Some Aspects of the Natural Environment of the
Bladen Nature Reserve
by
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1. Geological History of the Landscape:

There is little doubt that the Bladen Nature Reserve includes not only some of the oldest rock formations of Belize, but some of these came from volcanic rock which, starting as a product of a submarine volcano at the bottom of the Paleozoic Ocean, gradually built up a mountain of lava and ash which emerged above the sea to form the first emergent land mass at the future site of today's country of Belize.

The landscape of Belize first appeared above the sea along a volcanic fissure that extended from near Richardson Peak westward to near Little Quartz Ridge. This was about 345 million years ago, by which time life on Planet Earth had evolved to the stage where marine environments had primitive forms of shellfish and bony fishes; and some localities of wetland marginal to the sea had dense, low forests of tree ferns and other primitive plants reproducing by spores, inhabited by early forms of amphibia. Some of these might qualify as the first Belizeans, but the fossil record does not indicate any great abundance of early Belizean life.

Some of the more common fossils from that time were members of the crinoid family which are still alive and well today on the steeply-sloping inshore waters of western New Zealand and Chile. Crinoids have the popular name of "sea lilies" but they are not plants, but rather a colony of animal cells protected by a stalk formed from calcium carbonate protruding from which are unprotected, waving, feeding tentacles.
Fossil crinoids are only found in Belize in rocks of the Maya Mountains but so far have not been recorded from the Bladen River Nature Reserve -- although they are almost certain to turn up when the Paleozoic sedimentary rocks are more fully studied.

Sedimentary rocks of Paleozoic Age (between 400 and 230 million years ago) are mixed with the volcanic rocks of the Bladen River Nature Reserve because, when the volcanic fissures developed, the molten lava had to explode its way through accumulated layers of silt and sand resting on the floor of the Paleozoic ocean, mixing this material amongst the volcanic rock materials. Landscapes formed from volcanic rock uncontaminated by sediment could only build up when the crests of the volcanoes were above sea level, but the geological evidence suggests that, from time to time during the approximately 100 million years of volcanic activity, the relative level of the sea and land oscillated many times. This mixture of Paleozoic volcanic and sedimentary rock materials forms most of the highland of the Bladen River Nature Reserve. If you want to find relatively pure Paleozoic sediments (dark-colored siltstone, mudstone or sandstone) uncontaminated by volcanic materials, try looking in places where the Bladen River is not running over a limestone base. That is where some fossils might be found.

Granite is another kind of rock commonly found in the Maya Mountains, but so far areas of granite rock have not been identified in the Bladen, although they do occur in the Swasey River watershed adjoining the reserve and areas of granitic rock may yet be discovered in the Bladen River Nature Reserve.

The really curious event in the geological history of the Maya Mountains is that during the Late Paleozoic geological time (perhaps about 350 million years ago), most of the continental land masses of Planet Earth, on their various mobile tectonic plates, seem to have drifted towards each other to form one supercontinent which geologists have christened, “Pangea.” First they formed themselves into a northern mass of emergent land (known as the “Old Red Sandstone” continental mass) and this drifted toward a southern mass known as “Gondwanaland.” These two huge continents collided together and the future territory of Belize was very close to the point of impact. In other words, the Bladen River Nature Reserve came to occupy a central position in the super continent of Pangea. The geological period of the remarkable event was perhaps Early Triassic.
time, some 230 million years ago, and Belize was then near the center of all the continental land in the world.

Pangea began to split up again after only a few million years, and a rift developed allowing a seaway to form connecting the ocean of the east to the ocean of the west. This seaway, known to geologists as the “Tethys Sea,” separated Pangea into a northern continental mass, and the new rift passed somewhere near the present Gulf of Mexico. Belize was probably near the southern tip of the Northern Continent, perhaps on the northern shores of the Tethys Seaway or perhaps dragged away by the rifting process and left as a small island with its own tectonic plate. Geologists are still arguing about this, but whatever their final conclusions, it is pretty certain that the Bladen River Nature Reserve had a ringside seat in the Tectonic Circus. No marine sedimentary rocks were being laid down over the ancient Paleozoic rocks of Belize during the 100 million years of the Great Tectonic Circus, and this means that the Belizean landscape must have been above sea-level for all of this time, and probably thus subject to a long interval of erosion by rain and wind. Much of the basic topography of the Bladen River Nature Reserve may have been established by erosion in Triassic, Jurassic, and Early Cretaceous geological time.

