

Evolution and adaptation: a tribute to Richard Essex Barwick

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Richard (Dick) Essex Barwick was an influential researcher whose interests spanned many branches of biology and zoology, including herpetology, vertebrate morphology, palaeontology and evolutionary biology. Although born and raised in New Zealand, he spent much of his career in Australia and made considerable contributions to Australian zoology.

Born in Christchurch in 1929, Dick spent many hours in his youth watching and studying animals that were local to the region. After earning his bachelor's degree at Victorian University College (later Victorian University of Wellington (VUW)), he then completed an MSc (Honours) that investigated the life cycles and ecology of scincid lizards. This work marked the beginning of Dick's career in herpetology, although this was only one area in which he applied his tireless efforts.

After completing his MSc in the mid-1950s, Dick was appointed a junior lecturer at VUW, which sparked his second major area of investigation. He was one of four adventurers (along with Colin Bull, Barry McKelvey and Peter Webb) who initiated studies of the biology and geology of the dry valleys of the Antarctic. Dick was the biologist and artist on three Antarctic summer trips and developed an affinity for all things Antarctic as a result (Fig. 1). The VUW Antarctic Expedition named Barwick Valley in the dry region (77° 21' 0" S, 161° 10' 0" E) in his honour.

In 1959, Dick was appointed as one of the original members of the newly created Department of Zoology in the Canberra University College (shortly to become the School of General Studies) at the Australian National University. His speciality was herpetology, and since the other two members of staff were parasitologists, he became the vertebrate morphologist and physiologist. In addition to lecturing, Dick completed a PhD on the biology and ecology of Cunningham's rock skink, as these animals were abundant in west Canberra at that time. He undertook a year's sabbatical at the University of California, Berkeley, with Stuart McKay in 1965, where he learned about animal radio-telemetry. Dick brought the technique back to Australia, and he and Stuart ran a workshop at ANU in which they taught the use of telemetry to more than 100 participants.

It wasn't all work. Besides starting a new career in Australia, Dick met and married Diane MacEachern, a Canadian post-graduate student studying indigenous cultures, in 1961. The partnership was more than just personal, as Dick's interests in ethnographic art – as well as history, archaeology and anthropology from his university days – led to professional collaborations with Diane. As he was experienced in fieldwork, illustrations and map production from his days in the Antarctic,

Dick made an excellent partner in Diane's research. His skills in those areas were also highly sought after by many of her colleagues.

Dick's legacy may be most noticeable within the herpetology research community. Apart from guiding many Honours and PhD students through their work in the 1960s and 70s, Dick was a founding member of the Australian Society of Herpetology in 1964 and served two terms as vice-president during its early years. The field was in its early days of expansion in Australia at the time, and Dick played an important role in the development of herpetology as a formal research area.

Beyond herpetology, Dick was always interested in vertebrate morphology and evolution. In the early 1980s, Dick began a collaboration with Ken Campbell of the ANU Department of Geology on fish fossils that had been unearthed in the Burrinjuck region of New South Wales and in the Gogo deposits in the Kimberley ranges of Western Australia. This collaboration led to publications on the evolution and functional anatomy of the lungfishes from the Lower Devonian (Burrinjuck) and on the anatomy of the mid-Devonian fish from the Gogo region. Even after his retirement from teaching at ANU in 1992, Dick continued with this work on the functional anatomy of fossil fish, extending the work to the Mogo region of New South Wales, where sharks, armoured fish and ancestors of present day lungfish were discovered. In these studies, Dick also worked with Tim Senden of the Research School of Physics and Engineering, ANU, who had developed three-dimensional X-ray computer



Fig. 1. Richard Barwick on one of his Antarctic expeditions.

tomography to allow fossils to be examined with greater detail without dissection. This technique was complementary to Dick's own artistic renderings, and was important for confirming some of their findings on the Mogo fossils. Dick and Ken's work on fossils was a change in direction for Tim, which he continues to enjoy – he now regularly participates in the fossil-hunting field trips of both John Long and Gavin Young, two of the contributors to this special issue.

A great number of students passed through Dick's laboratory over the years, many of whom have themselves made great contributions to Australian zoology. Some notable names include Ross Pengilley (for both his MSc and PhD work), H. Robert Bustard (PhD), Rick Shine (Honours), Klaus Henle (PhD) and Will Osborne (PhD). Charles Marshall (Honours) – now well known for his own work in evolutionary biology – was one of the students that Dick shared with Ken Campbell.

In this special issue dedicated to Dick Barwick, several of his students, collaborators and friends contribute publications that are written in honour of him and his work.

A theoretical paper from Charles Marshall examines the evolution of morphogenetic fitness landscapes, or the interplay between development and ecology that can lead to the beginning of changes in the morphology of organisms (Marshall 2014). He uses a landscape approach that incorporates morphogenetic rules to attempt to understand how the various changes that appear in organisms are a result of variations either in ecology or in development.

The next three papers focus on fish evolution. Ken Campbell and Sharyn Wragg discuss the differences in craniofacial structure of the early Devonian dipnoans collected from south-east Australia and compare them with closely related taxa (Campbell and Wragg 2014). John Long, Elga Mark-Kurik and Gavin Young revise the characterisation of buchanosteoid placoderms that have been collected from areas within south-east Australia and Russia, using head shape or trunk shield structure to distinguish the Buchanosteidae and Parabuchanosteidae families, as well as to describe two new species (Long *et al.* 2014). Palaeontological work is extended to Victoria Land, Antarctica, in the contribution by Gavin Young and John Long, who describe new placoderms from the Middle Devonian that have been collected from that region (Young and Long 2014).

Modern Australian lungfish, *Neoceratodus forsteri*, are a threatened species from south-east Queensland and the only extant representative of the dipnoans in Australia. The species is similar to fossil species from the Devonian period. Anne Kemp describes differences in the abundance of lungfish populations and the environmental effects on larval development in various locales (Kemp 2014). She found that food availability, habitat alterations and genetic factors may affect lungfish survival, and emphasises that such factors must be taken into account when studying these living fossils.

The focus of the special issue then moves from water to land with a contribution from Peter Pridmore and Peter Hoffman on

the aerodynamic performance of feather gliders (*Acrobates pygmaeus*). The authors describe these small marsupials and their adaptations for gliding, using measurements to determine how their performance compares with larger glider species (Pridmore and Hoffman 2014). The pattern of limb movements and the rates of descent are compared with gliding distance to demonstrate gliders' control mechanisms and the importance of functional morphology in animal activity.

The lack of historical information regarding the herpetological species present in south-east Australia is the *raison d'être* for the paper by Klaus Henle, William Osborne and Frank Lemckert, as they were all inspired by the early work of Dick Barwick in this region (Henle *et al.* 2014). They report on the past distribution of reptiles and frogs around Kioloa (where the ANU's Kioloa Field Station is based) and consider this data as part of the information necessary to assess future changes in populations and species, particularly as a result of climate change.

Dick Barwick died in 2012, leaving behind a long and varied list of achievements in zoological research. He was indeed a Renaissance man, as he was accomplished in both artistic and scientific endeavours, and contributed to work on indigenous societies, particularly aboriginal history, even after his wife's death in 1986. We present this special issue in Dick's honour, to mark not just his own work but also his influence on subsequent generations of scientific research. Vale Richard Essex Barwick. Your legacy lives on.

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