sandy soils
41	Tropical evergreen seasonal broadleaf alluvial forest
42	Tropical evergreen seasonal broadleaf lowland swamp forest: high variant
43	Tropical evergreen seasonal broadleaf lowland swamp forest: low variant
51	Riverine mangrove forest
54	Tropical evergreen broadleaf scrub forest on calcareous crags
56	Broad-leaved lowland shrubland: Miconia variant
60	Deciduous lowland riparian shrubland of the plains
62	Short-grass savanna with needle-leaved trees
63	Short-grass savanna with shrubs
65	Eleocharis marsh
67	Fire-induced lowland fern thicket
71	Tropical lowland tall herbaceous swamp
72	Tropical floating leaf communities of freshwater lakes
73	Tropical underwater communities of freshwater lakes
74	Rooted underwater communities of flowing water
77	River
80	Shifting cultivation including unimproved pasture
83	Woody perennial crops

Map 10: Ecosystems of the Peccary Hills Area



Key to the Ecosystems of the Peccary Hills Area

- Tropical evergreen seasonal broadleaf lowland Forest over steep calcareous hills
- Tropical evergreen seasonal broadleaf lowland forest over calcium-rich alluvium
- Tropical evergreen seasonal broadleaf lowland swamp forest: high variant
- Tropical evergreen seasonal broadleaf lowland swamp forest: high variant
- Tropical evergreen seasonal broadleaf lowland swamp forest: high variant
- Tropical lowland tall herbaceous swamp
- Eleocharis marsh
- Tropical evergreen seasonal broadleaf lowland swamp forest: low variant
- Woody perennial crops
- Tropical evergreen seasonal broadleaf lowland forest over poor or sandy soils
- Broad-leaved lowland shrubland: Miconia variant

6.3 Flora of Peccary Hills area

With its considerable diversity of topography, soils and hydrology, it is perhaps not so surprising to have such a breadth of ecosystems as those now identified within the Peccary Hills and adjacent lands leading to Northern Lagoon. A total of 262 plant species, representing 88 families, have been identified to date from this area. Whilst this is indeed an impressive diversity of plants to have been identified within this rapid ecological assessment, and in the earlier environmental impact assessment (for the Hwatchy Development), it is but a small fraction of the overall flora.

The flora of the Peccary Hills is notable for a number of reasons:

- Its near pristine state throughout the majority of the property, with old-growth trees rarely encountered in the coastal plains of Belize, with intact ecosystems from riparian floodplain to the surrounding hilltops.

- The presence of endemic species such as the *Louteridium chartaceum* (endemic to this specific locality), *Passiflora urbaniana*, and the hilltop *Zamia sp. nov.* (currently being described and thought to have a total distribution of less than 9,000 acres, Meerman, pers. com).

- The presence of several species of national and / or international conservation concern, such as *Cedrela odorata, Gaussia maya* and *Swietenia macrophylla* (Vulnerable), and the *Zamias* ranging from Near Threatened to anticipated Endangered (once classified).

- The similarities in species assemblages between this site and those at higher elevations in the Maya Mountains to the west.

6.4 Fauna of Peccary Hills area

6.4.1 Mammals of Peccary Hills area

Mammals were recorded opportunistically throughout the survey period, during both diurnal and nocturnal transects, from sightings, tracks, calls, and from local reports.

Results

A total of thirty-one mammal species were recorded within the Peccary Hills area, with a species composition representative of the tropical broadleaf forests and savanna ecosystems of Belize. Five of these were observed directly during the survey (agouti, spider monkey, white-tailed deer and kinkajou), eleven were recorded during the survey from their tracks or faeces (Common/Virginia opossum, nine-banded armadillo, paca, grey fox, white-nosed coati, Neotropical river otter, jaguar, ocelot, collared peccary, Baird's tapir, and red brocket deer), one species was heard (Yucatan black howler), and community members from Gracie Rock confirmed the presence of a further fourteen species within the project area. An additional species, the greater white-lined bat, was also recorded in a previous survey (Meerman, 1996)

Table 7: Mammal Species of National and International Concern of the Peccary Hills

Species		International Status	Status in Belize	Justification
Water Opossum	*Chironectes minimus*	VU		
Yucatan Black Howler Monkey	*Alouatta pigra*	EN	VU	4,8
Central American Spider Monkey	*Ateles geoffroyi*		VU	4
Neotropical River Otter	*Lontra longicaudis*	DD	VU	5
Jaguarundi	*Herpailurus yaguarondi*		LC	5
Ocelot	*Leopardus pardalis*		VU	1,4,5
Margay	*Leopardus weidii*		VU	1,4,5
Jaguar	*Panthera onca*	NT	NT	1,4,5,6
Puma	*Puma concolor*	NT	NT	1,4,5,6
Baird's Tapir	*Tapirus bairdii*	EN	VU	1,4,5
West Indian Manatee	*Trichechus manatus*	VU	VU	1,4

IUCN Categories

EN Endangered
VU Vulnerable
NT Near Threatened
DD Data Deficient

Criteria for inclusion in national critical species listing

1 Hunted – Fished
2 Colony breeder or restricted number of nesting locations
3 Specialized ecological requirements
4 Charismatic species drawing national and international attention
5 Persecuted as a perceived pest
6 Requires a large range
7 Genetically different from South American counterpart
8 Small range – regional endemic

Of these thirty-one species, six (just under 20%) are considered to be species of international concern (Table 7), with two species (Yucatan howler monkey and Baird's tapir) listed as 'endangered' under the IUCN Red List classification. One species is listed as vulnerable (West Indian manatee), whilst three are classified as 'lower risk / near threatened' (jaguar, puma and water opossum). Two species are listed as 'data deficient' (Neotropical river otter and red brocket deer) - potentially at risk, but for which there is insufficient data on abundance and/or distribution to allow an assessment of viability.

Three of the non-Redlist species (jaguarundi, ocelot and margay) are listed in Appendix One of the Convention of International Trade in Endangered Species, with strict regulation of international trade, in recognition of their threatened populations. These three species are also hilghlighted in the provisional national list of critical species (Meerman, 2005).

There are three Yucatan endemics recorded within the area - the Yucatan and Deppe's squirrels, and the Yucatan black howler monkey. These have ranges restricted to Mexico, Belize and Northern Guatemala. It is possible that further work on small mammals such as rodents and bats may well show the presence of other regional endemics. The sub-species of Central American spider monkey (*Ateles geoffroyi yucatanenis*) is also restricted to this region, and is considered vulnerable.

The majority of the species were recorded within the karstic broadleaf forest area. The Yucatan howler monkey, for example, is restricted to the broadleaf forest, and shows a further preference for the forested river-edge vegetation, whilst the spider monkey, also found only within the broadleaf forest, was recorded throughout the karst area. The white-tailed deer and gray fox appear to be more abundant in the coastal pine savanna, and signs of raccoon were most abundant around the ephemeral pools near Freshwater Creek.

Four species of Didelphidae have been listed for the Peccary Hills area. Tracks of either the Virginia opossum (*D. virginiana*) or common opossum (*D. marsupialis*) (or both) were common along the ATV trail, in the broadleaf forest of the Sibun floodplain. Local reports confirmed the presence of both the gray four-eyed opossum (*Philander opossum*) and the 'near threatened' water opossum (*Chironectes minimus*), the latter being considered relatively common along the Sibun River. The Central American woolly opossum (*Caluromys derbianus*), listed as 'vulnerable' (IUCN, 2004) has also been reported locally, though there is no confirmed sighting of this species to date.

It is likely that the smaller Mexican mouse opossum (*Marmosa mexicana*) may also occur within the area, though it may not be recorded until specific research techniques target the smaller mon-volant mammals.

Two species of Edentata were recorded, the northern tamandua (*Tamandua mexicana*) from local reports, and the nine-banded armadillo (*Dasypus novemcinctus*) from tracks on the ATV trail. *T. mexicana* is considered to be relatively common in the broadleaf forest areas, whilst *D. novemcinctus* is known to use both the forested areas and the more open savanna (field assistants, pers. com.) - all tracks of *D. novemcinctus* recorded during the current fieldwork were within broadleaf forest. Whilst the armadillo is a favoured game species, populations near the Sibun River appear to be high, suggesting that hunting pressure in the area is low. There is hunting pressure on armadillo in the savanna areas, with people from Gales Point hunting as far north as Freshwater Creek and Tum Tum Creek (Gales Point community, pers. com.).

Two species of primates are present in Belize, the Central American spider monkey (*Ateles geoffroyi*) and the Yucatan black howler (*Alouatta pigra*), and both were recorded within the Peccary Hills area during the 2005 fieldwork:

Local reports indicate that both species experienced reduced populations during the yellow fever epidemic of 1956/57, and from the effects of Hurricane Hattie in 1961, but have recovered since then. During the fieldwork, *Ateles geoffroyi* was encountered several times, either in troops or single males. Sightings included a mother with young (confirming the existence of a breeding population). The presence of the Yucatan black howler (*Alouatta pigra*) was established through its distinctive call, local reports, and previous fieldwork (Meerman 1996).

Atleles geoffroyi is particularly vulnerable to human disturbance in Belize, requiring a large area of relatively undisturbed forest in order for viable populations to occur. Much of the population is restricted to the least disturbed hillslopes of the Maya Mountains, or to the Gallon Jug forest node in the west of Belize. This species is also established within the karst hills of the Peccary Hills area, spreading into northern Manatee Forest Reserve and Runaway Creek (private reserve).

With increasing habitat fragmentation and loss, the Belizean subspecies (*A. g. yuctanensis*) has recently been upgraded to Vulnerable, as the population is projected to decline by 35% over the next 30 years in the region, primarily due to deforestation and fragmentation of habitat (IUCN, 2004).

Photograph 16: Central American spider monkey (*Ateles geoffroyi*)

The Yucatan black howler monkey, *Alouatta pigra,* is a regional endemic, being found only in a small area of Belize, Mexico and Guatemala. As with *Ateles geoffroyi*, the increasing rate of forest fragmentation, and the continued conversion of forest to agriculture is placing this species at risk. Within the Peccary Hills area, *A. pigra* is reported to occur more frequently in the vegetation on the banks of the Sibun River, though it is known to range throughout the forested area.

Whilst forest connectivity is of major concern for arboreal species such as these, *Alouatta pigra* (unlike *Ateles geoffroyi*)) have been reported to swim across rivers, and have been observed crossing savannas with scattered pine trees in the Manatee Forest Reserve area (Gales Point resident, pers. com.). The construction of the Coastal Road and subsequent roadside development has affected connectivity for these primate populations between the Peccary Hills area and the remaining Manatee Forest Reserve. The last remaining forested link connecting the two is the riverine vegetation that follows the Sibun River. Once this is cleared, the *A. geoffroyi* population will become isolated within the Peccary Hills area.

Two species of squirrel are reported to be present within the Peccary Hills area - Deppe's squirrel (*Sciurus deppei*) and the Yucatan Squirrel (*Sciurus yucatanensis*), though only one (*S. deppei*), was recorded during the fieldwork. Throughout Belize, Deppe's squirrel appears to show a preference for cohune dominated areas of the broadleaf forest (pers. obs.), and was indeed recorded during the assessment in cohune-dominated vegetation. The presence of the Yucatan Squirrel was confirmed by local reports, but not observed during the survey.

