

The origin of tiger snakes on Carnac Island

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Abstract

Despite considerable research on the origin of the tiger snakes (*Notechis scutatus*) on the small island of Carnac off the coast of Perth in Western Australia, their source remains a mystery. Small morphological and ecological differences between the Carnac snakes and tiger snakes in other parts of Australia have been taken to suggest a unique lineage, but this is confounded by the possibility of colonisation of the island during the last marine transgression some 7000 years ago. Tiger snakes are also present on nearby Garden Island and elapid snakes are excellent swimmers. On the other hand, anecdotal reports suggest that the snakes were deliberately released on the island in 1930 by a snake handler. Information from the National Archives shows, with high probability, that this island population was established from a small number of snakes released in the early decades of the 20th century and that the scenario of isolation due to marine transgression does not apply. Now, interpretations of population-specific phenotypic and genotypic variations in the ecology, ecophysiology, demographics of the Carnac Island tiger snakes can be made with more confidence, based on the resolution that the population is less than 100 years old.

Keywords: phenotypic plasticity, adaptive evolution, island, evolution, ectotherm, reptile, snake, *Notechis scutatus*

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INTRODUCTION

The biology of island tiger snakes is well known and well documented. This large elapid occurs in high densities on islands along the southern coast of Australia and on the adjacent mainland in contrasting conditions (Shine 1987; Schwaner & Sarre 1990; Schwaner 1991; Bonnet *et al.* 2002). Moreover the populations show very low levels of genetic divergence at the molecular level (Scott *et al.* 2001). Within south-eastern Australia, where populations of island giants, island dwarfs, and mainland tiger snakes co-occur, the maximum genetic divergence is only 0.38% (Keogh *et al.* 2005). Structure plots currently being generated show a clear picture of relatedness between neighbouring populations with overall clinal variation from the eastern states to Western Australia (G Thomson pers. comm.).

This ecological scenario (isolated populations existing in close proximity to mainland conspecifics) presents novel opportunities to investigate adaptive evolution and exaptation (Gould & Vrba 1982), primarily because of the variable time since separation of the sub-populations. In many cases (southern Australia and Tasmania) populations have been separated for 5000–7000 years, and in all cases not more than 10 000 years (Keogh 1998). In each case, the closest relatives of the giant or dwarf populations on islands are mainland tiger snakes and the

most proximate island and mainland populations are, in most cases, the most-closely related (Keogh *et al.* 2005).

Carnac Island, located less than 7.5 km off the coast of Western Australia and 10 km from the port city of Fremantle (Fig. 1), supports a population of Western Tiger Snakes. Keogh *et al.* (2005) and G Thomson (pers. comm.) suggests these snakes are most closely related to conspecifics from local lakes throughout the inter-dune swales of the mainland Swan Coastal Plain, less than 15 km to the east of Carnac Island. These snakes have been the subject of considerable scientific attention over the last decade and a half (Bonnet *et al.* 2002; Ladyman & Bradshaw 2003; Aubret *et al.* 2004a,b, 2006; Bonnet *et al.* 2005; Ladyman *et al.* 2006; Aubret & Shine 2007, 2009, 2010). Each of these studies has shown clear and consistent patterns of dimorphism in behaviour, ecology, breeding biology, growth trajectories and physiology, driven by differences in the microhabitats present on the mainland and Carnac Island rather than by genetic divergence and natural selection. Nevertheless, some traits that differed between individuals within the populations were attributed to genetic divergence: these were traits measured as different at birth. Scale counts and relative jaw length were two such traits (Aubret *et al.* 2004a).

More recently, studies on the Carnac Island snakes considered the relative contribution of the two major drivers for polymorphism: phenotypic plasticity and adaptive evolution. Using this ideal ecological model as a basis, Aubret & Shine (2009) concluded that phenotypic plasticity was the primary driver when the snakes first

