

A THREE-WEEK SNAPSHOT OF BRAZIL ITS CAVES, KARST & CAVE FAUNA

- Arthur Clarke

Three weeks in Brazil is three weeks too short to adequately describe the caves, karst and cave fauna of such a vast country! During the second and third weeks of July 2001, there were two back-to-back international cave biology symposiums in different parts of Brazil: the second being a symposium session of "SPELEO BRAZIL 2001" during the 13th International Congress of Speleology for the International Union of Speleology (UIS). In the last week of July, there were a number of post-UIS congress field trips throughout Central and South America, including a weeklong eco-tourism excursion in the Atlantic Forest, SSW of Sao Paulo city.

Encompassing an area of 8.512 million km², the Federal Republic of Brazil is the fifth largest country in the world, covering almost half of the continent of South America. Brazil is the only Portuguese speaking country in South America; the dominant language of most neighbouring countries is Spanish. There are 27 politically separate States in Brazil within five broad compass-oriented geographic regions, each with its own distinct climatic regime and vegetation types. Although organised speleology commenced quite recently in the late 1960's and there are only 2,700-recorded caves in Brazil – caves are known from almost all of the Brazilian states. Many of these caves are situated in parks or reserves. In addition to the numerous state parks, there are 34 national parks and 15 biological reserves in Brazil.

The speleological heritage of Brazil is well protected by some very progressive legislation. All caves are protected by law and belong to the Federal Republic of Brazil, including those caves located under private land. The government agency responsible for the management and protection of the speleological heritage in Brazil is IBAMA: the Brazilian Institute for the Protection of the Environment and Renewable Natural Resources – a section of the Ministry of the Environment. In recognition of the extent and importance of karst systems in Brazil and the need for protection of their speleological, palaeontologic and archaeological heritage – an additional body was formed by IBAMA in 1997. Known as CECAV: the National Centre for the Study, Protection and Management of Caves, this organisation effectively manages and co-ordinates all the scientific, historical, cultural, economic and social issues associated with Brazilian caves.

The first cave biology forum in Brazil - held from 15-22 July 2001 - was the 15th international symposium of the Société Internationale de Biospéologie (International Society of Biospeleology). Organised by Dr. Eleonora Trajano

and students from the Dept. of Zoology, in the Institute of Bioscience at the University of São Paulo, the symposium was sited at the Parque Estadual Intervales (Intervales State Park), 270km SSW of São Paulo city (in the state of São Paulo). São Paulo city and its urban sprawl is something else – a city containing the whole population of Australia and New Zealand – a city with four airports and constant traffic jams on 4-5 lane motorways, where it takes nearly two hours to drive from one side of the city to the other! The highway (SP-280) running west of São Paulo goes through some quite magnificent forest and granite boulder scenery, branching off SSW along Rodovia SP-127 through agricultural areas, passing plantations of bananas and sugar cane, then groves of citrus fruit. The road degenerates near the city of Ribeirão Grande, where streets are paved with flat stone pieces and the final 25km to Intervales is not paved.

Unpaved or unsealed gravel roads were very much the norm in this part of Brazil; many of them were former 4WD tracks used to access mining or logging areas. Most of the roads have a rough or rocky surface, often washed out or severely potholed with slushy mud sections in shaded road cuttings. Very few 4WD vehicles were seen; the roads are mainly used by conventional 2WD vehicles but also accessed by heavy truck transport and passenger or tourist buses. Despite being a narrow, winding and potholed gravel pavement, the State Park information brochure describes the road from Ribeirão Grande to Intervales as being "well conserved".

At 24.5°S, Intervales State Park is one of four adjoining protected areas located within the incredibly diverse Atlantic (Coast) Forest in the southern coastal hinterland of the "South-East" region of Brazil. There is only about 4-5% of the original Atlantic Forest remaining, thanks to the legacy of many decades (a hundred years or more) of land clearing for coffee, sugarcane and/ or banana plantations, the urban coastal sprawl and the effects of heavy metal mining and forestry activity in the hinterland. UNESCO has declared the remaining Atlantic Forest as a "Biosphere Reserve" and the protected area contains many exciting geomorphic features with waterfalls, rivers, steep valleys, ravines and caves of course, plus many endangered species of flora and fauna.