There has been no research to date into the small rodent species present within the Peccary Hills area, but three larger species are known to occur – the Mexican porcupine (*Coendou mexicanus*), the Central American agouti (*Dasyprocta punctata*) and the paca (*Agouti paca*)

C. mexicanus has been reported from the broadleaf karst areas by field assistants from Gracie Rock, who also observed an individual within one of the numerous caves of the region. Tracks of the paca (*A. paca*) were observed along the ATV trail, in the Sibun River floodplain, and through the karst area, where they appear to be abundant They inhabit the numerous cave systems (all of those visited had cohune nuts deposited within the caves, having been carried in by the paca. Local reports also suggest that they are found in the low forest adjacent to Freshwater Creek. *A paca* is a favoured game species, the high population density within the forested area indicating that hunting pressure is low. The Gracie Rock community provide active protection for the area by controlling access across the bridge – the only easy access point. However, reports from Gales Point suggest that this community and

that of Freetown Sibun, hunt the savanna, targeting this species along the banks of Freshwater and Tum Tum creeks.

Agouti tracks were evident throughout the area, though this species is not considered a game species by either the Gracie Rock or Gales point communities, so is under little hunting pressure.

Six species of non-Felidae carnivores were recorded from the Peccary Hills area. The gray fox (*Uocyon cinereoargenteus*) was recorded from tracks crossing the savannah, and those of the northern raccoon (*Procyon lotor*) were recorded from the freshwater creek area. Reports suggest that both these species are abundant within the area. Tracks of the whie-nosed coati (*Nasua narica*) were most frequently encountered in broadleaf forests, and the presence of the kinkajou (*P. flavus*) was confirmed from sightings during the night transect on the ATV trail. Scats of the Neotropical river otter (*L. longicaudis*) were recorded adjacent to Freshwater Creek, and community field assistants confirm that this species is relatively common in both the Sibun River and Freshwater Creek. The striped hog-nosed skunk (*Conepatus semistriatus*) is also confirmed as present (field assistants, per. com.).

All five of the cat species found in Belize are present within the Peccary Hills area. Tracks of jaguar (*Panthera onca*) and ocelot (*Leopardus pardalis*) were recorded during the fieldwork, and Meerman (1996) reports the presence of a puma (*Puma concolor*), preying on dogs and pigs from Gracie Rock itself. Local reports suggest that the other two cat species – margay (*Leopardus wiedii*) and the jaguarundi (*Herpailurus yaguarondi*) are also present.

Photograph 17: Jaguar (*Panthera onca*)
WCS/Wildtracks

Baird's tapir (*Tapirus bairdii*) is the largest herbivore present on the coastal plain, and tends to be associated with the creeks, freshwater inundation areas and riverside, where it grazes on the herbaceous vegetation. Whilst shy and infrequently seen, its tracks were recorded on the savannah and broadleaf forest areas, adjacent to Freshwater Creek. It is listed as Endangered (IUCN, 2004), but is thought to be widespread and relatively common in Belize, where it is seldom hunted. The main threat to this species is the increasing rate of habitat fragmentation and conversion to agriculture The protection of significant tracts of unfragmented riparian vegetation and other suitable habitats (such as those adjacent to Freshwater Creek, within the Peccary Hills area), is a priority for its continued survival.

Of the two peccary species recorded in Belize, only the collared peccary (*Tayassu tajacu*) occurs within the Peccary Hills area. White-lipped peccary (*Dicotyles pecari*) are reported to have occurred throughout the area until extensive flooding (following Hurricane Greta, in 1978) combined with intensive hunting pressure, is thought to have caused the local extinction of this species – not just in the Peccary Hills area, but throughout the broadleaf forest areas of Manatee Forest Reserve, south to Gales Point. Coupled with the increasing fragmentation of forest habitat, the construction of the Coastal Road and the increased traffic, hunting and clearance associated with the Hummingbird Highway, this species is unlikely to be able to recolonize the Peccary Hills area without human intervention.

T. tajacu has been reported from both the broadleaf forest and short grass savanna areas, and local reports also suggest that this species utilizes caves for shelter. In the savanna areas it comes under pressure from hunters from Gales Point to the south and La Demcoracia to the north, as well as hunting parties from Belize City, Belmopan and even San Ignacio, accessing the area from the Coastal Road during the dry season.

Two deer species are present in the Peccary Hills area. The larger of the two, the white-tailed deer (*Odocoileus virginianus*), is favoured by hunters from adjacent communities, and comes under intense pressure during dry season. It prefers the savannah ecosystems, and is lured to newly burnt areas for the minerals in ash, and the new shoots, encouraging hunters to set fires throughout the coastal plain. The smaller red brockett (*Mazama americana*) is a forest species, rarely venturing into the open areas, so is confined to the broadleaf forest of the karst areas.

Belize is particularly important for maintenance of viable populations of the West Indian Manatees (*Trichechus manatus*), having the largest population of in Central America. This large aquatic mammal is listed as 'vulnerable' by IUCN, with an estimated population of less than 1,000 individuals in Belize (Auil, pers. com.). Southern Lagoon has been highlighted as one of six areas that has been found to be consistently important to manatees, with the availability of freshwater, seagrass and shelterered areas. Both mother-and-calf and mating herds have been observed here (Auil, pers. com.) – with animals moving north into Northern Lagoon and entering Freshwater Creek in search of freshwater. Individuals have also been observed in the Sibun River at Gracie Rock, during high waters (community field assistants, pers. com.).

A complete list of mammal species recorded to date for the Peccary Hills area is included in Appendix 2.

6.4.2 Birds

A total of 307 species of birds have been listed for the Peccary Hills and adjacent area, 76% of these (229 species) being considered permanent residents. Birds were surveyed using both transects and point surveys, with recordings of opportunistic sightings by all members of the fieldwork team. Data was also provided by the adjacent Runaway Creek Nature Preserve, where Birds without Borders (a project of the Zoological Society of Milwaukee), has been conducting long-term surveys of migratory and resident bird species. Mist netting and banding activities between the years of 1999 and 2002, both in the karst and savanna, has provided significant data on the bird species that use the area, and with the similarities in ecosystem types and proximity of sites, there is expected to be complete overlap between the bird fauna with that of the Peccary Hills area.

Five species have been highlighted for their status as species of international concern (IUCN, 2004). A further species, the jabiru (*Jabiru mycteria*), has also been highlighted through its listing in CITES Appendix I. On the national level, a provisional list of 46 critical bird species has been generated, of which twenty three (50%) have been recorded within the Peccary Hills / Runaway Creek area (Table 8).

Table 8: Bird Species of National and International Concern of the Peccary Hills area*

Species		International Status	Status in Belize	Justification
Agami Heron	*Agamia agami*		VU	2,3
Yellow-headed Parrot	*Amazona oratrix*	EN	EN	1,3,4,5
Yellow-lored Parrot	*Amazona xanthlora*		VU	5
Great Blue Heron	*Ardea herodias*		VU	1,5
Muscovy Duck	*Cairina moschata*		VU	1
Great Curassow	*Crux rubra*	NT	VU	1,4
Black-bellied Whistling-Duck	*Dendrocygna autumnalis*		VU	1,5
Cerulean Warbler	*Dendroica cerulea*	VU	VU	
Snowy Egret	*Egretta thula*		VU	2,5
Tricolored Heron	*Egretta tricolor*		VU	2,5
White Ibis	*Eudocimus albus*		VU	2
Magnificent Frigatebird	*Fregata magnificens*		VU	2
Jabiru	*Jabiru mycteria*		VU	1,4,5,6,7
Black Catbird	*Melanoptila glabrirostris*	NT	NT	3,4
Wood Stork	*Mycteria Americana*		VU	1,2,5
Yellow-crowned Night-Heron	*Nyctanassa violacea*		VU	2
Black-crowned Night-Heron	*Nycticorax nycticorax*		VU	2
Brown Pelican	*Pelecanus occidentalis*		VU	2,5
Crested Guan	*Penelope purpurascens*		VU	1
Neotropic Cormorant	*Phalacrocorax brasilianus*		VU	1,2,5
Brown-hooded Parrot	*Pionopsitta haematotis*		DD	
King Vulture	*Sarcoramphus papa*		VU	3,4,6
Painted Bunting	*Passerina ciris*	NT		

IUCN Categories

EN Endangered
VU Vulnerable
NT Near Threatened
DD Data Deficient

Criteria for inclusion in national critical species listing

1 Hunted - Fished
2 Colony breeder or restricted number of nesting locations
3 Specialized ecological requirements
4 Charismatic species drawing national and international attention
5 Persecuted as a perceived pest
6 Requires a large range
7 Genetically different from South American counterpart

* **Including Runaway Creek**

The yellow headed parrot (*Amazon oratrix*) is classified as Globally Endangered following a very rapid 90% population decline throughout its range since the 1970's, to an estimated 7,000 individuals in 1994 (Birdlife, 2004). In the last ten years alone, the population is thought to have declined by 68%, and significant rates of decline are expected in the future with increased habitat destruction for development, increased man-made fires over the pine savanna areas, and the theft of nestlings for the pet trade (Birdlife, 2004).

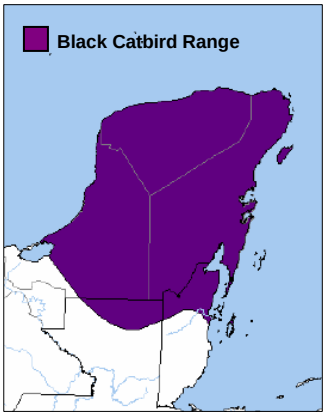
The sub-species *Amazona oratrix belizensis* is restricted to the pine savanna of Belize and northern Honduras, and has been recorded within the Runaway creek area. Once common throughout the coastal savannas of Belize, the range of this species has contracted to small, fragmented pockets, primarily in north west Belize. Local reports from Gracie Rock suggest that it may no longer be present within the Peccary Hills area, following the degradation of the pine savanna through increased frequency of fires, removing the majority of large pine trees used by the parrots for nesting. Conservation measures such as artificial nest boxes, fire management and enforcement to prevent nestling theft, may, however, encourage this species to return to the area, if further studies show that it is, indeed, no longer present.

The threat of increasing frequency of fire in the savanna areas faces not only the yellow-headed parrots, but other savanna species too – such as the fork-tailed flycatcher, black-throated bobwhite, and savanna sparrows – species that nest low down within the grass layer. Another bird that has been observed frequenting the savanna is the jabiru stork (*Jabiru mycteria*), listed in CITES Appendix One. The Central American population of this species is thought to be genetically isolated from that of South America, resulting in a limited gene pool available for viability. Nests have been reported from adjacent savanna areas (Figueroa, 2005) and it is probable that the Peccary Hills savannas are important for fledgling feeding.

The great curassow (*Crax rubra*), highlighted as a high priority in the Cracid Action Plan, 2000 – 2004 (Brooks and Strahl, 2000), has a wider regional distribution, stretching from Mexico southwards to Ecuador, though it is restricted to forested areas. This species is becoming uncommon to rare (and in parts locally extinct), through much of its range (Birdlife, 2005). Throughout the Neotropics, Curassows are heavily persecuted as game species, and populations in Belize are no exception, coming under serious hunting pressure (Belize is highlighted within the Cracid Action Plan as one of the few countries where hunting of this species is still legal). Within the Peccary Hills area, there has been hunting for the table in the past from Gracie Rock, but this has decreased with the increase in employment opportunities through the partnership with Maya World Adventures. Hunting from other communities, however, is still taking place.