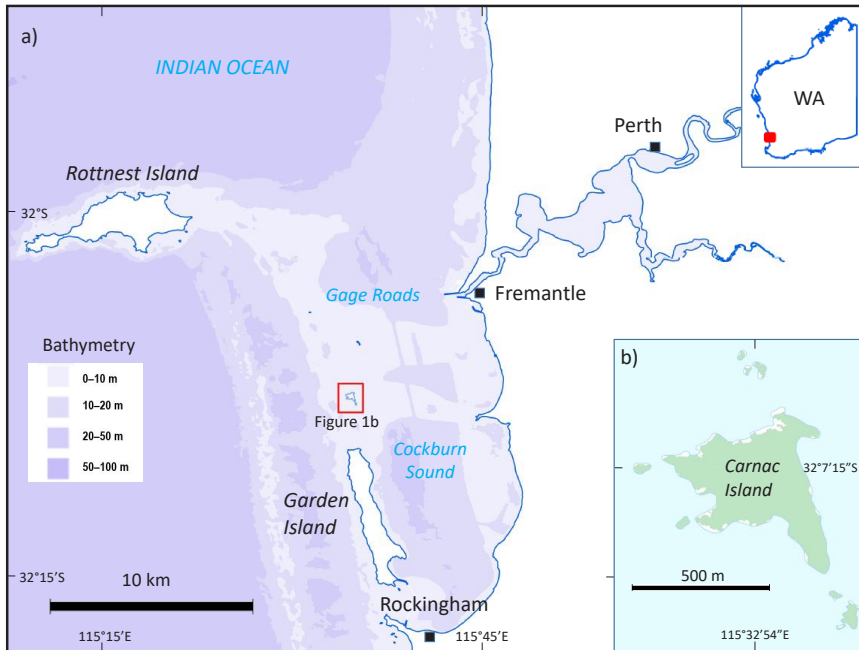


Figure 1. Location of Carnac Island relative to Rottneest Island, Garden Island and Fremantle, Western Australia (bathymetric image from GeoView.WA, Department of Mines, Industry Regulations and Safety using data from the Royal Australian Navy and the Department of Transport Marine Division).

colonise these novel island environments but, over time, changes in the genome are canalised to become fixed at birth. The benefits of these canalised traits lead to greater fitness over the life of an individual that possesses phenotypic traits of value at birth. Alternatively, individuals suffered an opportunity cost if these same traits were required to develop throughout the growth phase, regardless of their capacity to do so (Aubret & Shine 2009).

For the majority of studies referenced herein, the time since separation of the populations was not a dependent variable from which conclusions were drawn about adaptive evolution. In most cases conclusions simply described the differences between mainland and Carnac Island populations relative to the differences in their respective habitats and in the absence of genetic divergence and these differences were attributed to the exaptive potential of the reptilian bauplan (Bradshaw 1986).

But for the studies that seek to determine the role of phenotypic plasticity in novel environments versus genetic divergence in older populations, there is a fundamental requirement to know the age of the population, or the time since separation. This is because, although the adaptive advantages of phenotypic plasticity versus genetic assimilation are obvious, the relative rates of change of these drivers are more difficult to determine.

Conclusions reached with respect to the Carnac Island snake population have been based on the premise that the population is less than 100 years old and test individuals were the descendant progeny of a small founder population of some 40 snakes released on the island by a travelling showman called Lindsay Vagne (aka Rocky Vane) in 1930. However, for these conclusions to be valid requires a level of certainty that this was the only origin of the snakes and that the population did not arise as an isolated relic about 5000–10 000 years ago as a result of

marine transgression (Playford 1983). We believe that the required level of certainty about the origin of the Carnac Island population has eluded previous scholars.

FEASIBILITY OF A NATURALLY-OCCURRING POPULATION ON THE ISLAND, 1829–1930

Given that there is a naturally-occurring population of tiger snakes on adjacent Garden Island, and that tiger snakes are excellent swimmers known on near-shore islands, it is perfectly reasonable to expect that they would have been present on Carnac before 1930. However, at 19 ha, Carnac Island is far smaller than any other island along the west coast of Australia that supports a stable population of large elapid snakes. Along the entire central and south west coast no islands smaller than 1000 ha are known to support a naturally-occurring population of a large elapid snake. Garden Island, Rottneest Island and Barrow Island all support elapids and each is greater than 1500 ha. Early records by naturalists also do not document the presence of tiger snakes on Carnac Island.

THE LACK OF EVIDENCE OF SNAKES ON THE ISLAND 1829–1930

Our research has revealed the existence of early newspaper and other articles that suggest snakes did not occur naturally on the island. They also provide clues as to why a snake showman would choose to release snakes on the island in the first place.

The first article of note was an anonymous letter to the Editor the West Australian Newspaper describing Carnac Island as a delightful and convenient resort only an hour or two's sail from 'the town' (Fremantle; Anon. 1878). The article was written as an expression of the

author's distress that access to the island by the general public was, at that time, being denied by the lessees who had stocked the island with rabbits for the purpose of hunting. The author's grievance about limited access to the island was that there was no alternative destination. Garden Island has too many snakes and Rottneest Island has too many other issues. The article unequivocally states that there are no snakes on Carnac Island.¹

Carnac Island was also used as a quarantine station for many years prior to the turn of 20th Century. During this time up to 275 people, all who had showed signs of illness during passage from Europe to Australia, were detained on the island (Anon. 1897). A search of the National Archives revealed articles describing the tent village in which the detainees were housed, the means of transportation of food and water from Woodman Point to Carnac Island and the many trials and tribulations endured, but none of these articles mentions the presence of snakes. Given the origin of the detainees (predominantly from England) and their prior lack of exposure to venomous snakes, one would expect the presence of a large and highly venomous elapid to feature prominently in any communications about life on Carnac Island. The majority of these articles is dated between 1850 and 1920. It is only anecdotal evidence in Abbott (1978) that tiger snakes are first mentioned as present on the island by the early 1960s. A search of the reptile database of the Western Australian Museum found that the earliest records of tiger snakes from Carnac Island are in 1982 (Accession Nos R4975, R12818 and R12827), collected by Dr Dom Serventy, Eric Car and Harry Butler respectively, with a large collection by Dr Terry Schwaner in 1985.