The vegetation is an amazing mix of broad and narrow-leaf evergreen trees, short or long-leaved trees with many tall trees including several pink and red flowering species and the 3.0-3.5metre diameter fig trees. Many tree branches are covered in saprophytes or epiphytes, such as the tree orchids or bromeliaceous monocots with their

pineapple-like leaves, plus the long draping twirls of lichen and numerous tree-hanging bryophytes including long filament strands of moss. The incredible mix of temperate rainforest species with occasional conifers and tropical plants (palms, palmettos, figs, vines, etc.) blend in with an understory dominated by tree ferns (including species that look very similar to the *Dicksonia* and *Cyathea* tree ferns in southern Australia) which all stand above a ground cover of other broad-leaved and narrow-leaved plants. Amongst the smaller non-flowering plants on the forest floor there are many ferns: Maidenhair leaf types and an *Asplenium* look-alike, very similar to the species in Tasmania – perhaps another example of the Gondwana connection.

The Atlantic Forest contains a myriad of flowering plants: ground cover *Begonia* and violets; plus the large orange-red *Bico de Papagaio* (“Beak of the Parrot”) flowers on reed stems; another reed-like plant with orange flowers (Zingiberaceae); the small delicate purple and yellow or occasionally red and purple flowers of native passionfruit on tangly vines; the orange and red Bromeliaceae florets hanging off tree branches; and the intensely pink mass of *Bougainvillea* flowers in forest verges. Away from settled areas there are species of tree monkeys, occasional tracks of a tapir or puma and visual evidence of the peccary (a large wombat sized rodent) that leaves great mounds of faecal pellets everywhere! Not surprisingly, there was an abundance of birds and it seemed that many of the foreign delegates to the SIB symposium had been pre-warned to bring a pair of binoculars.

85 participants from all continents of the world attended the 15th international symposium of the Société Internationale de Biospéologie (SIB) in the Intervales State Park. There were two Australian attendees: Arthur Clarke from the University of Tasmania (School of Zoology) and Bill Humphreys from the Western Australia Museum (Biogeography, Ecology and Biospeleology section). Symposium attendees were accommodated in hostel type dwellings of varying standard with rooms containing 3-6 bunks or beds. The hostels – originally built to accommodate “bigshots” and administrative personal – were scattered amongst a number of houses throughout a cleared area in the park; a site that formerly belonged to a bank, as a mining and logging area (mainly eucalyptus logging). (Conditional in the establishment of the Intervales State Park was a proviso permitting former mining employees and their families to remain as residents and take up employment in the park.) The area also contained several large impoundments, formed by the damming of river valleys to divert water away from gold mining sites. Situated beside one of these lakes was a large purpose-built restaurant with a bar for drinks, but one of the drawbacks for symposium attendees without vehicles was the 1-1.5km long walk from the hostels to get breakfast, lunch and the evening meal.

Papaya (paw-paw), melon, pineapple and bananas were standard fare for breakfasts in Brazil, often served with sour cream yoghurt, plain cake or

cheese dough scones, plus sliced ham and cheese – washed down with various fruit juices including cashew nut fruit and very strong Brazilian coffee. There was often very little difference between the food served at lunch and evening meals, except that there was usually a soup option in the evening along with a fondue pot containing a slurry mix of beans, the juice of which could also be served as a soup. Although fish was sometimes served, meats were always in abundance. Apart from the large fleshy chicken pieces and occasional pork, there was plenty of good old Aussie style beef! Condiments always included various chilli options and sometimes some soft red-orange pepper seeds. The range of salad vegetables included familiar tomato (often served as green tomato), capsicum, onion slices and lettuce, but there were many less familiar salad vegetables. Hot vegetables included carrot slices, potato pieces, long-stalked cauliflower and/ or broccoli, plus manioc – a long white or yellow fibrous, but doughy, root vegetable that was sometimes served as a fluffy or crumbly textured ground meal (like tapioca or cassava). If you had room to eat dessert, there were the thick and sweet jam-like mixtures and coconut or banana based dishes, plus a wonderful choice of fruit-based ice creams.

