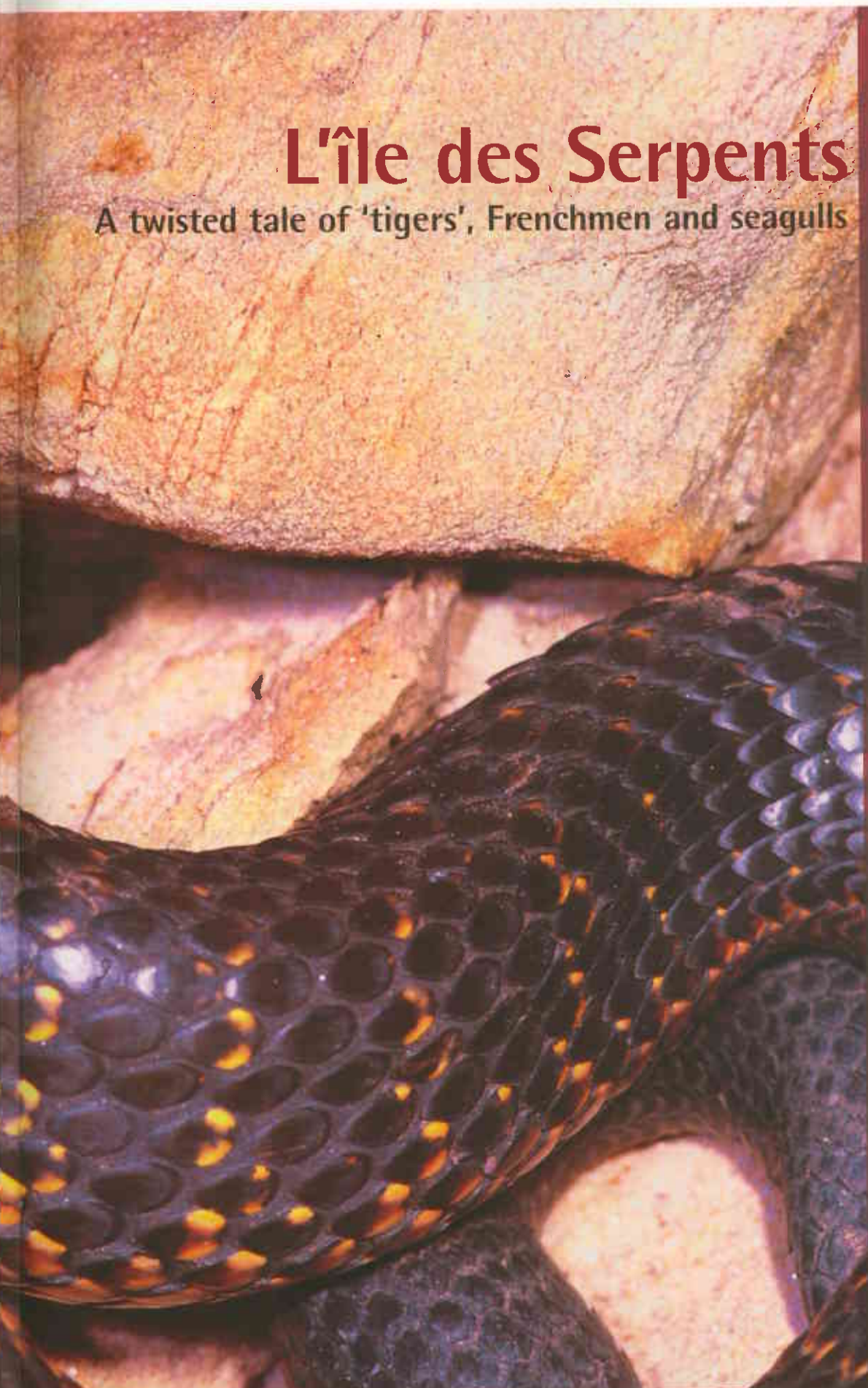
L'île des Serpents

A twisted tale of 'tigers', Frenchmen and seagulls

The mysterious arrival of tiger snakes on Perth's Carnac Island is a puzzle for researchers. Why are French researchers so interested in them and why are many of the snakes blind?



by David Pearson and Xavier Bonnet

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Main Tiger snake.
Photo – Jiri Lochman

Above Carnac Island's main beach.
Photo – David Pearson/DEC

Below Carnac Island.
Photo – Dennis Sarson/Lochman Transparencies

Carnac Island lies about 10 kilometres south-west of Fremantle, rising from the sea between its better-known and larger neighbours, Garden and Rottnest islands. Several thousand years ago, all three were joined to the mainland when sea levels were significantly lower. Nyoongar people knew this little island as Ngooloormayup, which means 'place of little brother' (Rottnest Island was the big brother).