The second large gamebird species in the area, the crested guan (*Penelope purpurascens*), is also declining in numbers and range in Belize. This species is considered of intermediate priority in the Cracid Action Plan, with recommendations for additional fieldwork to determine the status and monitor population numbers. Protection of the Peccary Hills area will strengthen the present protection of both *P. purpurascens* and *C. rubra*, once a strict no hunting regime is in place, allowing populations to recover.

The black catbird (*Melanoptila gabrirostris*), listed as 'near threatened' (IUCN, 2004) is a Yucatan endemic, restricted to the scrubby woodlands and mangrove of the the Yucatan and north east Belize (Map 11). Whilst the Peccary Hills area is mapped as the southern-most range of this species within Belize, it has been recorded further south in Paynes Creek, Toledo, and both the numbers and the range are thought to be



Map 11: Distribution of the Black Catbird, a Yucatan Endemic
InfoNatura, 2005

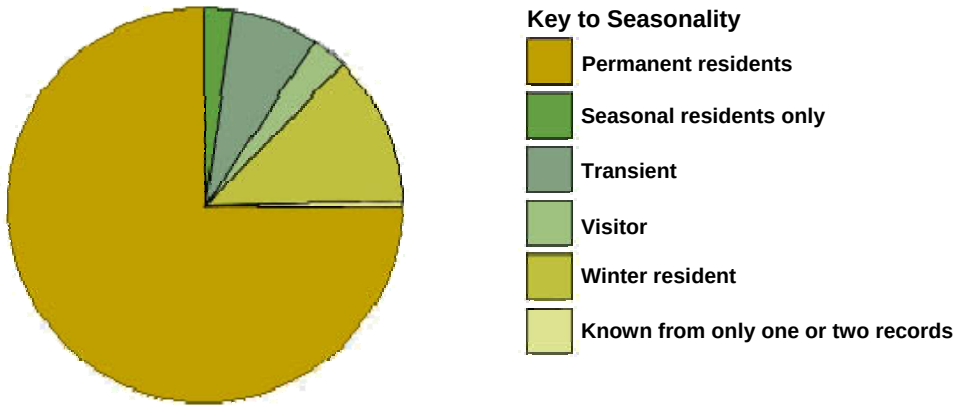
increasing (Jones, 2003), despite the rate of land use change for coastal development.

This focus on coastal development has also increased the risk to colony nesting birds, highlighted as national critical species, such as *Fregata magnificens, Eudocimus albus* and the majority of the herons and egrets. Many of these species use mangrove cayes, such as the bird sanctuary in Northern Lagoon. The increased clearance, human presence, and disturbance from boat activity may have a negative impact on these species unless mitigation measures are put in place.

The area is important for migratory birds, winter residents and transients comprising 19% of the recorded species. This is particularly true with the increasing deforestation further inland, reducing the area of quality stopping points for migrants heading further south.

A small number of species are visitors – the brown pelican (*Pelecanus occidentalis*), for example, venture inland during coastal storms and are therefore recorded overhead, especially adjacent to Northern Lagoon.

Graph 4: Population Structure of Birds of the Peccary Hills and adjacent Area



6.4.3 Amphibians and Reptiles

No formal herpetofaunal species list had previously been generated for the Peccary Hills area. A review of known distributions and habitat preferences of amphibians and reptiles indicates a potential herpetofauna of approximately 87 species, with potential for up to a further 11 species whose ranges could extend into the general vicinity.

Whilst Visual Encounter Transects were utilized as the primary survey technique for the amphibians, reptiles were surveyed largely opportunistically during the ground-truthing of the ecosystems. Additionally, local knowledge of the presence of easily identifiable species was recorded from community participants in the survey.

Results

A total of 12 amphibian species were recorded during the surveys (and 1 additional species being reported by Gracie Rock participants); 1 crocodilian was observed along with 5 freshwater turtles (and 2 additional species reported by Gracie Rock participants), 9 lizard

species (and 6 additional species reported by Gracie Rock participants), and 3 species of snake (with a further 18 species having been previously observed by Gracie Rock participants).

Thus a total of 30 species were thus recorded during the surveys, with an additional 27 species reliably identified from past sightings by Gracie Rock participants – giving a total species list to date of 57, or approximately 66% of all the species likely to occur there. The 57 species recorded to date represent 25 families.

It is clear from the surveys, and supported by the preliminary species list, that the Peccary Hills area supports a rich herpetofaunal community. As one would expect, this comprises the broad array of lowland species, and lacks those restricted to the higher elevations of the Maya Mountains to the west.

None of the amphibians recorded in the Peccary Hills area, or likely to occur there, is currently considered of conservation concern (all being rated as of Least Concern, IUCN, 2004). The majority of these amphibians can be considered lowland generalists occurring across a relatively broad array of habitats in Belize.

The Peccary Hills area harbours a diverse reptile fauna, ranging from species associated with mature broadleaf forest (such as *Corytophanes hernandezii*) to coastal savanna species (such as *Cnemidophorus angusticeps*). Whilst the conservation status of Neotropical reptiles is less poorly known than that of amphibians (Walker, pers obs), 6 species of conservation concern have been recorded in the Peccary Hills area: one is endangered, and five are classified as being of lower risk (Table 9).

Table 9: Reptile and Amphibian Species of International Concern (IUCN: Red list 2004) of Peccary Hills Area		
Endangered	Central American River Turtle	*Dermatemys mawii*
Lower Risk / Near Threatened	Morelet's Crocodile	*Crocodylus moreletii*
	Mexican Giant Musk Turtle	*Staurotypus triporcatus*
	Common Slider	*Trachemys scripta*
	Narrow-bridged Musk Turtle	*Claudius angustatus*
	Tabasco Mud Turtle	*Kinosternon acutum*

In terms of the herpetofauna, the evidently healthy population of the endangered Central American River Turtle or Hicatee (*Dermatemys mawii*) is by far the most conservationally important. Extirpated from much of its range in Mexico and Guatemala (as a result of hunting pressure), this species is also in decline in Belize, and is considered likely to be elevated to the status of Critically Endangered in the near future. It would appear that the population in this portion of the Sibun River and in Freshwater Creek may well be the largest in Belize, and therefore throughout its limited range. Whilst local reports indicate that large specimens are less frequent than previously (indicating potentially unsustainable hunting pressure), the population still has good recruitment. Gracie Rock and Freetown Sibun community members demonstrate a keen interest in assisting the continued survival of this highly endangered species. A national species survival plan is urgently needed for the Central American River Turtle, and it is clear that the population in the Peccary Hills area must figure highly in such conservation planning if the species is to be saved from looming extinction. Previously, conservation funding had been provided (by the Protected Areas Conservation Trust) to a CBO in Freetown Sibun to establish a hatchery

Photograph 18: Central American River Turtle (*Dermatemys mawii)*

for this species. Whilst the project was apparently successful during the funded period, the group reportedly lacked the capacity and financial sustainability to continue the project once the grant monies had been used (Lopez, pers. com.). The proposed purchase of the Peccary Hills area, to be managed for conservation, and sustained largely by tourism revenue, offers the long-term support structure needed to sustain a long-term conservation programme to ensure the survival of perhaps the only remaining viable population of the Central American River Turtle.

6.4.4 Fish Fauna of Peccary Hills

A total of fifty one species of fish have been recorded within the waterbodies associated with the project area – twenty-two of these being recorded within the present fieldwork. One of these is listed under the IUCN redlist as a species of international concern – the goliath grouper (*Epinephelus itajara*), which is critically endangered. This species is known to be in Northern Lagoon, and to enter the lower reaches of Freshwater Creek.

Tilpia, an exotic, invasive species, has been reported from the upper reaches of the Freshwater Creek (community field assistants, 2005), and has the potential to cause loss of diversity an density within the resident fish fauna (particularly the cichlidae), though pressures from overfishing, particularly with seine nets, are thought to have been responsible for the present decline in fish populations.

The Peccary Hills area has a complicated drainage system, with many creeks and lowland areas draining into Freshwater Creek to the south east, and Sibun River to the northwest. The fish species assemblage is predominantly freshwater, with a number of more saline-tolerant species being present in the lower Freshwater Creek system as it flows into Northern Lagoon, and in Northern Lagoon itself.

Five specific water body types were identified for investigation:

- The Freshwater Creek system
- Sibun River.
- Permanent Pools
- Ephemeral Pools
- Northern Lagoon

Freshwater Creek System

The Freshwater Creek system includes a series of creeks, pools and inundation areas draining the limestone karst areas, swamp forest and open, short grass savanna, with high fish diversity, and high densities of the most common species observed (particularly the yellowbelly cichlid (*Cichlasoma salvini*), firemouth cichlid (*C. meeki*), Mayan tetra (*Hyphessobrycon compressus*), and green swordtail (*Xiphophorus helleri*).

Photograph 19: Yellowbelly Cichlid (*Cichlasoma salvini*)

Shoals of the saline tolerant *Eugerres sp.* were observed in the lower reaches of Freshwater Creek, as were schoolmaster snapper (*Joturus apodus*) and the ubiquitous central tetra (*Astyanax aeneus*) – though the latter were not observed within the lagoon itself. The mojarra (*Eugerres sp.*) and *J. apodus* were observed only in the

lower reaches of the creek, being confined to the higher salinity of the lower reaches, as confirmed by local field assistants.

Sibun River

Ten species have been recorded in the Sibun River during the biodiversity assessment, either as sightings or through reports from field assistants. The majority of species (a further twenty three) were recorded in the Sibun River by Greenfield and Thomerson (1997).

Permanent Pools

Permanent pools were investigated, both in the forested areas (Washing Pond) and on the savanna. *Astyanax aeneus* were observed in Washing Pond, a permanent waterbody, with a freshwater spring maintaining water level. The majority of the savanna pools, however, were reported to have dried up as a result of the intense dry season of 2004, resulting in a lack of fish (even *A. aeneus*) when investigated during this survey.

Ephemeral Pools

The savanna, with its impermeable clay subsoil, floods regularly during wet season, with water overflowing the Freshwater Creek system, inundating the savanna, and allowing fish fauna to spread. These fish populations are then isolated in small pools as the water retreats with the onset of dry season. These ephemeral pools, too, were surveyed, with a total of six species being identified – *Belenosox belizanus, Gambusia luma, G, yucatana, Xiphophorus helleri, Ophisternon aenigmaticum* and *Cichlasoma meeki,* all species adapted for rapid response to optimal breeding conditions following heavy rainfall.

Photograph 20: Firemouth Cichlid (*Cichlasoma meeki*)

Northern Lagoon

Northern Lagoon appeared fairly species poor, though the saline tolerant Southern stingray (*Dasyatis Americana*), checkered pufferfish (*Sphoeroides testudines*) and shoals of the ocellated killifish (*Floridichthys polyommus*) were recorded. It is assumed that those saline tolerant species present in the lower reaches of Freshwater Creek (the mojarra (*Eugerres sp.*) and *J. apodus*) are also present in the lagoon. *Lobotes surinamensis* and *Cichlasoma uropthalmus* were also recorded in the lagoon, by Greenfield and Thomerson (1997).