The symposium at Intervales was conducted in a conference room situated on the very edge of the Atlantic Forest, beside one of the hostels just over a kilometre away from our restaurant! In a week of symposium events with all presentations in English, there were seven hour-long plenary lectures, a round table discussion, 42 half-hour oral presentations, three separate poster sessions for the 38 posters on display, plus videos and two full-day excursions. The seven plenary lectures featured presentations by the SIB President: Guiseppa Messana (Perspectives for subterranean biology), Valerio Sbordini (Genetic differentiation and speciation), Thomas Poulson (Ecology and evolution of cave fish), Uwe Passauer (Subterranean flora), Christian Juberthie (The history of the SIB and its contribution to science), Oana Moldovan (An overview of the study of hypogean beetles) and Paoli Forti (Biogenic speleothems). David Culver and Louis Deharveng lead the round table discussion describing the results of the recent workshop: “Mapping Subterranean Biology” held at Moulis in France (see *ACKMA Journal* #43: 34-36). The oral presentations were presented in five theme sessions: Genetics and evolution; Evolution, systematics and biogeography; Hypogean fishes; Biodiversity; and Ecology, morphology and physiology. Similarly the three poster session themes were: Genetics, evolution, systematics and biogeography; Biodiversity; and Ecology, morphology and physiology.

Symposium delegates visited three caves on the first excursion day from Intervales, looking at bat colonies in caves and invertebrate species. Unfortunately, I was unable to attend – spending the day with my Italian co-presenter: Leonardo Latella (from the Museum of Natural History in Verona) preparing and finalising our Powerpoint presentation titled: “*Preliminary assessment of the cavernicolous fauna of central-south China*”. Our

afternoon entertainment included a walk in the Atlantic Forest circum-navigating one of the lake impoundments: finding tapir tracks in the lakeside mud and mounds of peccary dung, then in the fading late afternoon light getting spiked by the thorny trunks of tree ferns and pointy tipped leaves of understory plants, and finally wading through an insect infested swamp containing sewage! The second daylong symposium excursion provided another chance to view the Atlantic Forest – this time, in an area remote from human settlement. Following an old gold miners' access track, we were guided to an area of luxuriant forest with 20-30m high trees and palmetto palms that were being raided by two different species of extremely agile black monkeys along with some large shrieking birds. Following the trail of the monkeys, we left our pathway and briefly inspected a karst area with limestone pinnacles vegetated by many different forest species including 4-5cm thick "Tarzan" jungle vines, before descending to a river where huge fig trees supported an array of fungal growths. We saw a few large butterflies in the understory and on the forest floor several other large invertebrates such as the giant (12cm long), dark tan coloured *Megalobulinus* land snail, an 8-9cm long beetle, several species of large purple-brown or grey coloured millipedes, big harvestmen and a 5-6cm long creamy-white leech with a very forceful sucking device.

Our first glimpse of cave fauna appeared on the colourful poster issued to all symposium attendees. In a mosaic of 30 colour photos, the poster depicts caves and cave animals found throughout Brazil: in the Upper Ribeira Valley (São Paulo state), Bodoquena (Mato Grosso do Sul) and Bambuí (Minas Gerais, Bahia and Goiás) karst areas. Sixteen of the images featured cave dwelling or cave adapted species: haematophagous (blood-sucking), frugivorous and insectivorous bats; terrestrial invertebrates: troglobitic springtails, millipedes and crab; troglomorphic caddis flies, harvestmen, pseudoscorpion, spider and cricket; aquatic troglobites (stygobites): amphipods and three species of cave fish; plus an image of a peccary skull found in a cave from the Intervales region. The same mosaic – which also appears as the front cover of our 84page book of symposium abstracts – includes an image of surface karst and 12 images featuring spectacular views of cave entrances, speleothems and the crystal clear blue waters from caves in various parts of Brazil. The poster and book of abstracts came with a small zip-fastening backpack – in choice of colours – with an imprint of the logo for the XVth SIB Symposium. Also appearing on the back cover of the abstracts book, the logo features a map outline of the State of São Paulo, the symposium dates (8-15 July 2001) and an outline image of a blind cave catfish.

