

The History of Christmas Island and the Management of its Karst Features.

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Abstract

Christmas Island is an external Territory of Australia. It hosts a diverse range of endemic and native terrestrial, subterranean and aquatic flora and fauna with Australian, Indo-Malesian and Pacific affinities. The Island has survived the impacts experienced on other tropical islands as a result of human settlement and is a highly valued ecological asset to Australia. The karst environment had been under-valued as an ecological entity until recently when extensive speleological surveys were conducted. These surveys were a part of broader attempts to prepare a management plan to conserve the values of the karst environment.

INTRODUCTION

Christmas Island is located in the Indian Ocean (10°25'S and 105°40'E) approximately 2,600 km west of Darwin and 360 km south of Java. The Island is volcanic in origin and has undergone a series of uplifts and subsidence during the last 80 million years. The geological setting of the Island is described in Grimes (this volume). Christmas Island covers an area of approximately 135,000 hectares of which 68% has been gazetted as Christmas Island National Park (Figure 1). The remaining tenure comprises the phosphate mine lease which is managed by Christmas Island Phosphates Ltd and the urban environment which is managed by the Christmas Island Shire Council and the Department of Transport and Local Government (Christmas Island Administration). Management of the karst environment is shared between Parks Australia North (PAN), Christmas Island Administration and the Christmas Island Shire Council; however the primary responsibility for conservation lies with Parks Australia North.

There are ninety-five known karst features including approximately 30 caves (Spate and Webb, 1998; Grimes, this volume). Until 1998, little was known about the Christmas Island cave ecosystem and biodiversity, with only a few species having been collected on an opportunistic basis (Harvey and West 1988; Short and Meek 2000). Many caves are used by Island residents for recreational pursuits and some are well known historic sites where Islanders took refuge from the Japanese invasion during the Second World War.

In 1997 an inexperienced group of local cavers narrowly escaped serious injury while exploring a cave. This incident raised concerns for public safety and the protection of the cave ecosystems. As a result, Parks Australia declared a moratorium prohibiting access into all caves until a survey could be undertaken to assess the risks to people and the threats to the cave ecosystem. In 1998, three consultancies were commissioned to assess the management of the caves and karst features

(Spate and Webb, 1998), the fauna and flora of the caves (Humphreys and Eberhard, 1998) and the public risk concerns (O'Toole and Grimes, 1998). The intent was to use these reports to develop a Christmas Island Cave Management Plan balancing conservation with cave use. This is currently under consideration (Environment Australia, 2000). This issue of *Helictite* presents initial reports on the scientific aspects of the consultancies.

THE ISLAND CLIMATE

Christmas Island experiences a tropical monsoonal weather pattern with a pronounced wet and dry season, although rain can fall in any month. December to April is generally recognised as the wet season with the highest rainfall during February to March and the dry season is August to October. Mean average rainfall is 2.1 metres per year and relative humidity maintains a fairly consistent 80-90%. The average temperature is 28° Celsius and can drop to 22° Celsius in the dry season.

KARST VEGETATION

The terrestrial vegetation has been divided into three main groups (DuPuy 1988); primary rainforest, marginal rainforest and scrub forest. The vegetation has Indo-Malesian affinities with some species also being found in north-eastern Queensland (DuPuy 1988). The tallest trees occur over the deepest soils and flora species decrease in size and diversity where the limestone is closer to the surface. Primary rainforest on the deep soils is dominated by emergent trees to 50 m high including broad buttress species such as *Planchonella nitida*, *Syzygium nervosum*, *Tristiropsis acutangula* and *Inocarpus fagifer*. Marginal rainforest is a more open habitat with trees between 20-30 metres high growing along the lower terraces and dominated by species such as *Pisonia grandis*, *Gyrocarpus americanus* and *Erythrina variegata*. Scrub forest occurs on the lowest terraces and comprises a low structured (5-10 m) scrubby