EVIDENCE FOR THE RELEASE OF SNAKES BY ROCKY VANE

The evidence we present to support a 'recent release' hypothesis is subjective, as it is based on our interpretation of the content of letters and articles by early pioneers about life on an island with the mention of the lack of any snakes made only once (Anon. 1878), but notable in its absence on all other occasions. To further validate our conclusions requires an explanation as to why a snake showman would go to the trouble of releasing some 40 adult tiger snakes on Carnac Island that were clearly, based on structure plots, collected locally.

Originally from Melbourne, Victoria, Rocky would have been very familiar with snakes on offshore islands, with many populations naturally found off the Victorian Coast. Upon moving to Western Australia, Rocky lived in Fremantle and most certainly would have known of Carnac Island. Carnac Island was known to be devoid of fresh water and, during the years that it was used as a quarantine station, water was carted to the island in wooden vats. However, a well constructed in around 1903

yielded brackish water clean enough for washing and other purposes, though not fit for human consumption. Considerable effort was invested in the search for fresh water on the island with an article in the *Western Mail*, dated 20 March 1914, identifying the presence of two wells and a rain water tank (Anon. 1914).

We collected many articles documenting the almost constant troubles in which Rocky Vane found himself with the local law enforcement both in Western Australia and in the eastern states and the financial difficulties he faced as a travelling showman in another state. For instance, Rocky's first wife died of snake bite in 1928 and his new partner Harry Melrose was also bitten and died in 1929 (Bonnet & Pearson 2007). Rocky also faced court for using snakes to intimidate his new wife in 1931. In addition, Rocky's wealth and security were dependent entirely upon the success of his snake shows at carnivals such as White City/Coo-ee City and Uglieland, which were under threat of closure by the local law enforcement in the late 1920s in Perth and the early 1930s in Fremantle. Whereas the former carnivals closed in 1929, Uglieland continued operating in Fremantle until 1936.

If Rocky Vane was ordered by the courts to release his collection, as suggested in a newspaper report (Anon. 1931), he could easily have replenished his collection in a matter of days. This could have been done by collecting from local lakes around Perth, given the prevalence of tiger snakes on the Swan Coastal Plain (pers. obs).

Previously, evidence that the snakes were released on Carnac Island in 1930 was based on only anecdotal references that are difficult, if not impossible, to verify. Aubret *et al.* (2004b) cite a personal communication from Dr Terry Schwanner, who had published extensively on island tiger snakes in the eastern states of Australia. Though there is a strong possibility that this story is true, there is a lack of clear evidence as to whether or not snakes existed on the island prior to their supposed release in 1930.

An exhaustive search of the newspaper archives in the National Archives failed to reveal any evidence to validate or verify the story concerning the release of the snakes by Rocky Vane. The most sound evidence—still ambiguous at best—was a short newspaper article called 'Snakes in Bed' (Anon. 1931) in which Rocky was reported to have told the court that he had "gotten rid of his snakes" during a court session where he was facing reprimand for harassment of his (then) wife.

Following an order of the Court to release his snakes, and having only been in Western Australia for a very short time, it is unlikely that Rocky Vane would have known anyone with whom he may have agisted his collection. Therefore Carnac Island may have provided an ideal potential temporary repository. Although covering just 19 ha, the island was large enough to support the snakes, small enough for him to retrieve them and easy enough to access by boat from Fremantle.

However, he was noted by a local newspaper to be back in possession of several snakes, which were housed in his tattoo shop in James Street in 1933 (Anon. 1933) and he was bitten again during a display in Rockingham in 1934 (Anon. 1934). These articles provide clear evidence that, though he was forced to release his snakes, he never intended to be without them for very long. A short journey

¹ Twenty eight of the first settlers to WA were initially put ashore on Carnac Island in June 1829 for some days. They complained about the lack of cutlery (James 2007), but no mention was made of snakes.

from Fremantle, Carnac Island would have presented a simple solution to this misfit's agistment problem.

CONCLUSION

We offer better than anecdotal evidence concerning the origin of the Carnac Island tiger snakes and give some certainty as to the question of the age of the population and the time since its isolation from the mainland. We are confident that there was no self-sustaining population of tiger snakes on the island prior to Rocky Vane's release in 1930. If accepted, this means that any differences between island and mainland populations must have developed in the intervening 90 years, rather than the many thousands of years for which Carnac has been an island. Whereas our interpretations are subjective, this suite of archival evidence goes a long way to validating many of the conclusions of Aubret & Shine (2009) thereby supporting the notion that phenotypic plasticity is most valuable and prevalent in novel environments recently colonised by snakes.

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