A major change in the geological history of Belize occurred about 100 million years ago. By this time many of the emerged continental parts of Planet Earth (including Belize) again passed below a rising sea-level, and all the older surface rocks became buried by new marine sediment. The difference was that these new sediments were predominately carbonates of calcium and magnesium whereas the ancient Paleozoic rocks were predominately rich in silica but mainly very poor in calcium and magnesium. Nobody seems to have offered an explanation for this, but it completely changed the nature of the rocks, soils, plant cover, and wildlife patterns during the past 100 million years right up to the present. The Belizean environment changed completely from a base-poor siliceous environment to one of abundant plant nutrients and excess of calcium carbonate. From Cretaceous geological time to the present day, we have been evolving in a new type of environment, as is well shown in the limestone dominated landscape of the Maya Mountain foothills and related lowland sectors of the Bladen River Nature
Reserve. The change of environment of Planet Earth, causing most marine sedimentation to henceforth be largely calcareous in nature, needs explanation. Something new had been added -- what was it?

My suspicion is that the change was in some way related to the cumulative effect of a growing increase in soil formation throughout the continental part of the world, the expanding and deepening of the soil mantle with increase in calcium, magnesium, and other elements released by cumulative weathering of rock minerals, and the transport of increasing amounts of these elements by rainfall leaching these elements and transporting them to enrich the marine environment. This could have contributed to an upsurge in the growth of minute plankton (nano-plankton) in the upper layers of seawater which contained an abundance of calcium and other elements enabling each single-celled micro-organism to create a protective coat of calcium carbonate. And, when an individual died, it drifted down to the sea-bed to form a calcareous ooze or mud which, in due course, produced limestone or other kinds of calcareous rock. The extra input of carbon dioxide required in the production of calcium carbonate world-wide might be related to the current evolution of seed-bearing plants (angiosperms) that were everywhere in the new environment spreading over landscapes that were not easily colonized by the more primitive plants of ancient times, and thus extending and accelerating soil formation, producing a deeper mantle of soil and increasing the rate of weathering of rock minerals. This is, of course, pure speculation, but certainly something happened to flood the world with limestone rock, and the geological timing is about right for a sudden upsurge in soil formation world-wide.

How did this affect the Bladen River Nature Reserve? In Early Cretaceous geological time, the Maya Mountains were certainly below sea-level again, perhaps completely covered or perhaps only partially covered -- geologists are of two minds about whether limestone rock originally covered all the Paleozoic rocks or whether some of the highest locations escaped flooding by the Cretaceous ocean. The main problem is that limestone decays relatively rapidly by a process of solution, and since many limestone rocks contain only 2% - 10% of non-soluble mineral impurities, a thin layer of limestone can disappear almost without trace, so that the only way to get evidence of its former
existence might be from careful examination of exiting surface soils to look for any residual, minute fossils of siliceous organisms which are usually indicative of marine environments. This has yet to be done with samples of soil from the highest parts of the Maya Mountains, and such an investigation would probably be worthwhile in summit locations of the Bladen River Nature Reserve.

The fact that limestone rock decays mainly through solution is well-illustrated by the pitted landscape on either side of the Bladen River. The process begins by rainfall penetrating small cracks and fissures (or even root channels) in limestone rock, enlarging the point of entry and forming subterranean tunnels and caves by continuing solution, until the landscape becomes a mass of small peaks of less-dissolved rock in a labyrinth of solution pits, underground tunnels and stream channels. Such landscapes are referred to as “karst” or karstic.” There are several spectacular, deep “pot-holes” in the Bladen karst -- some over 100 feet deep and 20 to 50 feet in diameter with almost vertical walls. Many of the affluent streams and even the Bladen River itself, run underground for some distance. Karst landscapes, because of the diverse variety of micro-environments are always good places to look for rare plants, and even animals, that have survived intervals of environmental change -- whether climatic or man-induced.