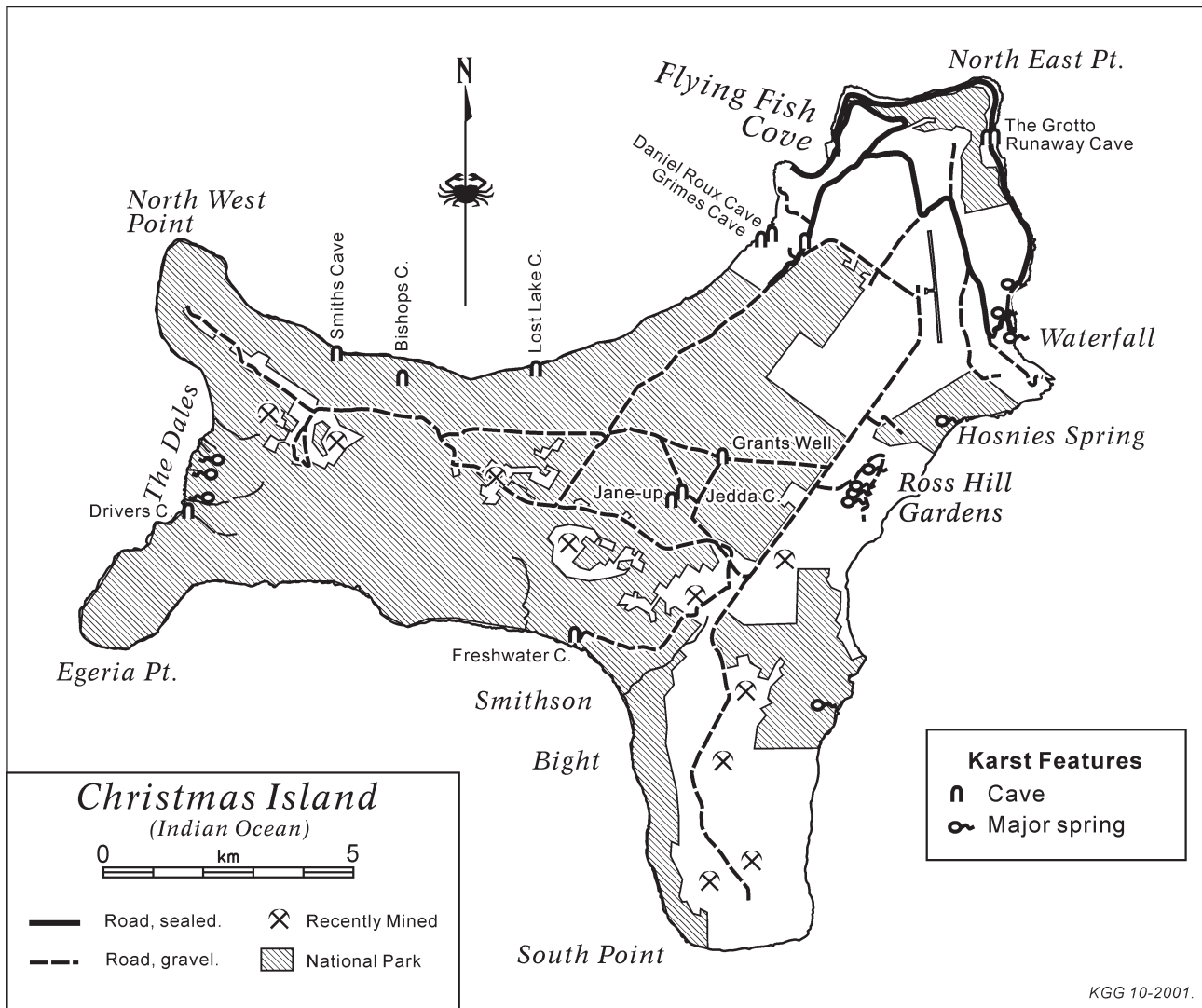


Figure 1: Locations on Christmas Island

understorey with spiny and scrambling shrub vines and the trees *Columbrina pedunculata*, *Celtis timorensis* and *Gyrocarpus americanus* which are mostly deciduous.

A fourth, localised, habitat type occurs around surface water and is the strong-hold of the Blue Crab *Cardisoma hirtipes*. The Dales, which are small surface stream valleys located on the western terraces, are dominated by the enormous *Inocarpus fagifer* or Tahitian chestnut. Another surface fresh water site occurs at the unique Hosnies Springs (RAMSAR site) where two species of coastal mangrove *Bruguiera gymnorhiza* and *B. sexangula* (DuPuy 1988) can be found in an area of less than one hectare .

ECOLOGICAL VALUES

There are nine main terrestrial habitat types (after Environment Australia, in draft) excluding disturbed urban environments, which provide habitat for Island species: sea cliffs, terrace forest, shallow soil rainforest, limestone scree slopes and pinnacles, deeper plateau and

terrace soil rainforest, mangrove forest, perennially wet areas, karst (caves) and mine fields.