French explorer Louis de Freycinet, captain of the *Casuarina*, was the first European to give the island a name, Île Pelée (meaning 'Bald Island'), in 1803. Captain James Stirling changed its name to Carnac Island in 1827 in honour of his First Lieutenant John Carnac. Two years later, Stirling returned as Lieutenant Governor with settlers to establish the Swan River Colony. One of his ships, the *Parmelia*, ran aground between Woodman Point and Carnac Island and 29 people were forced to spend five days on the island until their vessel could be refloated. Since that time, Carnac Island has been used briefly as a jail for Aboriginal prisoners, a whaling station and a quarantine station for the Port of Fremantle. During World War I, Carnac was acquired by the Commonwealth Government for defence purposes. It was returned to the State Government in 1961 and was declared a nature reserve in 1963.

After a 200-year absence, the French have returned to Carnac Island on a new quest of discovery. The attraction now is a remarkable population of tiger snakes (or just 'tigers' to their devotees) that exist on this tiny island of just 19 hectares. A chance meeting at a conference in Chizé, a little village 200 kilometres north of Bordeaux in west central France, led Professor Don Bradshaw of The University of Western Australia to invite herpetologist Xavier Bonnet of the Centre National de la Recherche Scientifique (the French equivalent of the CSIRO) to visit Perth to conduct ecological research on tiger snakes (*Notechis scutatus*). In 1997, Xavier travelled from his base in Chizé (which, as Xavier is keen to explain, was the site of a French victory over the British in 1373) to Perth to begin research. Since that trip, the work has blossomed to include researchers from the Department of Environment and Conservation (DEC) and the University of Sydney. The island has also been a major field site for two students who completed their doctoral studies on the evolutionary ecology of tiger snakes.

Mysterious origins

Tiger snakes occur across temperate southern Australia, including Tasmania. Their presence on a number of islands in Bass Strait and around the South Australian coast is well known. On some of these islands they feed primarily on muttonbird chicks and grow to impressive sizes, with some

Right Juvenile tiger snake.
Photo – Jiri Lochman

Right below Snake showman 'Rocky' Vane displaying tiger snakes at Perth Zoo in 1928.
Photo – Courtesy of John Cann

individuals reaching two metres in length. As tiger snakes eat their prey whole, and the chicks grow very rapidly, they are only able to swallow them early in the breeding season, so are often forced to fast for much of the year. Other neighbouring islands shelter dwarf tigers that feed heavily on lizards. Study of these populations by researcher Terry Schwaner provided an early example of the ability of snakes to evolve rapidly to cope with differing environmental conditions.

On the mainland, tiger snakes are typically day-time hunters and feed on lizards, birds, small mammals and frogs. Because of their love of frogs and sometimes tadpoles, tiger snakes are often found around the margins of freshwater swamps. They are accomplished swimmers and, around Perth, are frequently seen at places such as Herdsman Lake Regional Park. Tiger snakes only occur on two WA islands: Carnac and Garden islands.

The origins of the Carnac Island tiger snakes are a mystery. Were the ancestors of these snakes marooned on Carnac Island by rising sea levels 6000 to 7000 years ago? It seems unusual for such a small island to have had a large predator survive over such a long time period. Perhaps, being capable swimmers, tiger snakes were able to colonise Carnac Island from the larger Garden Island. As tiger snakes have been observed in the ocean off Carnac Island, it does seem possible that they could swim between the islands.

Another bizarre but plausible explanation is that a snake showman, 'Rocky' Vane (derived from Vagne, the surname of his French grandfather), released tiger snakes on Carnac Island. Vane travelled around Australia in the 1920s, displaying snakes and selling his own snakebite antidote. Sometimes he would allow tiger snakes to bite him to demonstrate the qualities of his home-made antidote. In fact, recurrent bites probably maintained his immunity against the venom, and offered a better protection than his 'antidote'. Vane and his wife Dot worked their way to Perth, where he was anticipating huge crowds as female snake-handlers had not been seen in the west.

