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Climate change of the past

It’s easy to imagine that the world always looked as it does now. Major changes are generally not apparent over the short span of a human lifetime, yet the study of earth history shows that they were relatively common. There is, for instance, evidence that, well over 500 million years ago, most of the surface of the earth was frozen over.

Since that time, at least, the earth has experienced multiple episodes of large-scale glaciation – with low temperatures and low sea level – alternating with “greenhouse” episodes characterized by high temperatures and high sea level.

The most recent sustained greenhouse phase is the Eocene (“dawn of the recent”) Epoch. It commenced around 56 million years ago with a global spike in temperature, about 4-5 ºC in less than 20,000 years. This so-called hyperthermal was short-lived (about 170,000 years) but it had long-lasting influence on the land faunas across the northern hemisphere by virtue of intercontinental dispersal – the ancient equivalent of invasive species. Temperature remained warm through much of the Eocene, but it dropped precipitously at the end of the epoch, by 4–5 ºC over about 200,000 years. It was at this time that the Antarctic ice sheet rapidly expanded and sea level dropped. The earth’s climate became suddenly more familiar, from our perspective.

Figure 1: This map shows the currently active paleontological sites in North America from which the author is studying lower vertebrates.
It is a major goal of paleontology – the study of fossils, or remains of prehistoric life – to elucidate how different groups of animals and plants responded to this climate change. Fossils clearly show that climate change had a major influence on terrestrial faunas. In the Eocene, warmth-loving crocodiles lived on what is now Ellesmere Island in Canada, 1000 km north of the Arctic Circle!

My own work has focused on so-called “lower vertebrates” (like reptiles and amphibians) in North America. Unlike mammals and birds, these animals are highly dependent on environmental warmth and so are sensitive to warming and cooling. Figure 1 on the previous page indicates sites where I am currently active.

My colleagues and I have found abundant evidence that the reptile fauna of the middle latitudes had a decidedly tropical aspect in the Eocene (Figure 2). For instance, Monkey Lizards (genus *Polychrus*) are a small group almost strictly confined to tropical South America today. Yet bone fragments and in some cases complete skulls of primitive relatives of *Polychrus* have been found as far north as North Dakota in the USA.

The same is true of the basilisks (Corytophaninae), which are presently native to Central America and feral in places like Florida and Cayman. Night lizards (Xantusiidae) are common elements of Eocene assemblages in the

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**Figure 2:**

A tree depicting the relationships between various extinct Eocene species (prefixed with †) from the middle latitudes of North America and extant species.
USA, but we only recently recognized that the Tropical Night Lizards (genus *Lepidophyma*) were also present in mid-latitude North America. Tropical snake groups, such as dwarf boas (Ungaliophiinae) and the Mexican Burrowing Python (*Loxocemus*) are also now well documented there.

To readers in the Caribbean some of the most familiar lizards must be the anoles (*Anolis*), which are virtually ubiquitous, scampering about on trees, bushes and rocks. Today there is a huge diversity of anole species, over 400 by last count. Yet their history too reaches back into the middle latitudes of North America during the Eocene, where the earliest representatives are known (Figure 2). Each of these discoveries relies on careful comparison of the bones of living species with the often fragmentary remains found as fossils.

It is an extremely challenging jigsaw puzzle, or rather several simultaneous puzzles. In any given site, the pieces pertain to many different puzzle images (species), which are unknown prior to study; many puzzle pieces are missing; and most pieces are fragmentary, so they don’t fit (Figure 3). Yet the study of these miserable remains is indispensable for understanding how reptile life responded to climate change!

**Studying fossil reptiles**

While genetics has overtaken the study of scales in herpetology, osteological collections (bones) remain indispensable for the study of fossils. For the most part, only the bones of extinct species are preserved, so they are the sole link we have to their living relatives.