Alligatorfish
Belonesox belizanus

Two-spot Livebearer
Heterandria bimaculata

Central Tetra
Astyanax aeneus

Green Swordtail
Xiphophorous helleri

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Appendices:

Appendix One: Plant Species of the Peccary Hills Area

Appendix Two: Mammal Species of the Peccary Hills Area

Appendix Three: Bird Species of the Peccary Hills Area

Appendix Four: Reptile and Amphibian Species of the Peccary Hills Area

Appendix Five: Fish Species of the Peccary Hills Area

Appendix Six: Data Sources for Mapping, BERDS

Appendix One: Plants of Peccary Hills		
Family	**Species**	**Common name**
Amaryllidaceae	Crinum erubescens	Crinum lily
	Hymenocallis littoralis	Spider lily
	Zephyranthes lindleyana	Small lily
Acanthaceae	Bravaisia berlandieriana	Hulub
	Louteridium chartaceum	Peccary Hills shrub
Adiantaceae	Adiantum tenerum	Maidenhair fern
	Vittaria sp.	
Agavaceae	Agave angustifolia	Agave
Alismataceae	Sagittaria lancifolia	White-flowered water plantain
Anacardiaceae	Astronium graveolens	Jobillo, Glassy wood
	Metopium brownei	Black Poisonwood, Chechem
	Spondias radlkoferi	Hogplum
Annonaceae	Annona glabra	Bobwood
	Xylopia frutescens	Polewood
Apocynaceae	Aspidosperma megalocarpon	Mylady
	Cameraria latifolia	White poisonwood
	Plumeria obtusa	Wild frangipani, flor de mayo
	Stemmadenia donnell-smithii	Cojeton
	Tabernaemontana alba	Dog balls
	Tabernaemontana arborea	Horse balls
	Thevetia ahouai	Dog balls, Cojon de mico
Araceae	Anthurium schlechtendalii	Cola de faisan, Creole gal
	Anthurium sp.	Birds' nest 'fern'
	Anthurium verapazense	Anthurium
	Philodendron sp.	Philodendron
	Philodendron tripartitum	Three-lobed philodendron
	Syngonium sp.	
Arecaceae	Acoelorraphe wrightii	Tasiste
	Attalea cohune	Cohune
	Bactris major	Pokenoboy - black fruit

Appendix One: Plants of Peccary Hills / 2		
Family	**Species**	**Common name**
Arecaceae	Bactris mexicana	Pokenoboy -red fruit
	Chamaedorea pinnatifrons	Single-stemmed bamboo palm
Arecaceae	Chamaedorea seifrizii	Bamboo palm, Xate
	Cryosophila stauracantha	Escoba palm
	Desmoncus orthacanthos	Bayal, basket tie tie, stay-a-while
	Euterpe precatoria	Mountain cabbage palm
	Gaussia maya	
	Roystonea regia	Royal palm, Cabbage palm
	Sabal mauritiiformis	Bay-leaf, Botan
	Thrinax radiata	Chit
Aristolochiaceae	Aristolochia grandiflora	Contribo vine
	Aristolochia maxima	Contribo vine
	Aristolochia sp.	Contribo
	Aristolochia trilobata	Contrayerba
Asclepiadceae	Asclepias curassavica	Asclepias
Asteraceae	Bidens pilosa	
	Neurolaena lobata	Jackass bitters
Begoniaceae	Begonia sericoneura	Begonia
Bignoniaceae	Crescentia cujete	Calabash
	Tabebuia rosea	Mayflower
Bixaceae	Cochlospermum vitifolium	wild cotton, cotton flower
Bombacaceae	Bernoullia flammea	Mapola / Santo Domingo
	Ceiba pentandra	Ceiba / cotton tree
	Pachira aquatica	Provision bark, Santo domingo
	Pseudobombax ellipticum	
	Quararibea funebris	Guayabillo, Batidos
Boraginaceae	Cordia alliodora	Salmwood
	Cordia bicolor	"Fiddlewood"
	Cordia sp.	Cordia

Appendix One: Plants of Peccary Hills / 3		
Family	**Species**	**Common name**
Bromeliaceae	Aechmea bracteata	Bromeliad (red-flowering)
	Aechmea sp.	Bromeliad (red-flowering)
	Bilbergia viridiflora	
	Bromelia plumieri (?)	Pinuela
	Tillandsia bulbosa	
	Tillandsia monadelpha	
	Tillandsia spp.	Air-plants
	Vriesea gladioliflora	Terrestrial bromeliad
	Vriesea heliconiodes	Epiphytic bromeliad
Burseraceae	Bursera simaruba	Gumbo limbo
	Protium copal	Copal
Cabombaceae		
	Cabomba palaeformis	
Cactaceae	Selincereus sp.	
	Selenicereus testudo	Devil's gut cactus
Capparaceae	Cleome sp.	Cleome
Caricaceae	Carica papaya	Wild papaya
Cecropiaceae	Cecropia peltata	Trumpet, Warumo
Chrysobalanaceae	Chrysobalanus icaco	Cocoplum
	Licania platypus	Monkey apple
Clusiaceae	Calophyllum brasiliense	Santa maria
	Clusia sp.	
	Vismia camparaguey	Wild annato
Combretaceae	Bucida buceras	Bullet Tree, Pucte
	Conocarpus erecta	Buttonwood
Commelinaceae	Tradescantia spathacea	Rhoeo
Convolvulaceae	Ipomoea sp.	Ipomoea
Costaceae	Costus pictus	

Appendix One: Plants of Peccary Hills / 4		
Family	**Species**	**Common name**
Costaceae	Costus pulverulentus	
	Costus sp.	Costus
Cucurbitaceae	Mormordica charantia	Sorosi
Cyperaceae	Carex polystachya	Sedge
	Eleocharis geniculata	Freshwater reed
	Eleocharis sp.	Freshwater reed
	Rhynchospora cephalotes	Armadillo grass
	Scleria bracteata	Cutting grass
Dennstaedtiaceae	Pteridium caudatum	Pteridium, Bracken
Dilleniaceae	Curatella americana	Yaha, Sandpaper tree
	Davilla sp.	
Dioscoreaceae	Dioscorea sp.	Chiny yam
Dracaenaceae	Dracaena americana	Candlewood, Dracaena
Euphorbiaceae	Cnidosculus souzae (?)	Chaya
	Croton sp.	Ca-pal che
	Dalechampia sp.	Pica-pica
	Plukenetia penninervia	Liana
	Sapium sp.	
Fabaceae		
Caesalpinioideae	Bauhinia herrerae	Pata de Vaca, Bauhinia vine
	Bauhinia jenningsii	Wild Bauhinia
	Caesalpinia gaumeri	Warree wood
	Cassia grandis	Bukut, Stinking toe
	Dialium guianense	Ironwood
	Schizolobium parahyba	Quamwood
	Senna peraltaena	Cat's claw
Mimosoideae	Acacia collinsii	Subin
	Acacia dolichostachya	Wild tamarind
	Acacia glomerosa (?)	Subin-like Mimosoid
	Balizia leucocalyx	Wild tamarind
	Calliandra sp.	Red-flowering calliandra
	Cojoba arborea	Barba jolote
	Enterolobium cyclocarpum	Guanacaste, Tubroos

Appendix One: Plants of Peccary Hills / 5		
Family	**Species**	**Common name**
Mimosoideae	Inga affinis	Bri-bri
	Inga pinetorum	Tama-tama
	Inga sp.	Inga
	Lysiloma latisiliquum	Salam
	Mimosa bahamensis	Catzim
	Mimosa hondurana	Dormilona, Sensitive weed
	Mimosa pellita	Sensible weed (pink - flowered)
	Mimosa pudica	Sensitive weed
	Mimosa watsonii	Haulback
	Pithocellobium keyense ?	xo-coy, red fowl
	Pithocellobium sp.	
	Samanea saman	Rain tree
Papilionoideae	Acosmium panamense	Billy webb
	Dalbergia glabra	Kibix
	Dalbergia stevensonii	Rosewood
	Desmodium adscendens	Strongback
	Gliricidia sepium	Madre de Cacao
	Lonchocarpus castilloi	Cabbage Bark, machich
	Lonchocarpus guatemalensis	Dogwood, Turtle-bone
	Machaerium sp.	Tiger claw
	Piscidia piscipula	Habin, Dogwood
	Pterocarpus officinalis	Kaway
	Swartzia cubensis	Catalox, bastard tambran
Fagaceae	Quercus sp.	Oak
Flacourtiaceae	Zuelania guidonia	Water Wood, Tamai
Heliconiaceae	Heliconia bourgaeana	Waha leaf
	Heliconia latispatha	Platanillo,
	Heliconia spissa	Limestone hill heliconia
	Heliconia vaginalis	Waha leaf, red
Lauraceae	Cassytha filiformis	Scorn de earth, jaundice tie-tie
Lentibulariaceae	Utricularia sp.	
Malpighiaceae	Byrsonima crassifolia	Sacpa, Nancen

Appendix One: Plants of Peccary Hills / 6		
Family	**Species**	**Common name**
Malvaceae	Hampea stipitata	Majagua
	Hampea trilobata	Majua
	Malvaviscus arboreus	Turk's cap hibiscus
Marantaceae	Calathea lutea	Waha
	Calathea sp.	Waha leaf
	Maranta arundinacea	Wild arrowroot
Melastomaceae	Clidemia sp.	
	Miconia argentea	White Maya
	Miconia bulbalina	
	Miconia sp.	Miconia
Meliaceae	Cedrela odorata	Spanish cedar
	Swietenia macrophylla	Mahogany
	Trichilia havanensis	Bastard lime
Monimiaceae	Siparuna thecaphora	Wild coffee
Moraceae	Brosimum alicastrum	Ramon, Breadnut
	Ficus insipida	Wild fig, Red fig
	Ficus sp.	Fig
	Trophis racemosa	Red breadnut, White ramon
Myricaceae	Myrica cerifera	Teabark
Myristicaceae	Virola koschnyi	Banak
Myrsinaceae	Ardisia sp.	Blossomberry
Myrtaceae	Eugenia sp.	Eugenia
	Pimenta dioica	Allspice
	Syzgium cumini	Black-berry
Nyctaginaceae	Pisonia aculeata	Tiger claw
Nymphaeaceae	Nymphaea sp.	Water lily
Onagraceae	Ludwigia octovalvis	Clavos

Appendix One: Plants of Peccary Hills / 7		
Family	**Species**	**Common name**
Orchidaceae	Bletia purpurea	Pink terrestrial orchid
	Brassavola nodosa	
	Catasetum integerrimum	
	Chysis bractescens	
	Cyrtopodium punctatum	
	Encyclia boothiana	
	Encyclia bractescens	
	Encyclia cochleata	Black orchid
	Epidendrum nocturnum	Butterfly orchid
	Epidendrum rigidum	
	Maxillaria uncata	
	Mormodes sp.	
	Myrmecophila tibicinis	cow-horn orchid
	Notylia barkeri	
	Oncidium ascendens	
	Pleurothallis brighamii	
	Pleurothallis grobyi	
	Polystachya clavata	
	Polystachya foliosa	
	Ponera striata	
	Psygmorchis pusilla	
	Sarcoglottis sceptrodes	
	Scaphyglottis leucantha	
	Tigonidium egertonianum	
	Vanilla sp.	Vanilla orchid
Passifloraceae	Passiflora biflora	Granadillo
	Passiflora cobanensis	
	Passiflora coriacea	Batwing
	Passiflora foetida	Passionflower
	Passiflora lancetillensis	
	Passiflora mayarum	
	Passiflora oerstedii choconiana	
	Passiflora rovirosae	
	Passiflora serratifolia	Passionflower
	Passiflora urbaniana	
	Passiflora xiikzodz	Narrow-leaved batwing
Pinaceae	Pinus caribaea	Caribbean pine