However, in January 1928, his wife was bitten and died. He took on a new partner, Harry Melrose, who was also bitten by a tiger snake and died in 1929. As a consequence, the coroner recommended that snake exhibitions be banned in WA. This much of the story can be verified from newspaper reports and investigations by herpetologist and author John Cann, but the remainder is as yet unconfirmed. According to a gentleman who contacted DEC 20 years ago, he had accompanied Vane when he rowed out to Carnac Island with his disgraced tiger snakes

and released about 40 on the island. Genetic testing of the Carnac tigers has been inconclusive in determining their precise origin; an unsurprising result. This is due to remarkably low genetic divergence between all populations, including WA and eastern Australian tiger snakes. The tiger snakes exhibited by Vane were probably caught around Perth, but current genetic markers cannot distinguish sub-populations within WA. An additional complication is that the two hypotheses for their origin are not exclusive—the Carnac tigers may be a mix of original Carnac snakes and those introduced by Vane, as it is likely that any tiger snake mating combination would be fertile.

Studying large venomous snakes

Conducting research on venomous species requires particular precautions to minimise the risk of being bitten, along with a contingency plan should this occur. Carnac Island tiger snakes appear to be much more 'relaxed' than their mainland compatriots and are easier to catch. Nonetheless, handling the snakes is kept to a minimum. Tiger snakes are not particularly tolerant of heat and tend to bask early in the day, then retreat to shelter. Consequently, most of the fieldwork was conducted in September, October and early November, when nights are cool and days are mild. At this time of year, tiger snakes are mating and feeding, and the females are developing follicles (they bear live young in later summer). Large numbers of tiger snakes could be captured early in the morning by searching the island when they were likely to be basking.

- Once located, the tiger snakes were pinned with a padded stick, then placed in calico bags and carried back to the beach. Here, under a shade shelter,

Above Left Tiger snakes usually have distinctive yellow bands.

Left Tiger snakes are handled with extreme caution by the scientists who research them.
Photos – David Pearson/DEC

Above Xavier Bonnet measuring a tiger snake.
Photo – David Pearson/DEC

each snake was measured and weighed. The stomach was gently squeezed to feel for prey items and, if possible, droppings were examined to see if they contained fur, feathers or scales. Adult female snakes were carefully palpated to determine if they contained follicles. Each snake was then individually marked by removing a few scales and returned to the site of its capture.

Over the past decade, more than 570 individual snakes have been captured, with many caught repeatedly over that period (1077 recaptures). Being able to collect such long term mark–recapture data for a snake species is unusual. Typically snakes do not occur in high densities, they have cryptic habits and are hard to capture and recapture. The beauty of the Carnac population is the density of the population and its novel ecology.

Heaven for serpents?

Carnac Island offers abundant food for tiger snakes in the form of small lizards, introduced house mice and birds. Diverse shelter from the sun and the cold of winter is available in limestone crevices and beneath large bushes. Once the snakes reach adult size, they appear to have no predators. Is it something close to heaven for a snake?

Juveniles are rarely observed and we do not know what may eat them. There is no evidence of cannibalism by larger snakes based on our examination of their diet. The reputation of Carnac Island for its tiger snakes—and the existence of a sanctuary zone limiting public access over much of the island—means there are few human-snake interactions which, on the mainland, usually lead to snake deaths.

Population estimates based on the mark–recapture study show that Carnac Island has between 250 and 400 adult snakes. This translates to a very high density of snakes—about 20 per hectare—an exceptional number for a vertebrate predator. How is the island able to sustain such a large number of snakes? The answer lies with the combination of large populations of house mice and silver gulls (*Larus novaehollandiae*). The vast breeding effort of the thousands of gulls results in many chicks and thus plenty of food for tiger snakes. If Carnac Island was not as close to the Perth metropolitan area, there would be many fewer gulls. The resources around the island alone could not support their numbers, but most of the Carnac gulls are commuters. They make frequent trips to the mainland to scavenge at rubbish tips and along the coastal strip (such as around food outlets), and so are able to obtain sufficient resources to breed in their thousands on Carnac Island. The large mouse population provides abundant food for new hatchlings, juveniles and small adult tigers. It is likely that the mice also benefit from the resources returned to the island by the gulls in the form of droppings that provide nutrients for plants.