![Figure 3: A confoundingly difficult puzzle: fossil lizard species are normally preserved as isolated bones, mixed together with other species. Their skeleton, as here with the basilisk *Oreithyia oaklandi*, must be painstakingly reconstructed.](image)
Although the skeleton has a long history of study in herpetology, museum collections of extant snake and lizard skeletons – over 10,000 living species are now known – are very poor compared to skeletons of birds and, especially, mammals.

With the generous support of the Department of Environment, I have been collecting selected non-endangered species of lower vertebrates from the Cayman Islands. After skeletonizing the specimens, these enter the collections of the Senckenberg Research Institute in Frankfurt am Main, Germany, where I use them to help understand the appearance and evolution of fossil species from North America, such as anole relatives.

Nowhere is environmental change of greater interest than on tropical islands like the Caymans, which are particularly susceptible to changes in sea level. Because of detailed studies of fossils, we know that species distributions shifted dramatically in response to climate change and geological events in the past. Understanding this history is crucial for understanding modern patterns of biodiversity and may provide clues to our future.

Continued collaboration with the Department of Environment will further these studies and results will be made available in Flicker.

Image 1, 2 and 3: Three examples of the species sampled by the author; Cayman blue-throated anole (*Anolis conspersus*), Cuban tree frog (*Osteopilus septentrionalis*) and Curly tailed lizard (*Leiocephalus carinatus*). Photo credits: Thijs van den Burg & Kristan Godbeer.
Dendropemon caymanensis’ rediscovery!

As readers may remember, *Flicker* issue #15 (Aug–Sep 2014) describes TRU’s first large mission to find the mysterious and endemic Mistletoe species, *Dendropemon caymanensis* on Little Cayman.

The TRU was, in 2014, collaborating on a project with longtime partner Royal Botanic Gardens Kew (RGB Kew), UK, to re-discover the endemic mistletoe. Very little is known about this parasitic plant but records from botanist George Proctor, author of the “*Flora of the Cayman Islands*”, indicate that it was located within the North Eastern interior of Little Cayman.

It is recorded to be a parasite of the headache bush (*Capparis cynophallophora*), the black candlewood (*Erithalis fruticosa*) and “other hosts”. Since 1991, no one had reported seeing this plant and there was no in-situ photographic record – just a single herbarium collection existed as proof of *Dendropemon*’s existence (see below).

Upon completion of the DoE project back in 2014, the Terrestrial Research Unit had managed to determine areas in which the endemic *D. caymanensis* was likely to be found. Being able to see individual trees from drone imagery was a very exciting prospect which enabled

efficient and timely mapping of ecosystems, plant clusters and community structures. The project was, however, not successful in its main objective: to re-discover the mistletoe!

This was all about to change when Environmental Programmes Manager of the National Trust, Stuart Mailer, went to Little Cayman on an altogether different mission. Here is his encounter:

“In January of this year, I was invited to inspect a network of trails that have recently been developed by a landowner on a large forested property on Little Cayman. As well as seeing the trails themselves, I was very interested in the opportunity to explore this remote forest, as several rare plants have been recorded from this area, including the first and last known collections of Dendropemon, the Little Cayman Mistletoe.

The inspection team consisted of Christine Rose-Smyth, (former Conservation Council Chair), Carla Reid, (former National Trust Chair), and myself, guided by Nick Hamilton who was involved in construction of the trails. As we wandered along the shady forest trails we were impressed by the care that had been taken in creating them with minimal environmental impact, and without disturbing the forest canopy. Many of the trees were amazing, such as towering Ironwoods, ancient Bitterplum trees, and the biggest examples of Wild Cherry I have ever encountered.

As the path ascended onto higher ground, the forest thinned into shrubland, and we encountered several moderate sized examples of Headache Bush, Caparis cynophallophora, reported by Proctor to be the primary host of the elusive Dendropemon.

*Dendropemon caymanensis* is here seen in the first photographic evidence of its existence. Courtesy of Stuart Mailer.
We scrutinized each one for the mistletoe as we passed. Nick suggested that we make a short detour to visit an owl roost in a cave. The cave turned out to be a small opening in the side of a deep sink hole, with water in the bottom, and disappointingly, the owl was not in residence.