Appendix One: Plants of Peccary Hills / 8		
Family	**Species**	**Common name**
Piperaceae	Piper amalago	Cordonzillo
	Piper auritum	Cowfoot, Xmacolan
	Piper hispidum	Cordoncillo
	Piper peltatum	Santiago, Sweet cowfoot
	Piper spp.	
Poaceae	Bambusa vulgaris	Cultivated bamboo
	Guadua longifolia	Riparian bamboo
	Gynerium sagittatum	Dumb cane, Cana brava
Polygonaceae	Coccoloba barbadensis	
	Coccoloba belizensis	Bob
	Coccoloba sp.	
	Gymnopodium floribundum	Canelita
Polypodiaceae	Phlebodium decumanum	Tallawalla, Cancer-fern
	Polypodium sp.	
Proteaceae	Roupala montana	
Rhamnaceae	Gouania sp.	
Rhizophoraceae	Rhizophora mangle	Red Mangrove
Rubiaceae	Alibertia edulis	Wild guava
	Alseis yucatanensis	Cacao-che, Wild mamey
	Guettarda combsii	Glassy wood
	Hamelia patens	Polly red head, Ixcanan
	Psychotria poeppigiana	Hot lips
Rutaceae	Zanthoxylum sp.	Prickly yellow
Sapindaceae	Cupania belizensis	Grande betty, palo carbon
	Cupania sp.	Grande betty
	Sapindus saponaria	Soap tree, Soap-seed tree
Sapotaceae	Chrysophyllum mexicanum	Chiceh
	Manilkara staminodella	Chiquibul sapote
	Manilkara zapota	Sapote
	Pouteria campechiana	Mammee cerillo

Appendix One: Plants of Peccary Hills / 9		
Family	**Species**	**Common name**
Sapotaceae	Pouteria sapota	Mamey apple
	Pouteria sp.	
Selaginellaceae	Selaginella sp.	Selaginella
Simaroubaceae	Simarouba glauca	Negrito
Smilacaceae	Smilax sp	Chinee yam, Chinee root
Solanaceae	Solanum sp.	Solanum
Sterculiaceae	Guazuma ulmifolia	Bay cedar, pixoy
	Helicteres guazumifolia	Red-flowering pixoy
Theophrastaceae	Jaquinia macrocarpa	Xcansic, Jaquinia
Tiliaceae	Luehea seemannii (?)	copper-leaf Luehea
	Luehea speciosa	Pixoy bala-max, Mountain moho
	Mutinga calabura	Capulin, mahoa
	Trichospermum grewiifolium	Balsa wood, Moho
Verbenaceae	Stachytarpheta jamaicensis	Stachytarpheta
	Vitex gaumeri	Yaxnik
Vitaceae	Vitis tiliifolia	Water vine
Zamiaceae	Zamia sp. nov.	
	Zamia polymorpha	Palmita
Zingiberaceae	Renealmia sp.	

Appendix Two: Mammals of the Peccary Hills area

Common Name	Scientific Name	2005	1996	Local reports	IUCN Status	CITES Status
Didelphimorphia						
Didelphidae						
Common Opossum	*Didelphis marsupialis*	T		x		
Virginia Opossum	*Didelphis virginiana*			x		
Grey Four-eyed Opossum	*Philander opossum*			x		
Water Opossum	*Chironectes minimus*			x	NT	
Wooly Opossum	*Caluromys derbianus*			x		
Edentata						
Myrmecophagidae						
Northern Tamandua	*Tamandua mexicana*			x		
Dasypodidae						
Nine-banded Armadillo	*Dasypus novemcinctus*	T	x	x		
Primates						
Cebidae						
Yucatan Black Howler	*Alouatta pigra*	H	x	x	E	I
Central American Spider Monkey	*Ateles geoffroyi*	x		x		
Chiroptera						
Greater White-lined Bat			x			
Rodentia						
Sciuridae						
Yucatan Squirrel	*Sciurus yucatanenis*			x		
Deppe's Squirrel	*Sciurus deppei*	x		x		
Erethizontidae						
Mexican Porcupine	*Coendou mexicanus*			x		
Dasyproctidae						
Central American Agouti	*Dasyprocta punctata*	xT		x		
Agoutidae						
Paca	*Agouti paca*	T	x	x		
Carnivora						
Canidae						
Grey Fox	*Urocyon cinereoargenteus*	T	x	x		
Procyonidae						
Northern Racoon	*Procyon lotor*		x	x		
White-nosed Coati	*Nasua narica*	T	x	x		
Kinkajou	*Potos flavus*	x	x	x		

Common Name	Scientific Name	2005	1996	Local reports	IUCN Status	CITES Status
Carnivora						
Mustelidae						
Striped Hog-nosed Skunk	*Conepatus semistriatus*			x		
Neotropical River Otter	*Lutra longicaudis*	F		x	DD	I
Felidae						
Ocelot	*Leopardus pardalis*	T	x	x		I
Margay	*Leopardus wiedii*			x		I
Jaguarundi	*Herpailurus yagouaroundi*			x		I
Puma	*Puma concolor*		x	x	NT	I
Jaguar	*Panthera onca*	T	x	x	NT	I
Perissodactyla						
Tapiridae						
Baird's tapir	*Tapirus bairdii*	T	x	x	E	I
Artiodactyla						
Tayassuidae						
Collard Peccary	*Tayassu tajacu*	T	x	x		
Artiodactyla (cont.)						
Cervidae						
White-tailed Deer	*Odocoileus virginianus*	xT	x	x		
Red brocket Deer	*Mazama americana*	T	x	x		
West Indian Manatee	*Trichechus manatus*			x	E	I

Appendix Three: Birds of the Peccary Hills Area

Species		Status	Habitats	2005	1996	Runaway Creek
Great Tinamou	*Tinamus major*	fP	BFL			x
Little Tinamou	*Crypturellus soui*	fP	SC	x		x
Thicket Tinamou	*Crypturellus cinnamomeus*	lP	BFL			x
Slaty-breasted Tinamou	*Crypturellus boucardi*	fP	BFL			x
Least Grebe	*Tachybaptus dominicus*	lP	WL,LA			x
Brown Pelican	*Pelecanus occidentalis*	vV	O			x
Neotropic Cormorant	*Phalacrocorax brasilianus*	oV	LA			x
Anhinga	*Anhinga anhinga*	fP	LA	x		x
Magnificent Frigatebird	*Fregata magnificens*	vC	O			x
Bare-throated Tiger-Heron	*Tigrisoma mexicanum*	uP	WL,LA			x
Great Blue Heron	*Ardea herodius*	cV	WL, LA			X
Great Egret	*Ardea alba*	vP	LA	x	x	x
Snowy Egret	*Egretta thula*	oV	WL,LA			x
Little Blue Heron	*Egretta caerula*	vV	WL,LA	x		x
Tricolored Heron	*Egretta tricolor*	cV	LA		x	
Cattle Egret	*Bubulcus ibis*	fV	SC			x
Green Heron	*Butorides virescens*	cP	LA	x		x
Agami Heron	*Agamia agami*	uV	LA			x
Black-crowned Night-Heron	*Nycticorax nycticorax*	fW	LA	x		x
Yellow-crowned Night-Heron	*Nyctanassa violacea*	lP	LA			x
Boat-billed Heron	*Cochlearius cochlearius*	lP	LA	x		x
White Ibis	*Eudocimus albus*	cP	MF, LA			
Limpkin	*Aramus guarauna*	cP	LA		x	x
Jabiru*	*Jabiru mycteria*	lP	SA			x
Wood Stork	*Mycteria americana*	fV	LA			x
Black Vulture	*Coragyps atratus*	vP	SA,O	x	x	x
Turkey Vulture	*Cathartes aura*	vP	SA,O	x	x	x
Lesser Yellowheaded Vulture	*Cathartes burrovianus*	fP	SA			x
King Vulture	*Sarcoramphus papa*	uP	O		x	x
Black-bellied Whistling-Duck	*Dendrocygna bicolor*	cP	WL			x
Muscovy Duck	*Cairina moschata*	uP	LA			x
Osprey	*Pandion haliaetus*	fP	MF, LA	X		x
Gray-headed Kite	*Leptodon cayanensis*	uP	BFL			x
Swallow-tailed Kite	*Elanoides forficatus*	uS	BFL,O			x
White-tailed Kite	*Elanus leucurus*	uP	WL,SC			x
Snail Kite	*Rostrhamus sociabilis*	fP	WL, LA			x
Double-toothed Kite	*Harpagus bidentatus*	uP	BFL			x
Plumbeous Kite	*Ictinia plumbea*	uS	BFL,O			x
Black-collared Hawk	*Busarellus nigricollis*	uP	LA			x
White Hawk	*Leucopternis albicollis*	uP	BFL,O			x
Gray Hawk	*Asturina nitida*	fP	BFL,SC,O			x
Common Black-Hawk	*Buteogallus anthracinus*	uP	SC,O			x
Great Black-Hawk	*Buteogallus urubitinga*	uP	BFL,O			x
Roadside Hawk	*Buteo magnirostris*	cP	SC,SA,O	x	x	x

Appendix Three: Birds of the Peccary Hills Area / 2						
Species		**Status**	**Habitats**	**2005**	**1996**	**Runaway Creek**
White-tailed Hawk	*Buteo albicaudatus*	uP	uP			x
Zone-tailed Hawk	*Buteo albonotatus*	oW	oW			x
Black Hawk-Eagle	*Spizaetus tyrannus*	uP	BFL,O			x
Ornate Hawk-Eagle	*Spizaetus ornatus*	rP	BFL,O			x
Barred Forest-Falcon	*Micrastur ruficollis*	uP	BFL			x
Collared Forest-Falcom	*Micrastur semitorquatus*	uP	BFL			x
Laughing Falcon	*Herpetotheres cachinnans*	fP	SC,SA	x	x	x
Bat Falcon	*Falco rufigularis*	fP	SC,O	x	x	x
Aplomado Falcon	*Falco femoralis*	uP	SA	x	x	x
Plain Chachalaca	*Ortalis vetula*	cP	BFL, SC	x		x
Crested Guan	*Penelope purpurascens*	lP	BFL	x	x	x
Great curassow	*Crax rubra*	lP	BFL		x	x
Black-throated Bobwhite	*Colinus nigrogularis*	lP	SA		x	x
Spotted Wood-Quail	*Odontophorus guttatus*	uP	BFL			x
Ruddy Crake	*Laterallus ruber*	lP	SC			x
Gray-necked Woodrail	*Aramides cajanea*	fP	LA		x	x
Sungrebe	*Heliornis fulica*	lP	LA			x
Limpkin	*Aramus guarauna*	lP	WL,LA			x
Killdeer	*Charadrius vociferus*	fW	WL			x
Northern Jacana	*Jacana spinosa*	cP	LA	x		x
Solitary Sandpiper	*Tringa solitaria*	fW	WL	x		x
Spotted Sandpiper	*Actitis macularia*	fW	LA			x
Pale-vented Pigeon	*Columba cayennensis*	vP	BFL, PFL, MF	x		x
Scaled Pigeon	*Columba speciosa*	uP	BFL			x
Short-billed Pigeon	*Columba nigrirostris*	vP	BFL	x	x	x
Red-billed Pigeon	*Columba flavirostris*	uP	BFL		x	x
Plain-breasted Ground-Dove	*Columbina minuta*	cP	SA			x
Ruddy Ground-Dove	*Columbina talpacoti*	vP	SC	x	x	x
Blue Ground-Dove	*Claravis pretiosa*	uP	BFL	x	x	x
White-tipped Dove	*Leptotila verreauxi*	cP	BFL	x	x	x
Gray-fronted Dove	*Leptotila rufaxilla*	cP	BFL			x
Gray-chested Dove	*Leptotila cassini*	mP	BFL			x
Ruddy Quail-Dove	*Geotrygon montana*	uP	BFL			x
Olive-throated Parakeet	*Aratinga nana*	vP	BFL,SC	x	x	x
Brown-hooded Parrot	*Pionopsitta haematotis*	cP	BF			x
White-crowned Parrot	*Pionus senilis*	cP	BFL	x		x
White-fronted Parrot	*Amazona albifrons*	vP	BFL,SA	x		x
Yellow-lored Parrot	*Amazona xantholora*	fP	BFL, SA			x
Red-lored Parrot	*Amazona autumnalis*	vP	BFL	x		x
Mealy Parrot	*Amazona farinosa*	lP	BFL	x		x
Yellow-headed Parrot	*Amazona oratrix*	fP	PFL, SA			x
Yellow-billed Cuckoo	*Coccyzus americanus*	uT	BFL, MF			x
Squirrel Cuckoo	*Piaya cayana*	cP	BFL	x	x	x
Striped Cuckoo	*Tapera naevia*	uP	SC			x