Carnac Island also has many other conservation values. It is an important breeding site for a variety of seabirds including little penguins, wedge-tailed shearwaters, pied cormorants and Caspian, bridled and crested terns. The Australian sea lion (*Neophoca cinerea*)—one of the world's rarest species of seal—hauls out on its beaches to bask and digest its food. Carnac Island is frequently used as a resting site for male sea lions taking a break from breeding activities on islands further north.

Surprising discovery

Examination of the tiger snakes that were caught led to a novel observation. Many of the adult tiger snakes had large wounds on their bodies and especially their heads. There was no apparent predator of adult tiger snakes on Carnac Island, so what was inflicting the wounds? It didn't take long to

Left Researcher Olivier Lourdais wearing the latest fashion in amphibous French field gear for snake catching.

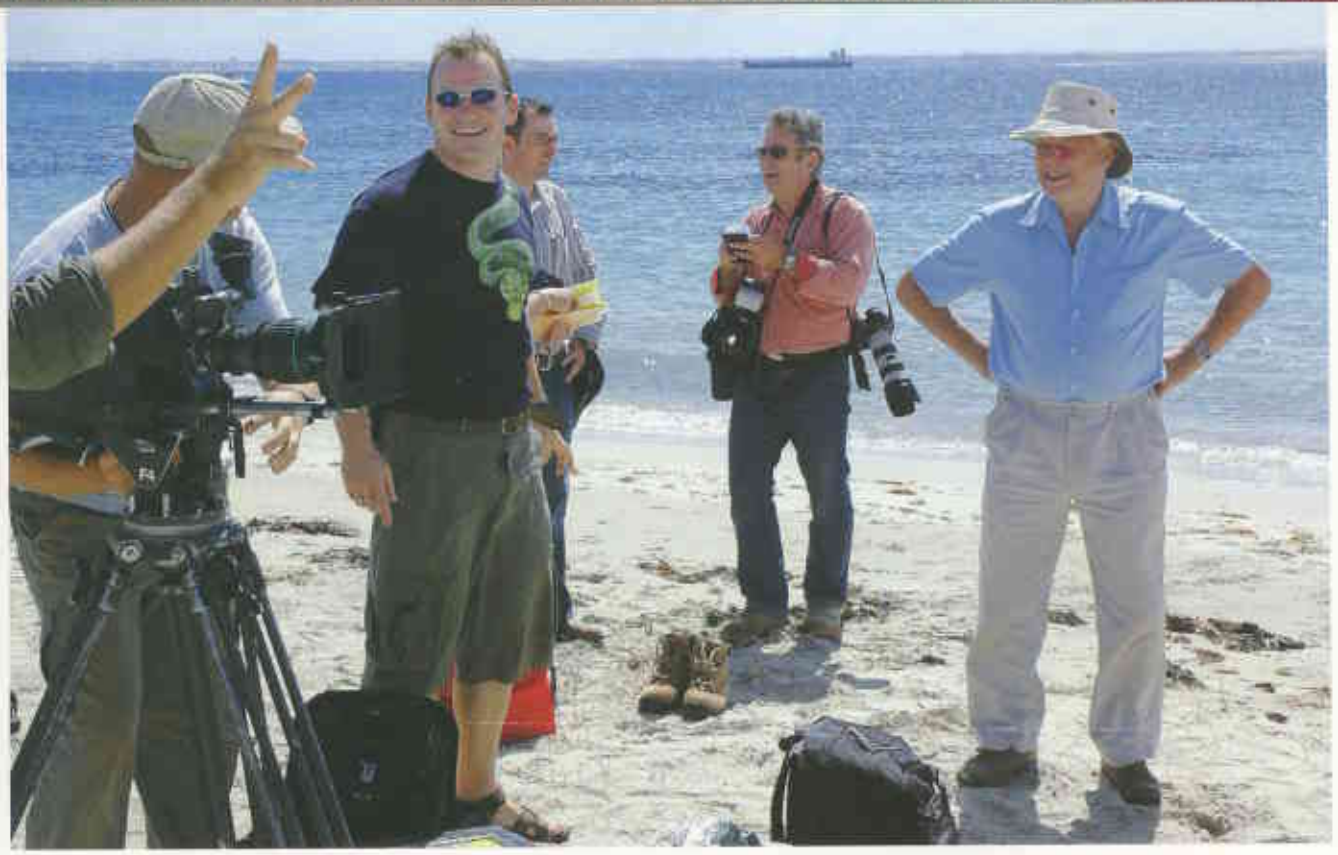
Middle left Many Carnac Island tiger snakes have wounds to their heads.
Photos – David Pearson/DEC