The international symposium of biospeleology was an excellent gathering, providing an opportunity to network with like-minded speleos and cave biology specialists, renewing friendships or developing new contacts, as well as seeing a small part of Brazil. A few planned social events and some Brazilian culture – along with bottles of

“cerveja” (beer) – aided the interaction of minds. Firstly a “Forró” dance party: a local derivation of the American term “For All” – a lively hip-hugging jive with music from accordion, guitar and a long narrow Brazilian drum. There were several cocktail parties where attendees were introduced to local wines and a popular drink named “Caipirinha” made with the juice of orange-skinned lemons or limes, lacings of sugar and ice and a very alcoholic spirit made from the fermentation of sugar cane. Known as “Cachaça” (pronounced as Cashassa), this spirit was probably akin to ethyl alcohol (or ethanol). Following the General Assembly of the Société Internationale de Biospéologie at the conclusion of the symposium, there was a traditional Brazilian barbecue.... and if there is one thing memorable about Brazil, it's their presentation of cooked meat. Raw meat is marinated in brine – sometimes with herbs – wrapped around a wooden or steel skewer and barbecued over coals. The meat is served (medium rare) on these skewers or sliced off the side (you grab it with tongs as it is sliced), then the skewer is returned to the barbecue for another short burst of cooking. After the barbecue, Fandango de Tamanco entertained us, as a group of male dancers wearing wooden clog-like sandals that echoed on the slate dance floor.

The next SIB symposium is scheduled for Verona (Italy) in September 2002, with the following symposium to possibly be held at Raipur (India) in February 2004. It was suggested that Australia could still put a bid in for 2004 (or 2006) – perhaps hosting a meeting in Tasmania.

Our departure from Intervales involved an early morning (0600am) bus, leaving in darkness amidst the morning fog that persists across much of southeastern Brazil. Many of the tour buses are ultra-modern with heaters, layback seats, video monitors and washrooms; our bus was not one of these! The road out had become a bit rougher due to washouts from recent rains and the bitumen surface beyond Ribeirão Grande was somewhat less than desired for sleeping bodies. A feature of roads through towns in Brazil is the presence of the numerous (too many) speed humps. (Supposedly, there was an announced proposal to introduce Federal Brazilian legislation to ban the construction of further speed humps, so there was a sudden flurry of activity in many municipalities to construct speed humps before the legislation came into effect.) The journey to São Paulo took about six hours and included a stop at a “Lanchonete” – a large roadside shopping centre cafeteria where you walk in, collect a docket, go to the various shopping stands or hot and cold food counters to collect your selections, get your docket marked with the item price then pay for the total as you exit the centre.

Later that afternoon I was in Brasília – following a two-hour flight from São Paulo – and despite a two-hour flight delay (due to fog), arriving in time to attend the opening ceremony of Speleo Brazil 2001. Brasília is a modern planned city (similar to Canberra) situated on a plateau at an elevation of 1100metres, in the midst of what was formerly

savannah woodland. Founded in 1961, it is described as a “model” city, with its formation as the capital of Brazil credited to the dedication of former Brazilian President: Juscelino Kubitschek. UNESCO has declared Brasilia as a World Heritage cultural site. Oscar Niemeyer was the principal designer of the city’s well-known modern architecture, with buildings functionally designed for the climatic conditions at this latitude of 15°S of the Equator. The tropical climate of Brasilia is hot and dry in winter: it was 25°C when I arrived at 6pm and the same temperature at 7am next morning.

Convened in the centrally located Brasilia Convention Centre from 15-22 July, Speleo Brazil 2001 incorporated the 13th International Congress of Speleology (ICS), the 4th Speleological Congress of Latin America and the Caribbean (CEALC) and the 26th Brazilian Congress of Speleology. Respectively, the three supporting bodies were the International Union of Speleology (UIS), the Speleological Federation of Latin America and the Caribbean (FEALC) and the Brazilian Society of Speleology (SBE). The theme for Speleo Brazil 2001 was “*Speleology in the Third Millenium: Sustainable Development of Karst Environments*”.

Clayton Lino a former President of SBE - headed the Speleo Brazil organising committee composed of volunteers, principally members of SBE, along with an executive and specific committee coordinators responsible for the different sessions and structures including the pre and post-congress excursions. Although SBE were responsible for running Speleo Brazil, a professional conference management team was engaged to organise the event on a day-by-day basis, handling the registrations, liaising with the session coordinators and Brazilian authorities, preparing symposia session venues and setting up visual media, providing an interpreter service and coordinating bus transport. Although non-cavers, many of the uniformed professionals spoke English fluently and were ably assisted by two Speleo coordinators from Estação Floresta – Speleo Brazil Treasurer: José “Scala” and Calina Scaleante. The event was directly supported by the Federal Brazilian Government and the Minister for the Environment as well as the two dedicated authorities: IBAMA and CECAV. Use of the massive Convention Centre “Ulysses Guimarães” - with its 20,000m² floor space, four auditoriums seating up to 800 people, 15 rooms equipped with audiovisual systems, plus a restaurant and snack bar – was donated free of charge to the organisers.