Appendix Three: Birds of the Peccary Hills Area / 3						
Species		**Status**	**Habitats**	**2005**	**1996**	**Runaway Creek**
Pheasant Cuckoo	*Dromococcyx phasianellus*	rP	BFL,SC			x
Groove-billed Ani	*Crotophaga sulcirostris*	vP	SC	x		x
Vermiculated Screech-Owl	*Otus guatemalae*	uP	BFL			x
Ferruginous Pygmy-Owl	*Glaucidium brasilianum*	lP	BFL,SC			x
Mottled Owl	*Ciccaba virgata*	cP	BFL			x
Striped Owl	*Pseudoscops clamator*	uP	SA			x
Common Pauraque	*Nyctidromus albicollis*	cP	BFL	x	x	x
Common Nighthawk	*Chordeiles minor*	oT	SA,O			x
Lesser Nighthawk	*Chordeiles acutipennis*	fP	SA	x		x
White-collared Swift	*Streptoprocne zonaris*	fP	O			x
Vaux's Swift	*Chaetura vauxi*	cP	O			x
Lesser Swallow-tailed Swift	*Panyptila cayennensis*	uP	O	x		x
Long-tailed Hermit	*Phaethornis supercilious*	uP	BFL, SC	x		x
Little Hermit	*Phaethornis longuemareus*	fP	BFL	x		x
Scaly-breasted Hummingbird	*Phaeochroa cuvieri*	uP	BFL			x
Wedge-tailed Sabrewing	*Campylopterus curvipennis*	cP	BFL			x
White-necked Jacobin	*Florisuga mellivora*	fP	BFL,LA			x
Green-breasted Mango	*Anthracothorax prevostii*	uP	SC			x
Canivet's Emerald	*Chlorostilbon canivetii*	uP	SA,SC			x
White-bellied Emerald	*Amazilia candida*	fP	BFL	x		x
Azure-crowned Hummingbird	*Amazilia cyanocephala*	vP	PFL	x		x
Rufous-tailed Hummingbird	*Amazilia tzacatl*	cP	SC,SA			x
Buff-bellied Hummingbird	*Amazilia yucatanensis*	lP	SC,SA			x
Cinnamon Hummingbird	*Amazilia rutila*	lP	MF			x
Purple-crowned Fairy	*Heliothryx barroti*	mP	BFL			x
Long-billed Starthroat	*Heliomaster longirostris*	x	SC			x
Ruby-throated Hummingbird	*Archilochus colibris*	uW	SC			x
Black-headed Trogon	*Trogon melanocephalus*	cP	BFL. PFL	x	x	x
Violaceous Trogon	*Trogon violaceus*	cP	,BFL	x		x
Slaty-tailed Trogon	*Trogon massena*	cP	,BFL	x		x
Tody Motmot	*Hylomanes momotula*	?P	BFL			x
Blue-crowned Motmot	*Momotus momota*	cP	BFL	x	x	x
Ringed Kingfisher	*Ceryle torquata*	lP	LA			x
Belted Kingfisher	*Ceryle alcyon*	fW	LA			x
Amazon Kingfisher	*Chloroceryle amazona*	cP	LA	x		x
Green Kingfisher	*Chloroceryle americana*	cP	LA	x	x	
American Pygmy Kingfisher	*Chloroceryle aenea*	cP	LA	x		x
White-necked Puffbird	*Notharchus macrorhynchos*	uP	SC			x
Rufous-tailed Jacamar	*Galbula ruficauda*	fP	BFL			x
Collared Aracari	*Pteroglossus torquatus*	cP	BFL	x	x	x
Keel-billed Toucan	*Ramphastos sulfuratus*	cP	BFL	x	x	x
Acorn Woodpecker	*Melanerpes formicivorus*	cP	PFL		x	x
Black-cheeked Woodpecker	*Melanerpes pucherani*	cP	BFL			x
Red-vented Woodpecker	*Melanerpes pygmaeus*	fP	BFL			x
Golden-fronted Woodpecker	*Melanerpes aurifrons*	cP	SC	x	x	x

Appendix Three: Birds of the Peccary Hills Area / 4						
Species		**Status**	**Habitats**	**2005**	**1996**	**Runaway Creek**
Yellow-bellied Sapsucker	*Sphyrapicus varius*	uW	BFL			x
Ladder-backed Woodpecker	*Picoides sclaris*	fP	PFL			x
Smoky-brown Woodpecker	*Veniliornis fumigatus*	fP	BFL			x
Golden-olive Woodpecker	*Piculus rubiginosus*	fP	BFL			x
Chestnut-colored Woodpecker	*Celeus castaneus*	uP	BFL			x
Lineated Woodpecker	*Dryocopus lineatus*	cP	BFL	x		x
Pale-billed Woodpecker	*Campephilus guatemalensis*	cP	BFL	x	x	x
Rufous breasted Spinetail	*Synallaxis erythrothorax*	fP	SC		x	x
Plain Xenops	*Xenops minutus*	fP	BFL	x		x
Scaly-throated Leaftosser	*Sclerurus guatemalensis*	uP	FM,BFL			x
Tawny-winged Woodcreeper	*Dendrocincla anabatina*	fP	BFL	x		x
Ruddy Woodcreeper	*Dendrocincla homochroa*	uP	BFL	x		x
Olivaceous Woodcreeper	*Sittasomus griseicapillus*	fP	BFL	x		x
Wedge-billed Woodcreeper	*Glyphorynchus spirurus*	fP	BFL			x
Northern Barred-Woodcreeper	*Dendrocolaptes sanctithomae*	fP	BFL, PFL			x
Ivory-billed Woodcreeper	*Xiphorhynchus flavigaster*	cP	BFL			x
Streak-headed Woodcreeper	*Lepidocolaptes souleyetii*	uP	BFL	x		x
Great Antshrike	*Taraba major*	lP	SC			x
Barred Antshrike	*Thamnophilus doliatus*	cP	SC	x		x
Dot-winged Antwren	*Microrhopias quixensis*	cP	BFL	x		x
Dusky Antbird	*Cercomacra tyrannina*	cP	SC			x
Black-faced Antthursh	*Formicarius analis*	cP	BFL	x		x
Yellow-bellied Tyrannulet	*Ornithion semiflavum*	fP	BFL			x
Northern Beardless Tyrannulet	*Camptostoma imberbe*	fP	PFL, SC, SA			x
Greenish Elaenia	*Myiopagis viridicta*	fP	BFL	x		x
Yellow-bellied Elaenia	*Elaenia flavogaster*	vP	PFL,SA	x		x
Ochre-bellied Flycatcher	*Mionectes oleagineus*	cP	BFL			x
Sepia-capped Flycatcher	*Leptopogon amaurocephalus*	fP	BFL			x
Northern Bentbill	*Oncostoma cinereigulare*	cP	BFL			x
Slate-headed Tody-Flycatcher	*Poecilotriccus sylvia*	uP	SC			x
Common Tody-Flycatcher	*Todirostrum cinereum*	cP	SC,SA			x
Eye-ringed Flatbill	*Rhynchocyclus brevirostris*	uP	BFL			x
Yellow-olive Flycatcher	*Tolmomyias suphurescens*	cP	BFL			x
Stub-tailed Spadebill	*Platyrinchus cancrominus*	fP	BFL	x		x
Royal Flycatcher	*Onychorhynchus coronatus*	uP	BFL			x
Sulphur-rumped Flycatcher	*Myiobius sulphureipygius*	cP	BFL			x
Eastern Wood-Pewee	*Contopus virens*	cT	BFL			x
Tropical Pewee	*Contopus cinereus*	fP	BFL			x
Yellow-bellied Flycatcher	*Empidonax flaviventris*	fW	BFL			x
Least Flycatcher	*Empidonax minimus*	fW	SC			x
Black Phoebe	*Sayornis nigricans*	lP	LA			x
Vermilion Flycatcher	*Pyrocephalus rubinus*	lP	SA,SC			x
Bright-rumped Attila	*Attila spadiceus*	lP	BFL	x		x
Yucatan Flycatcher	*Myiarchus yucatanensis*	uP	BFL, SC			x
Dusky-capped Flycatcher	*Myiarchus tuberculifer*	cP	BFL	x		x