II. Soils.

The soil pattern of the Bladen River Nature Reserve has only been studied superficially. The karst landscape soils are the most accessible and, hence, the best known. They are mainly shallow, rocky or bouldery, dark-colored clays and loams of the Xpichla and Cuxu soil sub-suites belonging to the Chacalte soil suite. Deeper, related soils occur in the side valleys and as alluvium in the main river valley. The clay fraction is mainly montmorillonite and most of the soils are slightly alkaline to weakly acid in reaction, well-supplied with available plant nutrients, and usually present no drainage problems since they are of good structure and under their natural forest cover have adequate aeration throughout the soil profile. They are too shallow to hold adequate soil moisture for most agricultural crops and too stony or rocky for agricultural machinery.
Many agricultural tree crops suffer chlorosis of foliage in mature plants due to excessive calcium content which produces an imbalance in nutrition. In fact, the potential for large-scale agricultural development of these soils is minimal.

The soils derived from the complex of volcanic and sedimentary Paleozoic rocks belong to the Richardson soil suite. Within this suite, the majority of soils belong to the Ramos sub-suite, which are the soils of the steep and often rugged mountainous landscape of the higher elevations of the Bladen River Nature Reserve. The volcanic rock is very deeply weathered and only a few overcrops or boulders of unweathered rock can be found in some stream beds. Mineral exploration using deep bore holes confirm that weathered rock is usually 150-200 feet below the surface soil. These steep and hilly landscape soils are extremely acid in reaction, with very few available plant nutrients and have exchangeable aluminia levels that may have almost toxic effects on many plant species. Many of the canopy trees of the natural forest begin life as epiphytes and most forest trees have a great development of large roots ranging across the surface soils. Few trees have root anchorage at depth. There is considerable evidence of mass erosion of forest throughout the steeper slopes. It would seem that the forest grows somewhat superficially, reaching quite a large size but vulnerable to a weight limit. When a patch of forest grows to the point where its combined weight exceeds the root anchorage capacity, the whole patch peels away, forming an avalanche of trees, roots, and soil which slides rapidly down into a creek bed to form a tangled mass which temporarily impedes movement of water down the creek bed. The scar in the canopy left by a debris avalanche is usually covered quickly by small palms, ferns, and mossy vegetation and slowly regenerates forest trees.

The soils of the highest part of the Bladen River Nature Reserve have been studied only in the vicinity of a location called “Doyle’s Delight,” whose elevation is over 1100 meters. These soils are placed in the Doyle sub-suite of the Richardson soil suite. This is probably the most exciting part of the Reserve since some of the soils of the broader ridges and ancient plateaux remnants are sufficiently stable to reflect a very long history of uninterrupted soil development — perhaps among the oldest soils to be found anywhere in Central America. The vegetation resembles a “cloud forest” with
very prolific mosses, ferns, and orchids thickly festooning the forest trees of which the tallest is a genus of palm whose only near relative occurs in Cuba. This palm seems to be almost the only forest tree with roots penetrating deeply into the soil mantle and weathering volcanic rock below the soil. Most other forest trees have only superficial root systems, and many begin life germinating in a thick superficial layer of living and dead roots or as epiphytes on palm trunks, oaks or other large trees. This is not surprising considering that the Doyle soils have a pH reaction of 2.7 to 3.1, are almost devoid of plant nutrients of all kinds, and also have a high content of active alumina. Samples of this most unusual soil have been used for growth trials for some species of this unusual forest and also for other plants. As might be expected from the soil analyses, very few plants can grow directly on this. Yet these soils can develop a forest cover in nature — a discovery that is somewhat interesting.