Speleo Brazil 2001 was officially opened by retiring UIS President: Julia James, along with a front table bench of Latin American and Caribbean delegates, the Brazilian Minister for the Environment and UIS General Secretary (Pavel Bosak). The opening and closing ceremonies were among the many highlights of Speleo Brazil. Ceremony attendees wore headsets to hear translations in a choice of six languages: headsets being “hired” by depositing your passport of some other form of photo ID. Despite a few shortcomings including language difficulties in a

Portuguese-speaking nation, lack of information about convention facilities, displays and some events, only having three internet access/ email computers for 465 attendees and the long wait for buses - the Congress was extremely well organised and coordinated. The 300 overseas visitors from 31 countries included a dozen Australians: Craig Barnes, Arthur Clarke, Annalisa and Stephen Contos, Jeanette and John Dunkley, Julia James, Grace Matts, Armstrong and Penny Osborne, plus Nick and Sue White. Most of the Australians presented papers or posters to different sessions of the scientific program.

The scientific program was composed of six separate sessions running concurrently; four of these were presented as symposiums. There were two general presentation sessions for papers related to geospeleology (and geoscience) and papers related to cave surveying, caving techniques and other special topics. The four concurrent symposiums were: archaeology and palaeontology in caves, biospeleology, cave diving and protection and management of show caves. The eight one-day excursions for Speleo Brazil included cave sites related to each of the six congress themes. The biospeleology site was a cave named *Gruta Primavera*, with owls (*Tito alba*) and colonies of the insectivorous bat: *Phyllostomus hastatus* plus two species of blood-sucking (vampire) bats: *Desmodus rotundus* which fed on mammals and *Diphylla ecaudata* which prey on birds. There were numerous guanophiles, plus arachnids including the fearsome looking amblypygid: *Heterophrynus* sp. (Phryniidae).

The Biospeleology Symposium at Speleo Brazil was coordinated and initially chaired by Pedro Gnaspini, also from the University of São Paulo. Being one of the few English-speaking persons, I was asked to chair two sessions and act as one of four cave biologists presenting summaries to a round table discussion. There was general consensus and agreement related to the conservation biology of species in Brazil, but some brief confusion in regard to cave names! Depending on where you are in Brazil, the word for “Cave” appears to change. In northeastern and central Brazil, caves are referred to as “*Lapa*”, but in southern Brazil as “*Gruta*”. The words Lapa and Gruta generally describe horizontal entrances, while the term “*Abismo*” is used when referring to vertical shafts. The word “*Caverna*” is a more generalised term used for all horizontal and vertical caves across Brazil.

“*Cavernas Brasil*” is the title of a large “coffee-table” book launched during Speleo Brazil. Produced by Clayton Lino, the book features magnificent colour photographs of caves, speleothems and fauna in Brazil with descriptions and geomorphic detail written in both Portuguese and English. Retailing for R\$120 book was sold to congress attendees at the reduced price of R\$100: about \$AUS90.00. There were other book launches and video presentations – all associated with cocktail parties – plus the on-going display of Speleo Art with paintings, drawings, engravings, sculptures, photographs of Brazilian caves and speleothems, along with caving memorabilia (a

calcified bucket, old caving lights and carbide lanterns). A run of 19 Speleo Media films was shown throughout the congress with Paolo Forti accepting the prize for the best production. Other highlights included the Andy Eavis presentations of 3D slides shown on a metal screen; the lakeside Brazilian Party and the raucous Banquet Dinner at Spettus Steakhouse with more barbecued meat served on skewers.