These habitats contain a high number of endemic species: 17 endemic plants, five endemic reptiles, seven endemic land-birds, three species of endemic sea-birds, five endemic mammal species including two extinct rats and a shrew, twelve endemic cave fauna (Humphreys and Eberhard, this volume) and two endemic land crabs. The Island is famous for its twenty species of land crab in particular the Red Crab *Gecarcoidea natalis* and Robber Crab *Birgus latro*.

The modern Christmas Island ecosystem is unlike any other tropical Island in that land crabs dominate the terrestrial landscape which is now devoid of any native mammals. Red crabs play an integral role in the ecology of the Island biota as leaf decomposers, and seed and seedling consumers—a role which ultimately controls the species composition of the rainforest (Green 1993, 1997).

Owing to the small size of the Island, all endemic taxa are at risk of decline due to their limited distribution and

vulnerability to major catastrophes. The island currently has seven threatened fauna, three listed as endangered and four as vulnerable under the *Environmental Protection and Biodiversity Conservation Act 1999*. Recovery Plans have been prepared for five of the flagship species although only two have been approved by the Minister for the Environment and Heritage (see <http://www.biodiversity.environment.gov.au/wildlife/plans/recovery/index.html> for further details). To ensure the protection of this unique flora and fauna, considerable work is required to update the number of threatened species and to facilitate their listing as rare or threatened and to develop recovery plans

HISTORY OF OCCUPATION

On Christmas Day in 1643 Captain William Mynors named Christmas Island while sailing past the Island on board the *Royal Mary*. However, the first detailed shore exploration was in 1887 by the crew of the *HMS Egeria*. The Island was later declared a part of the British Empire and settled in 1888 under a joint lease to George Clunies-Ross and John Murray. As there were no indigenous people on the Island, these pioneers shipped Malay workers to the Island from nearby Cocos Island. In the late 1890's mining leases were granted to the Christmas Island Phosphate Company and more Cocos Malays and Chinese workers were brought to the island to help establish the mining industry. Descendants of these early workers are still resident and have a long history of association with Christmas Island.

The only accessible point of landing on Christmas Island is in Flying Fish Cove on the North-Eastern end of the Island, known informally as the Dog's Head. Flying Fish Cove was established as the main settlement on the Island for the growing population although several camps were scattered throughout the Island for mine workers. As the population of the island grew and mining expanded through the 1900's, the demand for water for human consumption and mining increased and the first investigations to locate suitable subterranean supplies were undertaken.

In 1958 the administration of Christmas Island was handed over to the Commonwealth of Australia and the Island has been a Territory of Australia since. The population of the Island has fluctuated in size over the years from 1200–2500 depending on the availability of employment. The community is composed of Chinese–Malay (85%) and Australian–European (15%).

HISTORY OF CAVE AND KARST EXPLORATION

Exploration to locate phosphate resources was extensive across the Island and is still evident in some locations from the drill lines spaced throughout the Island landscape. The British Phosphate Commissioners (BPC) and the Phosphate Mining Company of Christmas

Island (PMCI) also conducted surveys in the 1960-70's to establish a water supply for the wash screen at South Point (Barrett, this volume) and it was in these surveys that some caves were reported. In one case water tracing was conducted at Jedda Cave in an attempt to map the underground water flow. Domestic water is now supplied to households and businesses from Jedda Cave and Grants Well, with back up pumps at Ross Hill Gardens on the southern side of the Island. There are few detailed reports describing the early explorations of Christmas Island caves apart from some historical notes on archived Christmas Island Phosphate Ltd files.

Speleologist, Roy Bishop conducted many surveys across the Island in search of water throughout the 1950-60's and this search was continued by Mr David Powell in the 1960's. Many caves were discovered and some were named by, or after, these early explorers. Letters on old files refer to the naming of some caves. Lost Lake was named in the 1960's by a team of Islanders including Roy Bishop; his undated article describes their finding; *"At the 1500 foot mark [450m] ... the next 300 ft. was all deep water, in fact an underground lake. It was a magnificent sight and one of the "romantics" in the party promptly names[sic] it "Lost Lake". The water was crystal clear, cold and drinkable, and the underwater torches picked out fantastic grottoes and limestone sculptures."* A letter dated 30 October 1969 by T.J. Kennedy, the Assistant Geologist for BPC, describes a cave exploration that was undertaken in October 1969 by a group of six. On the expedition he recorded a cave and named it Bishops Cave after Roy Bishop. During interviews between David Powell and this author in 1997 he revealed that Jane-up Cave was named after his daughter Jane. He later named Jedda Cave after his daughter Jeanna and son David although it has also been reported to have been named after Roy and David's wives Jeanne Powell and Daphne Bishop (Neale and Adams 1988).