III. Plant Cover:

Botanists are still at work recording the plant species in the Bladen River Nature Reserve. Clearly there will be some differences between the forest species found in abundance on the karstic limestone locations and those that are more common on the volcanic soils — and it may show that certain species are almost restricted to one or another of the two types of landscape. It is no easy matter to define the differences between various categories of subtropical/tropical broadleaf forest. Some forest species appear to be influenced by specific soil conditions and some by soil moisture, by rainfall, by soil or air temperature, and all are dependent on ability of seed to be available to take advantage of a chance opportunity to germinate in an opening of this canopy and compete successfully with other chance arrivals. If such a chance presents itself, then local climate or local soil conditions may eventually determine a particular type of forest. A realistic basis for classification of the broadleaf forests of Belize is still some way off; the Bladen River Nature Reserve is likely to be of great value to botanists attempting a realistic basis for classification of Belizean broadleaf forests. So Far, we have only indications that climatic factors do have a broad influence on forest composition and that probably there are specific trees indicative of local soil conditions. However, the unusual
vegetation associated with the Doyle's sub-suite of soils (mentioned earlier) does indicate that climatic conditions may be of much more importance than soil conditions. On Doyle soils we seem to have a soil completely unsuited to most broadleaf forest species but able to maintain a permanent forest cover through input of nutrients derived from moisture condensed from the ever-constant trade winds, bringing valuable nutrients from the Atlantic Ocean. All that we know at the moment is that some forest species are more abundant on (but not always restricted to) calcareous soils. Some are more common on the steep volcanic soils (but not necessarily restricted to these soils), and exterior supply of nutrients from condensed moisture may allow some species to survive on soils that are toxic to other species.

These are all very interesting botanical problems that emphasize the value of the Bladen River Nature Reserve for ecological research.

IV. The Influence of the Ancient Maya on the Natural Vegetation:

For a long time, it has been assumed that the ancient Maya had little interest in the Bladen River area other than as a source of forest products of value to their civilization. Archeologists are now finding that this was an erroneous assumption.

During recent decades, when the area was thoroughly explored by chicle and mahogany extractors, it has been known that some relatively small permanent occupation by the ancient Maya had once existed in the region (and, as usual, some clandestine export of Mayan relics has occurred), but it was assumed that the ancient Maya found little to interest them in the Bladen River Nature Reserve area. Recent explorations by archeologists tend to indicate that there was much more ancient Maya activity in the valley and in the surrounding hill soils than formerly realized. The present composition of the forest does indicate that some of the land was probably used for the traditional production of subsistence crops, and that this took place throughout much of the Reserve where limestone soils were available. Since no major Mayan population center has yet been located, it has to be assumed that it was perhaps never a major location of ancient Maya activity, but since the environment contains so many forest products of value for the ancient Maya, further exploration may change these provisional conclusions.
It is worth noting that some species of plants that occur in the Bladen River Nature Reserve are found nowhere else in Central America but are recorded from Cuba, some other West Indian islands, plus a few species from British Guiana. Some may be accidental (or deliberate) introduction by the ancient Maya who were -- as is often forgotten -- a sea-faring race. But other species may indicate that, at some time in the past, there may have been a land connection with Cuba and/or Santo Domingo and Jamaica, as well as Guyana and Venezuela, long before the Central American isthmus became a two-way channel for species from other parts of North and South Americas. For example, Brosimum alicastrum (breadnut) was a species of great food value to the ancient Maya, and it is thought to have arrived from the West Indies, perhaps with the help of the Maya. On the other hand, the Cuban palm genus, Cepothrinax is a major species in our highest forested land in the Maya Mountains, and its seeds are so large that arrival by air would have been most unlikely. Moreover, every expedition to Doyle’s Delight has produced plant species that are quite new and almost certainly endemic or have close relatives only in Jamaica or some other Caribbean island. Once again, the Bladen River Nature Reserve seems to be a central factor in ecological and environmental problems. Obviously, it is a place worthy of full protection and for carefully organized biological research.