Counting of the 39 eligible votes at the final congress session for Speleo Brazil 2001 produced several noteworthy outcomes for the UIS. Jose Ayrton Labegalini (from Brazil) is the newly elected UIS President, replacing Julia James, and the two UIS Vice-Presidents are Andy Eavis (UK) and Alexander Klimchouk (Ukraine). The eight elected Joint Secretaries are: Roman Hapka (Switzerland), George Huppert (USA), Andrej Mihevc (Slovenia), Claude Moret (France), Fadi Nader, (Lebanon), Armstrong Osborne (Australia), Song Linhua (China) and Abel Vale (Puerto Rico). The next UIS Congress will be held at Athens (Greece) in August 2005 and will be hosted by the Hellenic Speleological Society.

After a week in Brasilia, I was back 320km SSW of São Paulo again, joining Grace Matts and two couples from Japan and the Czech Republic in the post-Congress excursion: "Ecotourism in the Valley of the Ribeira River". Located southwest of the Intervalas State Park, our excursion area was the Upper Ribeira Valley in the PETAR region: (Parque Estadual Turístico do Alto Ribeira) – another part of the Atlantic Forest, rated as being more diverse than the Amazonian forest. The six of us had an accompanying team of 7-8 local Brazilian guides under the leadership of Ana Lopes, who did not speak a word of English! Our base was at the Pousada Casa de Pedra - a ranch-like guesthouse in the old gold-mining town of Iporanga on the banks of the Ribeira River - where we were lodged in bunkhouse rooms accommodating 2-6 persons. It was a homely setting and our hosts plied us with traditional Brazilian meals including T-bone steaks – all prepared on a wood stove in their farmhouse kitchen. On outside verandas there were nectar feeders for the migratory humming birds hanging from lines that were also used for drying clothes or caving gear.

Despite the fact that this was the dry season, it rained solid for six days. The presence of swollen rivers prevented us accessing some caves including the magnificent *Casa de Pedra* (House of Rock or "Rocky House") with its 215m high entrance. As it was, we had to swim through creeks - fully trogged up - to get to some caves and wade chest deep in others that were nearly siphoned out. Grace Matts and I had imagined we would be looking at the ecological maintenance of tourist caves and wild caves, but this was an adventure-caving trip. Some of our "eco-tourism" caving was quite severe, into wild caves or sections of caves that the eco-tourist visitors do not see. The excursion involved some of the most severe and exposed cave climbing I have done, like the ascent to *Areião Cave* climbing a 70 degree mud and sand bank slope with short vertical climbs without a handline. Other caves

involved standing on ledges barely an inch and a bit wide above drops, going through jagged rock squeezes and wading in creeks.

Our first cave was *Caverna Santana*: a developed eco-tourism stream cave with a raised walkway through the streamway, wooden planks and bamboo handrails, fixed log-rung ladders to the decorated upper levels and several cave fauna species such as the non-luminous "glowworms" (genus: *Neoditomyia*). A through trip was made from *Caverna do Couto* via its efflux stream, upper level chambers, a rockpile and squeezes, exiting at the large *Caverna do Morro Preto* (Black Hill Cave) entrance with huge tufa deposits and a hominid habitation site. Amongst the undeveloped caves of note was the *Alambari de Baixo Cave* with a chest deep exit wade under a siphon roof with harvestmen (*Goniosoma spelaeum*). Cristiano Lerche (a student of Pedro Gnaspini from São Paulo) guided me to several biological sites. In the recently discovered upper level *Laboratório II Cave* which still has many pristine speleothem deposits, fauna included the troglomorphic assassin bug (*Zelurus travassosi*), a millipede (*Pseudonannolene strinatii*) and the cave spider (*Ctenus fasciatus*) and in the flooded streamway section of the lower level *Laboratório I Cave* - two harvestmen: *Daguerreia inermis* and the blind white troglitic *Pachylospeleus strinatii*, a troglitic millipede (*Leodesmus yporangae*) and cave spiders: *Loxosceles* sp. and a pholcid: *Blechnoscelis* sp. The final wild cave involved a walk through the stunning Atlantic Forest to the huge *Laje Branca* (White Slabstone) stream cave entrance and an adrenalin rush side diversion, ascending to *Areião Cave* and its magnificent views. In *Laje Branca Cave*, white flower-like cave fungi grew amongst log debris with tiny land snails nearby and on the sand banks we saw two large millipede species, a cave centipede and spider species (*Loxosceles* and *Ctenus*), a cave cricket (*Endecous*) and an undescribed species (F. Labiidae) of dermaptera (earwig). (Incidentally, collection of species from Brazilian caves is not allowed without prior arrangement with the appropriate authorities and the issue of permits. Similarly, collected material can only leave Brazil - on a loan basis - for study purposes.)