Appendix Three: Birds of the Peccary Hills Area / 5						
Species		**Status**	**Habitats**	**2005**	**1996**	**Runaway Creek**
Great Crested Flycatcher	*Myiarchus crinitus*	fW	BFL			x
Brown-crested Flycatcher	*Myiarchus tyrannulus*	cS	BFL,PFL			x
Great Kiskadee	*Pitangus sulphuratus*	vP	SC	x	x	x
Boat-billed Flycatcher	*Megarynchus pitangua*	cP	BFL			x
Social Flycatcher	*Myiozetetes similes*	vP	SC	x	x	x
Sulphur-bellied Flycatcher	*Myiodynastes luteiventris*	cS	BFL	x		x
Piratic Flycatcher	*Legatus leucophaius*	cS	BFL			x
Tropical Kingbird	*Tyrannus melancholicus*	vP	PFL,SA	x	x	x
Couch's Kingbird	*Tyrannus couchii*	cP	PFL,SA			x
Eastern Kingbird	*Tyrannus tyrannus*	vT	BFL		x	x
Fork-tailed Flycatcher	*Tyrannus savanna*	cP	SA		x	x
Thrushlike Schiffornis	*Schiffornis turdinus*	cP	BFL	x		x
White-winged Becard	*Pachyramphus polychopterus*	uP	SC			x
Gray–collared Becard	*Pachyramphus major*	rP	BFL			x
Rose-throated Becard	*Pachyramphus aglaiae*	uP	BFL,PFL			x
Masked Tityra	*Tityra semifasciata*	cP	BFL	x	x	x
White-collared Manakin	*Manacus candei*	cP	BFL	x	x	x
Red-capped Manakin	*Pipra mentalis*	fP	BFL	x		x
White-eyed Vireo	*Vireo griseus*	cW	SC	x		x
Mangrove Vireo	*Vireo pallens*	cP	SC			x
Yellow-throated Vireo	*Vireo flavifrons*	fW	BFL	x		x
Red-eyed Vireo	*Vireo olivaceus*	cT	BFL			x
Yellow-green Vireo	*Vireo flavoviridis*	cS	BFL		x	x
Tawny-crowned Greenlet	*Hylophilus ochraceiceps*	cP	BFL			x
Lesser Greenlet	*Hylophilus decurtatus*	vP	BFL	x		x
Rufous-browed Peppershrike	*Cyclarhis gujanensis*	cP	SA,SC			x
Green Jay	*Cyanocorax yncas*	uP	BFL,PFL			x
Brown Jay	*Cyanocorax morio*	vP	BFL,PFL	x	x	x
Yucatan Jay	*Cyanocorax yucatanicus*	lP	BFL, PFL			x
Purple Martin	*Progne subis*	cT	O			x
Gray-breasted Martin	*Progne chalybea*	cS	O			x
Tree Swallow	*Tachycineta bicolor*	oW	LA			x
Mangrove Swallow	*Tachycineta albilinea*	cP	LA		x	x
Northern Rough-winged Swallow	*Steigidopteryx serripennis*	cW	BFL,SA		x	x
Ridgeways Rough-winged Swallow	*Steigidopteryx ridgwayi*	cW	BFL, PFL,SA			
Barn Swallow	*Hirundo rustica*	vT	SA,WL,LA			x
Spot-breasted Wren	*Thryothorus maculipectus*	vP	BFL	x		x
House Wren	*Troglodytes aedon*	cP	SC			x
White-bellied Wren	*Uropsila leucogastra*	fP	BFL, PFL			x
White-breasted Wood-Wren	*Henicorhina leucosticta*	cP	BFL	x		x
Long-billed Gnatwren	*Pamphocaenus melanurus*	fP	BFL			x
Blue-grey Gnatcatcher	*Polioptila caerulea*	cP	SC		x	x
Tropical Gnatcatcher	*Polioptila plumbea*	uP	BFL			x
Veery	*Catharus fuscescens*	oT	BFL			x
Gray-cheeked Thrush	*Catharus minimus*	uT	BFL			x

Appendix Three: Birds of the Peccary Hills Area / 6						
Species		**Status**	**Habitats**	**2005**	**1996**	**Runaway Creek**
Swainson's Thrush	*Catharus ustulatus*	uT	BFL			x
Wood Thrush	*Hylocichla mustelina*	cW	BFL			x
Clay-colored Robin	*Turdus grayi*	cP	BFL,SC		x	x
White-throated Robin	*Turdus assimilis*	cP	BFL			x
Gray Catbird	*Dumetella caronlinensis*	cW	BFL, PFL			x
Black Catbird	*Melanoptila glabirostris*	lP	MF			x
Tropical Mockingbird	*Mimus gilvus*	vP	SA		x	x
Blue-winged Warbler	*Vermivora pinus*	uW	BFL,SC			x
Tennessee Warbler	*Vermivora peregrina*	cT	BFL,SC			x
Orange-crowned Warbler	*Vermivora celata*	?W	BFL, SC			x
Northern Parula	*Parula americana*	oT	BFL,PFL			x
Yellow Warbler	*Dendroica petechia*	cW	SC	x		x
Chestnut-sided Warbler	*Dendroica pensylvanica*	cW	BFL,SC			x
Magnolia Warbler	*Dendroica magnolia*	cW	BFL,SC			x
Black-throated Green Warbler	*Dendroica virens*	fW	PFL,SC	x		x
Blackburnian Warbler	*Dendroica fusca*	uT	BFL			x
Yellow-throated Warbler	*Dendroica dominica*	fW	BFL,PFL			x
Grace's Warbler	*Dendroica graciae*	lP	PFL			x
Bay-breasted Warbler	*Dendroica castanea*	uT	BFL			x
Cerulean Warbler	*Dendroica cerulea*	uT	BFL			x
Black-and-white Warbler	*Mniotilta varia*	cW	BFL	x		x
Prothonotary Warbler	*Protonotaria citrea*	uT	BFL,LA			x
Worm-eating Warbler	*Helmitheros vermivorus*	uW	BFL			x
Swainson's Warbler	*Limnothlypis swainsonii*	rW	BFL			x
Ovenbird	*Seiurus aurocapillus*	fW	BFL			x
Northern Waterthrush	*Seiurus noveboracensis*	cW	LA	x	x	x
Louisiana Waterthrush	*Seiurus motacilla*	uW	LA			x
Kentucky Warbler	*Oporornis formosus*	cW	BFL			x
Common Yellowthroat	*Geothlypis trichas*	cW	SC			x
Gray-crowned Yellowthroat	*Geothlypis poliocephala*	lP	PFL,SA			x
Hooded Warbler	*Wilsonia citrina*	cW	BFL	x		x
Golden-crowned Warbler	*Basileuterus culicivorus*	cP	BFL			x
Yellow-breasted Chat	*Icteria virens*	uW	SC			x
Gray-throated Chat	*Granatellus sallaei*	uP	BFL			x
Gray-headed Tanager	*Eucometis penicillata*	fP	BFL			x
Black-throated Shrike-Tanager	*Lanio aurantius*	uP	BFL			x
Red-crowned Ant-Tanager	*Habia rubica*	cP	BFL			x
Red-throated Ant-Tanager	*Habia fuscicauda*	vP	BFL	x		x
Rose-throated Tanager	*Piranga roseogularis*	lP	BFL			x
Hepatic Tanager	*Piranga flava*	lP	PFL			x
Summer Tanager	*Piranga rubra*	cW	BFL			x
Scarlet Tanager	*Piranga olivacea*	fT	BFL			x
Crimson-collared Tanager	*Ramphocelus sanguinolentus*	fP	SC			x
Passerini's Tanager	*Ramphocelus passerinii*	fP	SC			x
Blue-gray Tanager	*Thraupis episcopus*	cP	BFL,PFL			x

Appendix Three: Birds of the Peccary Hills Area / 7						
Species		**Status**	**Habitats**	**2005**	**1996**	**Runaway Creek**
Yellow-winged Tanager	*Thraupis abbas*	cP	BFL			x
Scrub Euphonia	*Euphonia affinis*	fP	SC	x		x
Yellow-throated Euphonia	*Euphonia hirundinacea*	cP	BFL	x		x
Olive-backed Euphonia	*Euphonia gouldi*	cP	BFL			x
Red-legged Honeycreeper	*Cyanerpes cyaneus*	cP	BFL			x
Blue-black Grassquit	*Volatinia jacarina*	vP	SC	x		x
Variable Seedeater	*Sporophila americana*	cP	SC,SA			x
White-collared Seedeater	*Sporophila torqueola*	cP	SC	x		x
Thick-billed Seed-Finch	*Oryzoborus funereus*	fP	PFL,SC,SA			x
Blue Seedeater	*Amaurospiza concolor*	lP	SC			x
Yellow-faced Grassquit	*Tiaris olivacea*	lP	SC			x
Olive Sparrow	*Arremonops chloronotus*	cP	PFL, SA			x
Green-backed Sparrow	*Arremonops chloronotus*	cP	BFL,SC	x		x
Chipping Sparrow	*Spizella passerina*	fP	PFL			x
Savanna Sparrow	*Passerculus sandwichensis*	oW	SA			x
Grasshopper Sparrow	*Ammodramus savannarum*	cP	SA			x
Grayish Saltator	*Saltator coerulescens*	cP	SC			x
Buff-throated Saltator	*Saltator maximus*	fP	BFL			x
Black-headed Saltator	*Saltator atriceps*	cP	BFL	x		x
Black-faced Grosbeak	*Caryothraustes poliogaster*	cP	BFL			x
Northern Cardinal	*Cardinalis cardinalis*	fP	PFL, SC			x
Rose-breasted Grosbeak	*Pheuticus ludovicianus*	cT	BFL			x
Blue-black Grosbeak	*Cyanocompsa cyanoides*	cP	BFL			x
Blue Bunting	*Cyanocompsa parellina*	fP	fP			x
Blue Grosbeak	*Passerina caerulea*	cT	SC			x
Indigo Bunting	*Passerina cyanea*	cT	SC			x
Painted Bunting	*Passerina ciris*	oT	SC			x
Dickcissel	*Spiza americana*	uT	SC,WL			x
Eastern Meadowlark	*Sturnella magna*	cP	SA			x
Melodious Blackbird	*Dives dives*	vP	SC	x	x	x
Great-tailed Grackle	*Quiscalus mexicanus*	vP	WL			x
Giant Cowbird	*Molothrus oryzivorus*	uP	SC			x
Black-cowled Oriole	*Icterus prosthemelas*	cP	BFL, PFL,SA			x
Orchard Oriole	*Icterus spurious*	cW	SC, WL			x
Yellow-backed Oriole	*Icterus chrysater*	fP	PFL			x
Yellow-tailed Oriole	*Icterus mesomelas*	fP	LA			x
Baltimore Oriole	*Icterus glabula*	cW	BFL			x
Yellow-billed Cacique	*Amblycercus holosericeus*	cP	BFL,PFL	x		x
Montezuma Oropendola	*Psarocolius montezuma*	cP	BFL	x	x	x

Status

Legend

v = very common
c = common
f = fairly common
u = uncommon
o = occasional
l = local

P = permanent resident
S = seasonal resident
V = visitor
T = transient (migrant)
W = winter resident
X = one or two records only

Habitat Preferences

Legend (Adapted from Jones and Vallely, 2001)

BFL Lowland broadleaf forest
PFL Lowland pine forest
SC Scrub, low second growth
SA Savanna
WL Wetland habitats with emergent vegetation
LA Lagoons, ponds, rivers, streams
O Overhead/aerial

Appendix Four: Amphibians and Reptiles of the Peccary Hills Area					
Family	**Species**	**English Name**	**Red List**	**Observed**	**Reported**
Plethodontidae	*Bolitoglossa mexicana*	Mexican Mushroomtongue Salamander	LC		X
Rhinophrynidae	*Rhinophrynus dorsalis*	Burrowing Toad	LC		X
Leptodactylidae	*Leptodactylus melanonotus*	Sabinal Frog	LC	X	
Bufonidae	*Bufo marinus*	Cane Toad	LC	X	X
	Bufo valliceps	Gulf Coast Toad	LC	X	
Hylidae	*Agalychnis callidryas*	Red-eyed Treefrog	LC	X	X
	Hyla loquax	Mahogany Treefrog	LC	X	
	Hyla microcephala	Yellow Treefrog	LC	X	
	Hyla picta	Painted Treefrog	LC	X	
	Phrynohyas venulosa	Veined Treefrog	LC	X	X
	Scinax staufferi	Stauffer's Treefrog	LC	X	
	Smilisca baudinii	Common Mexican Treefrog	LC	X	X
	Triprion petasatus	Yucatecan Casque-head Treefrog	LC	X	
Microhylidae	*Hypopachus variolosus*	Sheep Frog	LC		X
Ranidae	*Rana berlandieri*	Rio Grande Leopard Frog	LC	X	X
Crocodylidae	*Crocodylus moreletii*	Morelet's Crocodile	LR	X	X
Dermatemydidae	*Dermatemys mawii*	Central American River Turtle	EN	X	X
Chelydridae	*Claudius angustatus*	Narrowbridge Musk Turtle	LR	X	X
	Staurotypus triporcatus	Mexican Giant Musk Turtle	LR		X
Kinosternidae	*Kinosternon acutum*	Tabasco Mud turtle	LR	X	
	Kinosternon scorpiodes	Scorpion Mud Turtle		X	
	Rhinoclemmys areolata	Furrowed Turtle			X
	Trachemys scripta	Slider	LR	X	X
Eublepharidae	*Coleonyx elegans*	Yucatan Banded Gecko		X	X
Gekkonidae	*Sphaerodactylus glaucus*	Dwarf Gecko			X
	Hemidactylus frenatus	House Gecko			X
Corytophanidae	*Basilicsus vittatus*	Brown Basilisk		X	X
	Corytophanes cristatus	Smoothhead Helmeted Basilisk			X
	Corytophanes hernandezii	Hernandez's Helmeted Basilisk		X	X
Iguanidae	*Ctenosaura similis*	Black Iguana		X	X
	Iguana iguana	Green Iguana		X	X