Runaway Cave was so named as it was supposedly used by Island residents during the Second World War to hide from the Japanese. The best known, and most significant cave (Spate and Webb 1998) has a plaque on the entrance (Upper Daniel Roux Cave) indicating that it was named after Daniel John Roux, born Christmas Island 1957, died in Switzerland 1960 (aged 3.5 years).

In recent times other caves have been allocated colloquial names by those who have found and investigated them. Most have been allocated numbers in accordance with the Australian Speleological Federation (Spate and Webb, 1998). Recent finds of new caves by the local caving group had not been issued with numbers at the time of writing this paper.

DETAILED CAVE SURVEYS

The most significant speleological exploration was in 1987. This expedition (SEXI 1987) attempted to locate and map all of the Island's known caves (Brooks 1990). In the SEXI 1987 expedition, a scorpion was collected from Bishops Cave and sent to the Western Australian Museum by Mr. Neil Plumpy. This specimen was misdirected until 1997 when it was found at the Perth Hospital. It was later identified as a blind scorpion *Liocheles polisorum* (*Ischnuridae*) which is the first record of a blind cave scorpion in Australia (Humphreys and Eberhard, this volume) and a significant record for the Island.

In November–December 1996, this author accompanied a water engineer/consultant (Tony Faulkland) to inspect Lower Daniel Roux as a part of an ongoing consultancy to assess water flow and quality (Faulkland, 1999). On this expedition the author collected a fresh water prawn in Daniel Roux Cave, later identified as *Macrobrachium microps*. This species is known to occur in New Ireland and West Samoa (Holthuis, 1978; Bruce and Iliffe, 1993) and is a significant range extension for the species (Short and Meek, 2000). On a later visit to survey and collect more species for identification, the author collected a fresh water fish that was confirmed

to be the Brown gudgeon *Eleotris fusca* (Gerry Allen, pers. comm. 1998), thought to be extinct from the Island. This species was known to occur at the Waterfall Spring on the north-east coast (Allen and Steene 1988) but that habitat was destroyed by the construction of the Christmas Island Resort.

In 1997 the author started a trapping study to determine the status of the Christmas Island Shrew *Crocidura attenuata trichura* (Meek 2000). Longworth traps and hair tubes were located in the first chamber of Upper Daniel Roux Cave in an attempt to detect mammal presence. The survey was unsuccessful in trapping mammals although a nest containing a litter of rodents (probably *Rattus rattus*) was recorded in a major Swiftlet guano mound (Figure 2). Several necrophagic and saprophagic arthropods were collected from traps and hair tubes including; beetles *Carcinops* sp, *Alphitobius laevigatus* and the ant cricket *Pachycondyla* sp. These samples were sent to the Western Australia Museum and Western Australian Department of Agriculture for taxonomic identification. Robber crabs *Birgus latro* and red crabs are consistently recorded in the twilight zone of the first chamber of Upper Daniel Roux Cave and are commonly found in most caves and karst features on the Island.

These early surveys provided the foundations for the 1998 consultancies, which provided the most detailed reports on the caves of Christmas Island (Spate and Webb, 1998; Humphreys and Eberhard, 1998; O'Toole and Grimes, 1998). They have improved our understanding and appreciation of the caves, their geology, geomorphology, scientific value, fauna and the level of risk posed by recreational use. Scientific aspects of these reports are summarised elsewhere in this volume by Humphreys and Eberhard (this volume), and Grimes (this volume). Some management aspects are summarised later in this paper.

The caves and cave fauna of Christmas Island are undoubtedly unique and biologically valuable both for Christmas Island and for the Australian natural estate. The caves host an array of endemic cave species (Humphreys and Eberhard, this volume) and the karst provides the foundation for a unique and diverse biota.