Next to the sinkhole was a large Headache Bush, but an initial check for *Dendropemon* revealed nothing. Before we continued our hike, I decided to give it a more careful examination. This was not an easy task, as the tree was quite tall and dense, and the branches were tangled together with branches of other nearby trees. I eventually spotted something that could be a mistletoe just visible growing among the upper branches, but expected that it would turn out to be the common Scorn-the-Ground species hanging down from an adjacent Cabbage Tree. It took several more minutes and numerous zoomed in photographs before I, and the rest of the party were reasonably convinced that we had something more interesting. At this point we started searching the rest of the tree from different vantage points, and soon found several more mistletoes, including some small plants growing much closer to the ground, which I was able to photograph close up.

We were all quite excited by our find, but wanted to be cautious and not jump to premature conclusions, so after we completed our hike, Christine compared my photographs with Proctor’s description of the various mistletoe species recorded in Cayman. Based on the shape of the leaves and the berries she concluded that it was very likely that we had indeed rediscovered the elusive *Dendropemon*!

On our return to Grand Cayman I contacted the DOE to inform the TRU of our discovery. I sent my photographs, which were shared with several international parties who have been involved in the search to rediscover this plant. These included *Dendropemon* expert, Marcos Caraballo from the *Smithsonian Institute*, who confirmed our identification of the genus, with formal identity to species level to follow collection and examination of voucher specimens”.

Following on from Stuart’s amazing rediscovery, TRU accompanied by Marcos conducted an initial search which identified another 7 locations where *Dendropemon* occurs.

Ahead now lies a thorough systematic survey of this intriguing plant species which have caused serious head- (and heart) ache over the years! Such survey will allow its future protection and understanding as we get to know one of the rarest plant species on Earth.
Rare bird sightings in Cayman
-by Peter Davey

The Cayman Islands are well situated for migrating birds. During the Fall, many move south through Florida. Some fly onwards to South America, while others overwinter in the islands of the Caribbean, including the Caymans. In contrast, the Spring, or return migration finds most birds moving north through Central America, so Cayman sees fewer interesting birds at this time of year. Just over 240 species of birds have been recorded here, of which 50 are resident. Some are regular migrants, others are blown in after storms.

Some of the most challenging birds to identify are the American warblers. Thirty-five species have been recorded in Cayman, if you include our own Yellow Warbler (Golden) and the endemic Vitelline. Within each species, the plumages of the male, female and first-year birds differ. They also vary as the year progresses, passing in and out of breeding and non-breeding phases. In addition, feathers can appear as fresh or worn. This is why warblers are considered ‘difficult’. Separating the species, often within the second or two they give you, is the challenge which attracts many birders.

This Spring, at the very end of March, Denny Swaby and Peter Davey were lucky to find three rarities within two days, as these birds passed through to their breeding grounds in North America. Denny is an active birder, who has developed considerable skills with his camera. Achieving good results with these tiny, active birds, is always a

Denny Swaby’s rare photo of a Wilson’s Warbler (*Cardellina pusilla*) seen in the Queen Elizabeth II Botanic Park.
challenge, as they constantly flick and jump while gleaning the foliage in their efforts to regain some of their energy reserves.

On the previous page is Denny’s photo of a Wilson’s Warbler, the true champion of incessant movement! This bird is so rarely encountered here, years might pass between sightings. It breeds as far north as northern Alaska and overwinters in Central America, so this bird could well have flown 10,000 miles over the course of the previous year. The male has a papal black cap, whereas the female is all-yellow, and can easily be confused with our endemic Yellow Warblers and Vitelline Warblers. This bird moved so fast while gleaning, that Denny was forced to return the next day to try for better images, rejecting hundreds of exposures in the process. Even when the camera is set on multi-burst, the position of the bird can change from frame to frame. It’s common to find images within one burst, which show just an empty space where the warbler was when you pressed the shutter. You could say that to get a perfect photo of a Wilson’s Warbler, even with Denny’s experience, takes a thousand shots!