Appendix Four: Amphibians and Reptiles of the Peccary Hills Area					
Family	**Species**	**English Name**	**Red List**	**Observed**	**Reported**
Polychrotidae	*Anolis lemurinus*	Ghost Anole		X	X
	Anolis rodriguezii	Smooth Anole		X	
Scincidae	*Eumeces sumichrasti*	Sumichrast's Skink			X
	Mabuya unimarginata	Central American Mabuya			X
Teiidae	*Ameiva undulata*	Rainbow Ameiva		X	X
	Cnemidophorus angusticeps	Yucatan Whiptail		X	
Xantusiidae	*Lepidophyma flavimaculatum*	Yellow-spotted Night Lizard			X
Boidae	*Boa constrictor*	Boa Constrictor		X	X
Colubridae	*Coniophanes fissidens*	White-lipped Spotbelly Snake			X
	Coniophanes imperialis	Black-striped Snake			X
	Coniophanes schmidti	Schmidt's Black-striped Snake			X
	Dryadophis melanolomus	Lizard Eater		X	
	Drymarchon corais	Indigo Snake			X
	Drymobius margaritiferus	Speckled Racer			X
	Imantodes cenchoa	Blunthead Tree Snake			X
	Lampropeltis triangulum	Milk Snake			X
	Leptodeira frenata	Rain Forest Cat-eyed Snake			X
	Leptodeira septentrionalis	Northern Cat-eyed Snake			X
	Leptophis ahaetulla	Parrot Snake			X
	Leptophis mexicanus	Mexican Parrot Snake			X
	Ninia sebae	Redback Coffee Snake			X
	Oxybelis aeneus	Mexican Vine Snake			X
	Oxybelis fulgidus	Green Vine Snake			X
	Scaphiodontophis annulatus	Guatemalan Neckband Snake			X
	Spilotes pullatus	Tiger Tree Snake			X
Elapidae	*Micrurus diastema*	Variable Coral Snake		X	X
Viperidae	*Bothrops asper*	Fer-de-Lance			X
	Crotalus durissus	Neotropical Rattlesnake			X

Appendix Five: Fish of the Peccary Hills Area

Species		Freshwaer Creek	Fishing Ground	Washing Pond	Northern Lagoon	Sibun River	Ephemeral Pools	Meerman	Greenfield and Thomerson
Tarpon	*Megalops atlanticus*	GR				GR		X	
Threadfin shad	*Dorosoma petense*								X
Longfin gizzard Shad	*Dorosoma anale*								X
Key anchovy	*Anchoa cayorum*								X
Central tetra	*Astyanax aeneus*	X	X	X		X		X	X
Mayan tetra	*Hyphessobrycon compressus*	X	X			X			X
Guatemalan chulin	*Rhamdia guatemalensis*								X
Filespin chulin	*Rhamdia laticauda*	X						X	X
Redfin needlefish	*Strongylura notata*	X			X				X
Dogtooth rivulus	*Rivulus tenuis*							X	X
Mangrove rivulus	*Rivulus marmoratus*								X
Ocellated killifish	*Foridichthys polyommus*				X				X
Orange flagfish	*Jordanella pulchra*								X
Pike killifish	*Belonesox belizanus*	X				X	X	X	X
Sleek mosquitofish	*Gambusia luma*	X	X				X		X
Teardrop mosquitofish	*Gambusia sexradiata*	X							X
Southern Yucatan mosquitofish	*Gambusia yucatana*		X				X	X	X
Twospot livebearer	*Heterandria bimaculata*	X	X						X
Picotee livebearer	*Phallichthys fairweatheri*								X
Shortfin molly	*Poecilia mexicana*	X				X			X
Mangrove molly	*Poecilia orri*								X
Green swordtail	*Xiphophorus helleri*		X				X		X
Southern platyfish	*Xiphophorus maculatus*								X
Obscure swamp eel	*Ophisternon aenigmaticum*						X		X
Snook	*Centropomus sp.*								X
Jack sp.	*Caranx sp.*							X	
Snapper	*Lutjanus apodus*	X							X
Tripletail	*Lobotes surinamensis*								X
Striped mojarra	*Eugerres plumieri*	?							X
Brazilian mojarra	*Eugerres brasilianus*								X
Yellowfin mojarra	*Gerres cinereus*	X							X
Guapote, Mus Mus	*Cichlasoma friedrichsthali*		GR			GR			X
Northern checkmark cichlid	*Cichlasoma intermedium*							X	X
Firemouth cichlid	*Cichlasoma meeki*	X	X			x	X	X	X
Jack Dempsey	*Cichlasoma octofasciatum*								X
False firemouth cichlid	*Cichlasoma robertsoni*	X							X
Yellowbelly cichlid	*Cichlasoma salvini*	X	X			x			X
Blue-eye cichlid	*Cichlasoma spilurum*		X					X	X
Redhead cichlid	*Cichlasoma synspilum*	X	GR			x		X	X
Maya cichlid	*Cichlasoma uropthalmus*	x	GR						X
Bay snook	*Petenia splendida*	GR	GR			GR		X	X
Tilapia		GR							
Mountain mullet	*Agonostomus monticola*							X	X

Appendix Five: Fish of the Peccary Hills Area / 2									
Species	**Freshwaer Creek**	**Fishing Ground**	**Washing Pond**	**Northern Lagoon**	**Sibun River**	**Ephemeral Pools**	**Meerman**	**Greenfield and Thomerson**	
Large-scaled Spiny cheeked sleeper	*Eleotris amblyopsis*								x
Bigmouth sleeper	*Gobiomorus dormitor*								x
Slashcheek goby	*Ctenogobius pseudofasciata*								x
River goby	*Awaous banana*								x
Yucatan goby	*Gobiosoma yucatanum*								x
Southern hogchoker	*Trinectes paulistanus*								x
Checkered Puffer	*Sphoeroides testudines*				x				x
Southern stingray	*Dasyatis americana*				x				x

Appendix Six: Data sources for BERDS Maps

Meerman, J. C. and J. Clabaugh (*ed.*) 2005. Biodiversity and Environmental Resource Data System of Belize. Internet address: http://www.biodiversity.bz

Spatial Metadata

The metadata information for the various spatial (GIS) data layers (used in the BERDS Map Explorer application)

Spatial Layer: **DISTRICTS**

Source: Land Information Centre Spatial Layer
[Made public through Paseo Pantera Consortium
Univ. of Florida/USAID *Digital Geographic Database: Maya Forest Region: Mexico, Guatemala, Belize. Version 1, August 19110.*] Note: further modified by Jan Meerman
Projection: UTM Zone 16
Datum: NAD 27 Central
Spheroid: Clarke 1866
EPSG Code: 26716

Spatial Layer: **ECOSYSTEMS (incl. Agricultural Encroachment, Agricultural Use, Forest Types, Land Use, Mangroves, Marine Habitats and Wetlands Layers)**

Source: Meerman, J. C. and W. Sabido. 2001. Central America Ecosystems Map: Belize.
CCAD/World Bank/Programme for Belize. Version 040428. Major Revision by J.Meerman and posted 12 Feb 2005
Projection: UTM Zone 16
Datum: NAD 27 Central
Spheroid: Clarke 1866
EPSG Code: 26716

Spatial Layer: **ELEVATION**

Source: 1980 DOS 1:50,000 Topographic Maps
Projection: UTM Zone 16
Datum: NAD 27 Central
Spheroid: Clarke 1866
EPSG Code: 26716

Spatial Layer: **GEOLOGY**

Source: Cornec, J. 1986. Notes on the provisional geologic map of Belize, scale 1:250,000. UNDP/BZE/83/001. Petroleum Office, Ministry of Natural Resources, Belize. 22pp and fig. (unpub).
Projection: UTM Zone 16
Datum: NAD 27 Central
Spheroid: Clarke 1866
EPSG Code: 26716

Spatial Layer: **PROTECTED AREAS - updated 12 Apr 2005**

Source: GOB Gazettes
Note: Generated by Jan Meerman
Projection: UTM Zone 16
Datum: NAD 27 Central
Spheroid: Clarke 1866
EPSG Code: 26716

Spatial Layer: **RAINFALL**
Source: Walker, S. H. 1973. Summary of climatic records for Belize. Land Res. Div. Surbiton, Surrey, England, Suppl. No. 3 Note: further modified by Jan Meerman
Projection: UTM Zone 16
Datum: NAD 27 Central
Spheroid: Clarke 1866
EPSG Code: 26716

Spatial Layer: **RIVERS & STREAMS - Updated 14.10.2005**
(including riverine types, water sources, clarity and salinity layers)
Source: Land Information Centre Spatial Layer
[Made public through Paseo Pantera Consortium, Univ. of Florida/USAID *Digital Geographic Database: Maya Forest Region: Mexico, Guatemala, Belize. Version 1, August 19110.*]
Note: further modified by Jan Meerman & Peter Esselman
Projection: UTM Zone 16
Datum: NAD 27 Central
Spheroid: Clarke 1866
EPSG Code: 26716

Spatial Layer: **ROADS & TRACKS - updated 30 Jun 2004**
Source: Spatial Presentation of Belizes Road system describing paved, unpaved roads and the most important tracks and trails. Note: Generated by Jan Meerman
Updated 30 Jun 2004
Projection: UTM Zone 16
Datum: NAD 27 Central
Spheroid: Clarke 1866
EPSG Code: 26716

Spatial Layer: **SETTLEMENTS - updated 21 Jun 2004**
Source: Int'l Travel Map of Belize (1:350,000), 2000 GOB Census, 2001 CSO Abstract of Statistics
Note: Generated by Jan Meerman and Jerod Clabaugh
Updated: 20 Jun 2004
Projection: UTM Zone 16
Datum: NAD 27 Central
Spheroid: Clarke 1866
EPSG Code: 26716

Spatial Layer: **SOILS**
Source: Based on Wright, A. C, et al, 11109. Land in British Honduras. Colonial Res. Publ. No. 24. Note: Generated by PRONATURA for the TNC-led Selva Maya Project (draft form) Further modified to include information from *Baillie, et al. 1993. Revised Classification of the Soils of Belize. NRI Bulletin No. 59.*
Projection: UTM Zone 16
Datum: NAD 27 Central
Spheroid: Clarke 1866
EPSG Code: 26716

Spatial Layer: **WATERSHEDS**
Source: based on *NARMAP 19110. Environmental water quality monitoring report. Final Report and Annexes. Department of the Environment, Belize.* Note: further modifications using altitude, stream and ecological data by Jan Meerman and Jerod Clabaugh
Projection: UTM Zone 16
Datum: NAD 27 Central
Spheroid: Clarke 1866
EPSG Code: 26716