CURRENT MANAGEMENT

Two Commonwealth Government agencies currently administer the caves on the Island. Parks Australia North manage the caves found within the National Park and the wildlife in all caves while Christmas Island Administration are responsible for all caves outside of the Park. At present there are no organised tours of Christmas Island caves although there are some diving tours into Thunderdome, Thundercliff and Lost Lake caves. The Grotto and Freshwater Cave are the most



Figure 2: Guano mound of the Christmas Island Glossy Swiftlet in Upper Daniel Roux Cave.

frequently visited by local people as swimming holes and social gathering destinations, particularly The Grotto.

The impact caused by human access into the caves is alarming and many features have been damaged and destroyed by vandalism. Pollution of the ecosystem is prevalent in many of the well visited caves (Freshwater, Daniel Roux and Runaway). Litter occurs in some of the caves frequented by residents and there is some deliberate dumping of construction rubbish. Damage to cave formations has occurred extensively in some caves due to poor caving skills and deliberate vandalism (Figure 3). Concerns over cave impacts resulted in all caves within the National Park and Crown lands being closed to the public in 1997 until a cave plan was prepared. This moratorium has continued beyond the original period of closure but is not enforced although access is discouraged.

The risk of injury or death to cave users is an issue that has been considered crucial to the Commonwealth and has been addressed by O'Toole and Grimes (1998) and risks are also discussed by Spate and Webb (1998). The consultants have recommended that most caves have signs placed at the entrances indicating the potential dangers and risks. Further, that some restrictions are placed on cave entry at some sites and that a permit system is put in place to restrict inexperienced cavers from entering some caves. Those authors also suggest that cavers should register their planned expeditions with local authorities as a safety net in case of emergency. O'Toole and Grimes (1998) and Spate and Webb (1998) both recommend caving codes for normal caving and sump diving to ensure some safety measures are being conveyed to users. The ongoing training of local cavers and the development of an on-island rescue capability was proposed.

One of the recommendations in both Spate and Webb (1998) and O'Toole and Grimes (1998) was that route marking should be done in some caves to limit human impacts and to avoid dangerous areas. This was undertaken in two caves by this author and Ranger Matt Hudson in 1998. Reflectors were used to mark a route throughout Runaway Cave including a new section not shown on the maps of Spate and Webb (1998). Routes were also marked in Upper Daniel Roux to deter cavers from walking across the rim-stone pools and other formations at the rear of the first cavern.

FUTURE MANAGEMENT CONSIDERATIONS

Spate and Webb (1998) state that the karst features specific to Christmas Island are of national significance. They note the distinctive morphology of the coastal caves such as Lost Lake Cave, the well developed "spongework" of Smiths Cave and others, and the speleothems now found below sea-level. Twenty-six species have been identified by Humphreys and Eberhard (this



Figure 3: Vandalism by local residents in Runaway Cave.

volume) as "significant or having unusual biogeographical, evolutionary or conservation attributes". Twelve endemic species are recorded. The richness of the troglomorphic species of the island is reported to be comparable to those of Mexico, Central America, South East Asia, Virginia and the central Pyrenees (Humphreys and Eberhard 1998, this volume). The caves continue to be threatened by human induced pressures and the Island needs a specific cave management plan which is separate to the Plan of Management for the Christmas Island National Park, that facilitates the implementation of the recommendations of the consultant reports. Such a plan will need to balance the needs of residents and the tourism industry as well as conservation objectives.

The growing pressure to improve access for residents and visitors to the caves and the impacts caused by past cave use/abuse will need careful consideration. There are caves that could be developed to a limited extent to provide safe access; however development of show caves of the calibre seen on mainland Australia is not appropriate at this stage and the caves should remain "real caving experience" sites. Construction of major boardwalks and installation of lighting is also not recommended—the cost would be prohibitive and visitation is too low to warrant major development.

The local cave club should play a role in training residents and in assisting with management of the caves of Christmas Island. Cave conservation would also be improved by the appointment of a single governing agency to ensure appropriate and consistent measures are adopted for all caves. The continued use of the caves by residents and visitors should also be coordinated through the cave club to ensure people are aware of the caving code of conduct and to ensure safety measures are in place in the advent of an accident.

The Commonwealth's Cave Management Plan, which is currently being developed, will hopefully provide a strategy where cavers can continue to enjoy caving while also protecting the caves and the cave ecosystems from vandalism, development and pollution. Future monitoring and research in the caves needs to

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focus on comprehensive long term investigations to determine the species richness of subterranean fauna and the potential threats to these communities.

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