Bottom left Seagull chicks are important food items.
Photo – Jiri Lochman

establish the identity of the culprits. Adult tiger snakes feed mainly on silver gull chicks. An estimated 3000 to 4000 pairs of silver gulls nest on Carnac Island each year, so nests are spread across most of the island and situated close together. In spring, tiger snakes never need to go far to locate a gull nest with a chick. The adult gulls aggressively defend their nest from tiger snake raids, inflicting pecks to the body and head. Though the snakes are rarely perturbed by the seagulls, over time, some of the tiger snakes are badly damaged.

Around 5 per cent of the adult tiger snakes on Carnac Island are totally blind as a result of the pecking. Basic evolutionary theory (for instance, 'survival of the fittest') suggests that the loss of a major sense such as sight should lead to the starvation and death of these tiger snakes. Much to our surprise, blind tiger snakes were recaptured from year to year (some of them surviving the entire survey period from 1997 to 2006). They continued to catch food, gain weight and were found mating with other snakes. Despite their loss of sight, they were able to successfully function, implying either that vision was of little importance in locating prey and mates or that, once blinded, they were able to change their hunting technique.

Simple laboratory experiments showed that blindfolded tiger snakes had great difficulty catching mobile prey, so what was the explanation? The field data on the diet of Carnac tiger snakes indicated that blinded tiger snakes fed entirely on seagull chicks. There is only one record of consumed mice among hundreds of samples. Normally-sighted snakes ate gull chicks, but also took more mobile prey such as mice and lizards.



Above David Attenborough visited Carnac Island with a BBC film crew.
Photo – John Hunter/DEC

Therefore, blind tiger snakes were able to survive on Carnac Island because of the abundance of an immobile prey in the form of gull chicks that could be readily located by smell. This also explains why blind snakes are always large individuals—only huge tigers can swallow the chicks and so are subject to gull attacks.

This unusual feature of Carnac Island tiger snakes led to their recent inclusion in a forthcoming television series on reptiles called *Life in Cold Blood*, to be narrated by David Attenborough. In November 2006, Attenborough visited the island with a BBC film crew and local herpetologist and educator Brian Bush to document the remarkable ecology of the Carnac Island tiger snakes on film.

Questions for the future

Long term mark–recapture studies of snakes are rare, perhaps due to the difficulties of securing ongoing funding to study a species without an obvious charismatic 'cuddle factor'. People query why you would bother to research a large venomous snake on a tiny island and question its relevance to the conservation of biodiversity on mainland Australia. The Carnac Island study of tiger snakes has generated a valuable dataset with limited fieldwork (six to seven days per year for the capture of around 150 snakes per annum) that is useful for ecological comparisons with snakes elsewhere. It illustrates the remarkable ability within a species to cope with differing environmental conditions and change. Tiger snakes are important predators on Carnac Island, consuming several thousand seagull chicks each year in addition to vast numbers of mice and lizards, in contrast to their predominantly frog-eating mainland relations. Without the kind of information collected by such studies, there are few opportunities to establish educational programs (including natural history documentaries) that explain the interesting ecology of species rather than focusing on the sensational, such as the killing power of venom and the 'danger' of tiger snakes.

Despite the volume of data collected on the Carnac tigers, there are still unresolved questions that have wider implications for conservation. Why, for instance, do we catch many more males than females? Is it due to different sex ratios of births, or do females have higher mortality rates? Or perhaps males are just more easily captured due to more overt behaviour. High density populations of species on islands are very valuable to undertake cost-effective research that would be difficult and expensive to do elsewhere. So, despite the passage of 200 years since the visit of Freycinet, the unique wildlife of the south-west coast continues to attract scientific interest from both local and French researchers.

David Pearson is a Principal Research Scientist with DEC. He has particular research interests in threatened reptiles and mammals, impacts of the cane toad and biological survey.

Xavier Bonnet is a scientist with the Centre d'Etudes Biologiques de Chizé, Centre National de la Recherche Scientifique and works on evolutionary and ecological questions concerning a range of reptiles including adders, sea kraits and tortoises.

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