The next photo is of a Prothonotary Warbler. These birds breed in eastern North America. From their overwintering grounds in the Yucatan Peninsula and northern South America, they migrate north across the Gulf in the Spring, and if we are lucky, a few stop-over in the Cayman Islands. Three (which is an unusually large number) were reported this year, one of them from the Brac. When they work through the leaves to find insects, their bill closes with an audible snap, louder and more frequent than any other warbler I have encountered. In these circumstances, a blind birder would detect this warbler if it were close-by.

Another rare photo by Denny Swaby showing the Prothonotary Warbler (Protonotaria citrea) spotted by Governor Gore’s Bird Sanctuary.
Another, much smaller group of birds, the Vireos, are encountered in Cayman during migration. Three species of Vireo breed in the Cayman Islands, the Thick-billed, the Yucatan, and the Black-whiskered. This latter species, however, only breeds in the Sister Islands. When we find them in Grand Cayman, it’s typically because they are on migration. Five other American Vireos have been recorded here, the rarest being the Blue-headed and the Philadelphia Vireo. Denny and I found this Philadelphia Vireo feeding in a Red Birch tree near Governor Gore’s Bird Sanctuary.

During eBird’s Global Big Day, on the 5th May, I found a rare male Blackpoll Warbler near the Botanic Park. I’ve included it, because it’s a record holder when it comes to non-stop flights during migration. A few years ago, scientists attached half-gram tracking devices to these warblers, birds which weigh less than the 12 grams of an empty soda can. When the scientists retrieved three dozen of these tiny devices after the migration, they were astonished by the stories they told. The Blackpolls breed in the taiga forests of northern Canada and Alaska, and then fly southeast to the east coast of America. These tracked birds then flew over the Atlantic until they reached land in the Caribbean. One bird was recorded as flying non-stop for 88 hours, over a distance of 1,800 miles. Blackpolls continue on to northern South America, though some have been found as far south as southern Brazil. This means that some Blackpolls must fly 18,000 miles a year on migration, equivalent to three quarters of the way around the Earth. So when you look at his handsome, but diminutive bird, it’s hard not to be astounded by its athletic ability.

A final and charming migratory story from this year, concerns a female Summer Tanager (see front page) that I discovered roosting in the ‘V’ formed by the fronds of an Arica Palm, growing next to our deck in Savannah. I found it the evening of December 31\textsuperscript{st} 2017. Every night I would check for its return. Apart from the half-a-dozen times it ‘slept out’, it roosted there every night, always calling to announce its arrival. It left us on the 2\textsuperscript{nd} of April 2018, a period of three months. I wonder if it will return next year. I expect that it will.
The Broadleaf (*Cordia sebestena var. caymanensis*) is a unique Caymanian variety of an otherwise widespread plant which is found throughout the West Indies. The Caymanian variety is found on all three Cayman Islands and grows well in coastal areas as well as in dry, rocky inland woodlands.

Recognised by its broad leaves, orange-red flowers and white fruits, this tree usually grows tall and thin with a somewhat sparse crown. The bark on the trunk becomes thick and corky with age and will show deep horizontal cracks over time. As the leaves resemble sandpaper they were traditionally used for polishing turtle shells, however, they can apparently also be boiled to make a tea with cooling effects. The leaves can even act as drinking glasses also.

The Cayman variety of this tree may eventually be in some danger of losing its unique identity, because of hybridization with the large number of ordinary Broadleaf trees imported for garden landscaping from Florida. Our Broadleaf is, however, easy to propagate from seed, though very slow to germinate, it grows quite fast.

Broadleaf (*var. caymanensis*) is an attractive ornamental plant, native to Cayman and therefore tolerant to our climate here. Photos by Mat Cottam and Ann Stafford.