Outside of the PETAR region, east of Iporanga, we inspected our only tourist cave: *Caverna do Diabo* (Cave of the Devil) – a stream swallet cave with large chambers and very large speleothems. Although there were two drawbacks: broken formations (collected by souvenir hunters or during construction of the tourist access) and lampenflora growths, the developed section was quite different with an unusual approach to cave lighting. Visitors needed a light source, because the cave illumination was only partial; lights were used to just highlight a particular path, bridge, wall or formation section, giving a more natural appearance, i.e., as a dark cave stream passage, albeit with huge chambers and large speleothems. A solitary specimen of the common cave harvestman (*Goniosoma spelaeum*) was seen near the entrance.

Access to caves in the PETAR region is controlled by the three government managed operational

centres or “Núcleo”, such as the Núcleo Santana, about 30km west of Iporanga. These centres also supply some basic caving equipment and cave guides. In similarity to the neighbouring Intervalles State Park, the PETAR region was a former gold mining area and contains a number of small villages, farms and side roads (tracks) branching from the single main gravel road through the park. Most villages rely on the cave eco-tourism for survival – providing trained guides, having accommodation centres, tourist souvenir shops and craft wares, food and liquor stores or “bares” (“pubs” or bars), plus supply outlets such as the Pousada do Quiririn that act as provedores to the guides: supplying drums of carbide, helmets and overalls. Access to most caves in the PETAR is via the single main road running west from Iporanga (or east from Apiai). Following the valley of the Betari River (a tributary to the Ribeira River), this unpaved road would be one of the worst I have ever traversed in a 2WD vehicle. The road is extremely rough and potholed in flat sections, washed out on slopes where boulders protrude or it runs over bare rock and is a 20-25cm deep muddy quagmire in the shaded road cuttings that rarely see any sunlight. It’s a “Catch-22” situation for authorities such as CECAV and the Atlantic Forest villagers, highlighting the problem of cave conservation and the effect on the social system or living situation of local inhabitants. Many villagers have houses or farms situated immediately adjacent to the road and in the dry season they get windblown dust from the road, then in the wet they are splashed with mud. Villagers want to see the road surface sealed to give them better access to the outside world and encourage more tourist visitors. Combined with the fact that it is an impoverished area in rural decline with limited revenue from the cave eco-tourism, authorities are reluctant to make improvements because it is a conservation area and the park is designed to be a natural area. There is also the concern for motorists – the

road is very winding and dangerous; if sealed, the road speed would increase as well as accidents. Despite the poor roads, the town of Iporanga – also known as “Capital of the Caves” (with 253 known caves in the area) - is an exciting place for visitors from a cultural point of view. The town has narrow, cobble or paving stone lined streets with slate footpaths and many older style street-fronting buildings; a quaint church with a bell tower giving great town views; an amazing low budget “hands-on” museum, more like an antique shop; numerous public houses and weekend street markets. About 20km further west there is the Serra Village – a hub of activity in this PETAR cave area – situated a few kilometres east of Núcleo Santana. Referred to as a “city” (?), there are two street-side pubs including the popular Bairro da Serra, known as JJ Bar, run by a local caver: Joaquim Justino. A favourite drink is “Jaguars Milk”; made to a secret (?) formula, it is probably UHT milk with sugar cane spirit. It was obvious that the locals like to drink and they also know how to party – on our final night in Iporanga we were treated to a Brazilian dance party; but the room was so crowded with partying drinkers, there was little room for dancing!

Brazil is an exciting country for caves, karst and cave fauna, so departure time was very much an anti-climax. The management of caves, karst and cave fauna by IBAMA and the legislative protection is impressive. Federal law protects an area 250m beyond the horizontal limit of any cave and there is legislation before parliament to extend this buffer to 300 metres. This protection zone is already extended to one kilometre in the case of any development (industrial, quarrying etc.) where there is proof of likely impacts. Karst catchments are also protected from misguided forestry or agricultural activity and the Brazilian government is empowered under Law Number 9605 to impose penalties ranging from \$25.00 to \$25million for breaches in land practices in order to protect the karst catchment. Well done Brazil...